Business, legal and socioeconomic impacts

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Abstract

This deliverable provides an analysis and assessment of the impacts of the solutions developed by ETICS. The analysis is focused on impacts in four distinct, but strongly interrelated, domains: the business domain, the legal domain, the socioeconomic domain and the Net Neutrality domain. Exploring how these complementary impacts may affect the ETICS project is fundamental for envisioning the evolution of ETICS and for setting appropriate governance policies.

For each domain, the deliverable will first introduce the methodologies employed for carrying out the process of identifying, describing and assessing the different business, legal, socioeconomic, and Net neutrality impacts. These methodologies will be applied to obtain: 1. an identification of the stakeholders involved and/or the key issues under scrutiny; 2. a definition of the expected impacts and their mutual relationships; and 3. a set of guidelines and recommendations for properly leveraging expected positive impacts and for containing the effect of expected negative impacts (Sections 2, 3, 4 and 5).

The analysis for each single domain will be followed by an evaluation of how the different impact levels mutually affect one another, in order to synthesize the previous domain-specific analyses and to provide a unified vision (Section 6).

Finally, conclusions will be drawn on the overall impact identification and analysis process performed, highlighting the effect of the ETICS framework on the cooperation between operators and other relevant actors as well as proposing future work avenues (Section 7).

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

1. INTRODUCTION

1.1. OPEN ISSUES AND OBJECTIVES

The on-going ETICS WP3 activity on Economy & Regulation has been progressing along an evolutionary path characterized by incremental depth, span and complementarity of activities performed. While [Del3.1] put on the basis for future discussions by depicting the business and legal framework for Network Interconnection (IC), [Del3.2] laid the foundation for QoS-aware services business models analysis and definition of requirements; [Del3.3] further progressed this assessment of IC financial and economic challenges through a dynamic analysis which presented significant results with a potential impact on the marketplace.

Once different business scenarios are envisioned, and several business model alternatives are analysed, many previously undisclosed or partly not assessed aspects rise. These aspects could influence the redesign of the Internet IC ecosystem and marketplace. Indeed, the technological deployment and commercialization of an Assured Service Quality (ASQ) offer, based on original IC policies, may trigger a plethora of impacts in different domains.

Hence the objective of the present work is to shed light on such aspects, and on the related impacts affecting, or being affected by the introduction of the ETICS framework and associated ASQ offer. The actual implementation, commercialization and ultimately, success of ETICS does not only depend on business viability. Beyond this, the project is even meant to modify and virtuously craft the current business domain for the Internet ecosystem, the assessment proposed in this work examines four domains considered to be crucial to the ETICS success and sustainability in the long run. The focus is hence directed to the impacts at the Business, Legal, Socioeconomic and Net Neutrality domains.

1.2. IMPACTS ASSESSED

BUSINESS IMPACTS

The business domain is central to ETICS, and essential for a project of such remarkable size, width and expected magnitude: the Business domain is hence investigated in the first section of the present report, as it is a key factor to ETICS uptake and competitive advantage sustainability in the long run. The main issues impacting on ETICS business performance are analysed in depth, specifically focusing on: first, a quantification of the target markets where the ETICS offer will be deployed; second, a discussion of other strategic and tactic impacts resulting from the introduction of such offer. Target markets to be analysed are identified and selected on the basis of their significance for the project (e.g. growth and revenue generation potential; impact of an ASQ-based offer; consistence with Future Internet scenarios and use cases investigated in previous WP3 and WP2 deliverables; declared interest and commitment of partners). A stand-alone quantification is then performed for eight different markets, identified within four macro areas representing substantial business opportunities: High-definition (premium) person-to-person rich multimedia communication; Off-net (premium) content delivery; Inter-provider ASQ connectivity for

Business customers; Consumer Cloud Services. For each market, the quantification process covers the following aspects: the economic and financial viability of the crafting of ETICS-related offer; the target market size and penetration for ASQ offer; the ability of the ETICS ASQ offer to modify the as-is target markets and trigger growth. Based on the provided market quantifications, strategic and tactic business impacts are then drawn and considered, to understand whether and how the project could modify and virtuously craft the current business domain for the Internet ecosystem.

SOCIOECONOMIC IMPACTS

To describe and assess the socioeconomic impact of the ETICS project, the report presents a straightforward yet accurate methodology derived from the SESERV project, which suggests to assess the socioeconomic impact of technologies, protocols and mechanisms by means of tussle analysis. According to this methodology, the various ETICS functionalities and mechanisms are examined addressing the potential impact and implications among the stakeholders involved. The discussion concentrates on investigating socioeconomic tussles driven by the introduction of ASQ IC goods, and analyses these impacts: interconnection agreements strategies; investments/capacity planning for Best Effort services versus ASQ services traffic; NSPs and InfSPs pricing and revenue sharing in ASQ interdomain; routing network functionality; High-value application deployment and network performance; market transparency and monitoring; and contention tussles corresponding to the influence that an ASQ proposal could have on the entry barriers and revenue thresholds that new potential stakeholders attempt to gain from entering the business of Internet services.

LEGAL IMPACTS

The introduction of the ETICS framework and the related business models developed in previous WP3 deliverables may lead to different scenarios with different legal and regulatory implications for both the ETICS market and architecture. Various aspects rise with reference to the legal domain, whose impacts shall be carefully considered. Therefore, the report analyses several aspects related to the competition environment resulting from the adoption of the ETICS ASQ solution and the introduction of a consortium of partner model, which may lead to opportunistic behaviours and strategies. Particularly, monopolistic, oligopolistic and cartel models are described, and causes/consequences of such markets configuration and alliance models are investigated. Then, issues on control of content availability, SLA enforcement and denial of service are defined to understand the respective legal implications.

NET NEUTRALITY IMPACTS

Net Neutrality broadly represents the idea that Internet users are entitled to services that do not discriminate their performance on the basis of source, destination, or ownership of Internet traffic. The idea is rooted in the manner through which the Internet has been historically operated, where all traffic is forwarded as quickly as possible with a best effort approach, with limited differentiation based on the applications generating or requiring such traffic, and with limited performance guarantees. There is disagreement (e.g., among different stakeholder categories, and even among different regulatory entities), however, about the future implications of this relatively simple idea of neutrality, as the Internet progresses and as the economic communications landscape changes. The report provides a preliminary view on Net Neutrality and an updated picture of the regulatory landscape in some relevant countries; it then investigates several macro-economic impacts carried by Net Neutrality vs. Non-Net Neutrality. The

field research is coupled with an essential literature analysis of seminal studies on the subject, whose contribution and impact for the ETICS project is critically synthesized.

1.3. STRUCTURE AND CONTENT

The four sets of impacts (or "impacts domains") mentioned above are addressed in dedicated sections (Section 2, 3, 4 and 5, respectively) of the present report: for each section, a research methodology is first presented, which is subsequently leveraged to carry out the activities of impact identification, description and analysis; hence, conclusions are drawn for the impacts domain under scrutiny. The following two sections (Section 6 and 7) are devoted, first, to assess any existing interplay between impacts belonging to different domains, and second, to draw overall conclusions for the research performed in this deliverable and propose avenues future work.

More in detail, the remainder of this document is structured as follows.

Section 2 is devoted to the assessment of core Business-related impacts affecting, or being affected by the introduction of ETICS framework and related ASQ offer, so as to address the economic viability and potential of an ETICS commercial endeavour. To activate the analysis, the section first provides a methodology and sets common guidelines for stand-alone market quantifications (Section 2.1), identifying four macro-market of interests for a would-be ASQ offer; these macro-markets are further segmented into eight different business opportunities or target markets, for which the revenue generation potential for the ETICS offer is estimated (Section 2.2). Therefore, basing the discussion on (though not limiting it to) the market quantifications performed, Section 2.3 concentrates on expected business impacts, rising from the introduction of ETICS. Conclusions and research outcomes are restated in Section 2.4.

In Section 3, the focus is directed from the Business domain to the Socioeconomic domain. In order to define, describe and assess the socioeconomic impact of the ETICS project, Section 3.1 presents a simple yet accurate methodology that will be used in the remainder of this chapter. According to the methodology described, Section 3.2 focuses on identifying and studying the properties of the most important stakeholder roles and their positions related to a protocol, service, or application instance. Therefore, with reference to the previously mentioned stakeholders, a list of the major socioeconomic issues currently on-going and envisioned is provided and described in Section 3.3, while conclusions and a first discussion on inter-domain relationships existing among impacts of different nature are presented in Section 3.4.

The analysis then shifts to the Legal domain in Section 4, identifying a set of aspects of a legal and regulatory nature that may arise from the introduction of ETICS ASQ solutions. Subsequently, Section 4.2 addresses the definitions and description of each legal aspect previously identified from an ETICS perspective in order to better understand the possible criticalities and impacts arousing because of the adoption of the ETICS solution. Brief legal recommendations conclude the discussion (Section 4.3).

Section 5 provides a preliminary view on Net Neutrality in order to support the argumentations which will be further elaborated in [Del3.5]. To provide the work baseline and common ground on the topic, this main goal has been split in four specific objectives. First, a summary of Net Neutrality definitions in literature is provided in Section 5.1; then, an updated picture of the regulatory landscape on Net Neutrality in some significant countries is given in Section 5.2 to stress the most important aspects per each country/area. Subsequently, Section 5.3 outlines a general overview of macro-economic impacts driven by Net Neutrality

vs. Non-Net Neutrality options. Taking into account the implications of Net Neutrality regulation on some possible Internet business models, Section 5.4 highlights impacts for NSPs determined by Net Neutrality, so as to understand whether and how the Internet economic paradigm needs to evolve and what role regulation should play in this process.

While the aforementioned discussions on the core Business, Socioeconomic, Legal and Net Neutrality impacts related to the ETICS project largely consider such impacts as stand-alone pieces, Section 6 aims at closing the potential gap arising from this limited interrelation by synthesizing all results in a unified vision, whose goal is to address how the listed impacts pertaining to the four domains mutually affect one another. In order to perform the interplay assessment process, the analysis is organized in four steps. Section 6.1 presents the possible interplays available for discussion; Section 6.2 provides a list of impacts as extracted from each of the four domains; Section 6.3 addresses the assessment of intra-domain cross-effects of impacts for each of the four domains, so as to highlight how impacts belonging to the same domain mutually influence one another; Section 6.4 first covers the assessment of impacts mutual interdependencies (investigating the potential cross-domain nature for each and every impact), and second, provides the assessment of inter-domain cross-effects for impacts, describing how each impact of a given domain may mutually affect other impacts belonging to different domains.

To conclude, Section 7 draws final remarks on the overall impacts identification and analysis process performed. Guidelines and insights regarding the ETICS project are provided, and future work developments are outlined.

Section 8 provides a complete list of references mentioned in the whole deliverable.

Section 9 presents the full stand-alone quantification studies carried out (a synthesis of which is included in Section 2.2), here attached in the form of Appendix.

2. ASSESSMENT OF BUSINESS IMPACT FOR THE ETICS FRAMEWORK

2.1. METHODOLOGY FOR ETICS MARKET QUANTIFICATION AND BUSINESS IMPACT ASSESSMENT

This section is devoted to the assessment of core business-related impacts affecting – or being affected by – the ETICS project.

The fundamental assumption which triggers this discussion, consistent with the previous WP3 work, is that the business dimension is key to ETICS uptake and competitive advantage sustainability in the long run. Both these aspects shall be considered with reference to several issues impacting on ETICS success:

- economical and financial viability of the crafting of an ETICS-related offer;
- size of target markets for the ETICS Assured Service Quality (ASQ) offer;
- ability of the ETICS ASQ offer to modify the as-is target markets and trigger growth;
- market penetration (in terms of achieved market shares and revenues) of the ETICS ASQ offer;
- ETICS business sustainability and success in the medium-long terms.

In the light of these arguments, the section first focuses on elaborating ETICS markets quantification. Such quantification process constitutes an essential input for any assessment of the viability and sustainability of an ETICS commercial endeavour, and may well provide a justification for OPEX and CAPEX from the set of stakeholders involved.

Therefore, WP3 partners committed themselves to:

1. identifying target markets of interests for a would-be ASQ offer (Section 2.2.1);
2. providing guidelines and a shared flexible methodology for the evaluation of those markets' size, value, growth potential, and revenue generation potential for ETICS members (see section 9.1);
3. performing the stand-alone quantification for each of the markets identified (Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5);
4. carrying out a final integration and consolidation of all stand-alone studies, so as to obtain estimation for the overall ETICS macro-market (Section 2.2.6).

Notwithstanding the quantification process limitations, mainly due to criticalities in data availability, heterogeneity in methodologies applied, and diverse partners' backgrounds, the analysis outcomes are valuable for grounding the performance forecasts and goals setting of the ETICS offer.

Beyond the sustainability of ETICS, the need to investigate how ETICS's introduction would potentially modify the Internet ecosystem's business landscape from a Future Internet perspective arises. This is the objective of Section 2.3, which addressed and summarizes all business impacts, including (but not limiting the discussion to) those related to ETICS market size and expected financial performances.

2.2. ETICS MARKETS QUANTIFICATION

2.2.1. MARKET QUANTIFICATION SCOPE – ANALYSED MARKETS IDENTIFICATION

The identification of target markets to be quantified and evaluated was performed according to the "significance" logic, that is, markets had to be important for the ETICS project.

Markets' significance and subsequent selection was argued on the basis of the following points:

- the markets had to be actually reachable and penetrable by a commercialized ETICS offer, that is, they should be somewhat impacted by the rise of an ASQ offer;
- the markets had to conform to the "future Internet" perspective, i.e., they are innovative (at least in terms of some key features/characteristics, which may be enhanced by the introduction of ASQ) and their development is tightly coupled with the overall ecosystem's evolution;
- the markets showed a plausible growth potential, especially in a to-be scenario enabled by the introduction of ASQ;
- the markets, when considered as a portfolio of businesses, allow to guarantee a satisfactory coverage of all macro-industries and macro-business areas of interest for the project (e.g. both Consumer and Business sectors are covered);
- the markets had been object of previous studies, i.e., data and information on which to ground any estimation are available publicly or internally among partners (in the latter case, only non-sensitive information were shared);
- the markets are of interest for the ETICS partners (with a focus on industry partners), who declared commitment to analyse them;
- the markets are consistent with the scenarios and use cases investigated in previous WP3 deliverables [Del3.1], [Del3.2], [Del3.3] (e.g. the Gaming as a Service market), and emerge from a close WP2-WP3 cooperation.

As a whole, given that ETICS is focusing on services and markets enabled by ASQ traffic, primarily in the context of Internet, markets included typically referred to premium and high quality services and traffic; however, also services that are based on low priority traffic may be included, if such services can make sense from an Internet services point of view.

On the basis of the aforementioned elements, four main areas are identified as they represent substantial different business opportunities or markets:

1. **High-definition (premium) person-to-person rich multimedia communication;**
2. **Off-net (premium) content delivery;**
3. **Inter-provider ASQ connectivity for Business customers;**
4. **Consumer Cloud Services.**

These four macro-areas are further exploded into eight stand-alone markets:

- High-definition (premium) person-to-person rich multimedia communication:
    - Video Communication (Including multi-party calls).

        - Business;
        - Consumer;
    - Broadband HD Voice (any access);
    - Social networking triggered Rich multimedia communication;
    - Multimedia Applications Solutions.
- Off-net (premium) content delivery:
    - Without CDN;
    - With CDN.
- Inter-provider ASQ connectivity for Business customer:
    - Virtual Private Network (VPN).
- Consumer Cloud Services
    - Gaming as a Service

These eight markets, covering all four macro-sectors of relevance, are the object of the quantification process performed in Section 2.2.

2.2.2. High-Definition (Premium) Person-to-Person Rich Multimedia Communication

2.2.2.1. Video Communication

Market Definition

This video communication market study covers in general the consumer as well as the business market, where the solutions and services are ranging from direct video calling over Internet (e.g. Skype) to more advanced video conferencing or even high-end telepresence solutions for the executive business market. While there are still many factors that are impeding adoption and take-up of such solutions and services, we do observe several factors indicating that there are important shifts in this area indicating significant growth potential. A quote from an IDC Market Analysis Report [IDC11] is illustrative of current believes: “Enterprise videoconferencing is on the move and gradually on its way to become the "new normal" of business communications. IDC believes that vendors' enhanced technologies have increasingly delivered to end users experiences worthy of initiating a videoconference over a phone call or conducting business across locations that in the past required travel”.

However, we also observe that the size of the current market is rather small, which still make many NSPs reluctant to enter this market with full force. While this study will focus on the business market, we include some indications and numbers reflecting the emerging consumer video communication market. The main focus is on fixed network services, while in general we see that adoption trends of fixed wireless (e.g. Wi-Fi hotspots) and mobile broadband together with SW based solutions for personal clients indicate that wireless clients are becoming more and more ready to take part in this game. Up to now, the typical considerations made by business decision-makers were focused on a cost vs. savings trade-off where the reduction of travel costs is the most important driver. Nowadays we observe a shift towards valuation of additional factors such as faster decision-making, more inclusive teaming, more intimate customer

interactions, and entirely new ways of doing business [Wainhouse11]. In summary, the important drivers and enablers are:

- Increased management productivity and efficiency in business transformation.
- Globalization: employees, suppliers, partners and customers can be anywhere on the globe.
- Emerging cultural shifts impacting preferences by the workforce. Internet based services used at home such as messaging, voice and video calling influence user expectations in the business area as well.
- Concerns about climate change and desire toward lowering carbon footprint, impacting both business travels as well as tele-commuting.
- Improvements in unified communication and collaboration products and services, where video communication is an integral part.

In addition, cost reductions and performance improvements in the Layer 2 and Layer 3 of VPN domains as well as the general improvement in terms of bandwidths and unit price of broadband and basic Internet access make video conferencing more attractive to business customers. Moreover, we observe that SW based solutions both for clients and for video conferencing infrastructure emerge into the market. The quality of such solutions appears to be competitive with dedicated HW based solutions in a price performance perspective. Hence in a few years SW based clients on PC and Pads will surpass the installed base of dedicated endpoints. However the benefits of room and group based solutions will still make dedicated solutions attractive for the foreseeable future.

Other interesting market analysis messages, one originally from a Gartner study and a follow up message supplemented by Baird supports the above: “For example, Gartner expects that by 2015, over 200 million workers globally will run corporate-supplied video conferencing from their desktops. This considerable figure does not consider the massive proliferation of tablets (conservative estimates of 135 million shipments in 2015) and smart phones (a forecasted 1.0 billion shipments in 2015) being used in the workplace as well. We believe this portion of the market will significantly outpace the growth of the traditional video conferencing market and add substantially to IDC’s base-line figures.” [Baird11].

We also note that there can be special regional or global impacting events that can be wildcards in the evolution of and demand for video communication services. Examples are: volcanic eruptions producing ash clouds significantly interrupting air traffic; severe flu pandemics resulting in travel advice and even restrictions; and new climate change knowledge regarding CO2 emissions that results in significant CO2e taxation or even travel restrictions.

On the other hand there are still obstacles. A Norwegian research report [Ølnes11] states that the lack of sufficient broadband capabilities is an important issue for the private business sector, while being a lesser concern in the public sector, and that lack of information on meeting room and remote party capabilities is also an impediment to increased usage. While the technologies available to consumer customers via their PCs, laptops, pads and Smartphones have matured significantly over the last years so as to make such terminals more suitable for video communication, factors hindering services uptake are still present there are still remaining obstacles. Often the broadband service is still not suitable and/or the home gateway or network still causes issues that reduce customer experience.

One observation of great importance to ETICS is that today enterprise video conferencing is dominated by intra-business communication and based on specific business VPN solutions on Layer 3 or Layer 2 (or leased

lines). The estimation of the inter-NSP and B2B traffic has been rather difficult, as no reliable source has been found. However, a typical number business experts currently mention as a rough estimate is that 10% of the total traffic comes from B2B.

The aim of this study in terms of quantification is to derive numbers in the following areas:

- Overall end-customer facing revenues by service providers offering Video communication and conferencing as a service;
- Inter-NSP traffic and revenues related to inter-NSP ASQ traffic exchange or connectivity.

We observe that the later revenues will be only a fraction of the overall end-customer facing revenues. However, we believe that the inter-NSP ASQ traffic will be an important enabler and boost the end-customer facing markets.

Quantification Methodology and Hypotheses

In this section we briefly discuss the approaches taken to derive the quantification.

First we consider the overall end-customer facing revenues focusing on the offering of video communication as a service. The service provider is here typically a NSP or network service provider or an over-the-top service provider (OTT).

Based on given estimated numbers for 2012 videoconferencing equipment revenue globally [IDC10] [Baird11] we extrapolate the revenue potential as seen by the service provider side. In a simplistic fashion we are considering the market potential by assuming “all-inclusive” services provided in terms of service provisioning and operations, leasing of endpoints, and in terms of associated network and traffic services. More information on this will be provided in the sections below together with some arguments on how revenue can grow as a result of introducing ETICS ASQ services.

The next question we ask is what is the video communication traffic volume generated by the end-customers. The key source in this respect is the Cisco Visual Networking Index (VNI) [Cisco11]. For the Consumer segment the 2012 estimate is that Video calling will generate 659 Petabyte (PB) per month and by far this number is dominated by fixed access. The video calling traffic is however only 2,7% of the total Consumer Internet traffic. The 2010-2015 CAGR is estimated to 41%. A similar number for business video communication traffic is not given. However, in a similar fashion as for the consumer traffic, we take as a rough estimate that 3% of the total Business traffic is contributed by video communication.

Wherever inter-NSP traffic estimates are made we limit the analysis to the (Western) European market assuming this is a rather mature market where ASQ traffic services can be introduced and evolved in the 2013 – 2017 timeframe investigated. The baseline numbers used for inter-NSP traffic estimations are based on generated traffic by the end-customers as given by the VNI numbers. The Western European traffic generated is approximately 25% of the total traffic, that is 165 PB per month.

Based on the rough estimate of having 3% of the total Business traffic contributed by video communication and given the total business IP traffic is 6011 Petabyte (PB) per month in 2012 we get an approximate number of 180 PB per month of video communication traffic globally. Again, the Western European traffic generated is approximately 25% of the total traffic, that is 45 PB per month.

The key question for ETICS is how much additional revenue can be generated as a result of introducing inter-NSP ASQ traffic and connectivity into the market. An important starting point to consider is the

existing inter-NSP traffic volume, both in terms of Internet (BE) traffic and in terms of managed IP traffic if business IP traffic is considered.

As indicated above, a rough and typical number is that 10% of video communication traffic in the business area is B2B. Similarly we hear that 10% is inter-NSP traffic. Note that the inter-NSP and the B2B traffic are partially overlapping and the overlap is typically quite high. Hence in our studies we focus on inter-NPS traffic and anticipate that 10% of the video communication traffic is inter-NSP in 2012 as a baseline. The lack of Internet ASQ traffic services is considered an important impediment to inter-NSP and B2B video communication in addition to immature interoperation among different vendor equipment. These two factors are much dependent on each other as one is a driver for the other, and today's situation is a bit of a deadlock as described in ETICS Deliverable 2.1 [D2.1].

If ASQ traffic can be introduced in 2013, we will anticipate that the additional traffic generated by end customers (as a result of ETICS ASQ traffic introduction) is 3% in 2013 for both consumer and business. Considering the business market, we anticipate as a baseline that this additional overall traffic growth will be up to 15% in 2017. At the same time, considering inter-NSP traffic, we expect that this ratio will increase from the 10% as baseline up to 20% in 2017 and moreover that there will be a shift of traffic type from BE Internet to ASQ traffic. This is in particular the case for video traffic as the QoE is quite dependent on predictable network performance. In 2017 we assume that 75% of this total inter-NSP traffic will be ASQ based traffic. For simplicity we assume that all inter-NSP and B2B traffic is Internet based.

The underlying arguments for the above growth potentials are based on a few main aspects. The current penetration of video communication equipment or facilities in the business market is as low as 10%. Hence the current market is positioned rather low on "the growth S-curve", thus the potential for growth is quite high in theory. We anticipate that the price pressure will be rather high, driven by the introduction of SW based solutions. Coupled with ETICS ASQ traffic based services to ensure end-to-end quality and improved customer experience, we can see such a significant growth as anticipated in the below quantification. Next, considering the consumer side, the starting point is the Cisco VNI numbers and the estimated 2010-2015 CAGR of 41%. Considering the effect of introducing ASQ traffic is again a difficult task. One aspect that makes it difficult to estimate is that ASQ Internet traffic will not be introduced globally overnight. It will be a local or regional step-vice build out. For simplicity, we argue that the 41% CAGR is too optimistic in a five-year perspective without ASQ traffic services available on the Internet. In this time frame the customers may start experiencing more frequent difficulties (potentially leading to lower QoE rates) due to congestions as a result of NSPs lacking investment sources and the level of over-provisioning will not be as high as we have today. Hence our baseline for growth rate in 2017 is reduced to 35% without (ETICS) ASQ.

On the other side, if ASQ traffic is introduced gradually in 2013 and that in 2017 there has been a significant global adoption and build-out of ASQ traffic we anticipate that the growth rate for Western Europe could increase up to 45% in 2017. Sensitivity analysis should prove analysis on different evolution scenarios and future year-by-year growth rates. The effect of ETICS ASQ is anticipated to result in a difference of 10% growth rate in 2017 in regions where ASQ traffic is well established.

The last aspect to consider is the value or revenue generation associated with inter-NSP ASQ traffic or connectivity. For this part we use as baseline price information from Bill Norton ("Dr. Peering") [Norton12] who suggests a decline to about or even below $ 1 / Mbs. It is important to note that this decrease is heavily influenced by Tier1 carriers, which have global content providers pushing popular content traffic to eyeballs. Hence this price decrease is "subsidised" by this type of content traffic and the original transit

service and pricing is somewhat disrupted. The anticipated price levels for ASQ traffic and their interconnect services are positioned according to ETICS suggestions that the baseline will support the "sending party network pays" model or what is often called "traffic termination charging" by separating the market into, respectively:

i) inter-NSP between European NSPs;

ii) inter-NSP between European NSPs and non-European NSPs. This abstraction level appears to be feasible for our revenue analysis. Further reasoning around anticipated price levels will be provided in the below sections.

As-Is Market Value Quantification

The estimation of the potential revenues coming from the offering of Video Communication as a service is based on the figures provided by IDC studies [IDC10][Baird11] [Wainhouse12] and showed in the tables below.

The monthly fee categories presented can be considered as different scenarios. The high price is more representative of the situation today, with more costly solutions, while the lower price can be more realistic in the future with a transition towards more SW-based and general purpose solutions.

Without inter-NSP ASQ		**Years**				
		2013	2014	2015	2016	2017
Revenues ($ B)	Monthly fee $ 250	8,026	10,434	13,565	17,634	22,924
	Monthly fee $ 175	5,618	7,304	9,495	12,344	16,047
	Monthly fee $ 100	3,211	4,174	5,426	7,054	9,170
	Total ($ B)	**16,855**	**21,912**	**28,486**	**37,032**	**48,141**

TABLE 1 – VIDEO COMMUNICATION REVENUES ESTIMATION WITHOUT INTER-NSP ASQ WORLDWIDE

With inter-NSP ASQ		**Years**				
		2013	2014	2015	2016	2017
Revenues ($ B)	Monthly fee $ 250	8,065	10,627	14,164	19,137	26,250
	Monthly fee $ 175	5,646	7,439	9,915	13,396	18,375
	Monthly fee $ 100	3,226	4,251	5,666	7,655	10,500
	Total ($ B)	**16,937**	**22,317**	**29,745**	**40,188**	**55,125**

TABLE 2 – VIDEO COMMUNICATION REVENUES ESTIMATION WITH INTER-NSP ASQ WORLDWIDE

Worldwide revenues ranges (as is):

- Video communication without inter-NSP ASQ: **€12,641.25** billion (2013), **€36,105.75** billion (2017);
- Video communication with inter-NSP ASQ: **€12,702.75** billion (2013), **€41,343.75** billion (2017).

Assumptions:

- Full managed service delivered and device management included;
- Focus only on business market.

To-Be Market Value Quantification after the Introduction of ETICS ASQ – ETICS Inter-NSP Market Share and Revenues

The following tables show the generated inter-NSP revenues or value creation based on inter-NSP video communication traffic. The baseline traffic numbers have been taken from the Cisco VNI predictions [Cisco11]. To have a feasible level of abstraction for the analysis the market has been divided into:

- inter-NSP between European NSPs;
- inter-NSP between European NSPs and non-European NSPs.

General assumptions:

- ASQ traffic and their interconnect services are positioned according to ETICS proposal of adopting the "sending party network pays" model;
- BE traffic exchanging is based on sending party network pays principle. (This is an assumption made in order to have comparable cases. In this case, we look at value creation and not net revue exchange: Hence, "paid peering" or "send party network pays" appears to be a reasonable approach);
- A key number in the below analysis is the translation from Petabyte (PB) per month of two-way traffic into dimensioning capacity: 1 PB per month of average traffic will result in an average traffic of about 350 Gbs.

Business Market

Video Communication - Traffic evolution estimation						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Baseline Traffic evolution (Without ASQ) - Western Europe						
Traffic Growth %		30 %	30 %	30 %	30 %	30 %
Total Traffic (PB per Month)	45	59	76	99	129	167
Inter-NSP traffic (PB per Month) 10 % of total traffic	4,5	5,9	7,6	9,9	12,9	16,7
Intra-Europe (60%)	2,7	3,5	4,6	5,9	7,7	10,0
Intercontinental with Europe (40%)	1,8	2,3	3,0	4,0	5,2	6,7
Additional growth by intro of ASQ						
Growth in % of total traffic - After ASQ is introduced		31 %	33 %	37 %	39 %	40 %
Total Traffic (PB per Month)	45	59	79	108	150	209
% of Inter-NSP traffic	10 %	12 %	14 %	16 %	18 %	20 %
Traffic (PB per Month)	4,5	7,1	11,0	17,2	26,9	41,9
Intra-Europe (60%)	2,7	4,3	6,6	10,3	16,2	25,1
Intercontinental with Europe (40%)	1,8	2,8	4,4	6,9	10,8	16,8
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Ratio of ASQ traffic		25 %	37 %	49 %	61 %	73 %
Intra-Europe (60%)						
BE (PB per Month)		3,19	4,16	5,27	6,30	6,78
ASQ (PB per Month)		1,06	2,44	5,06	9,85	18,34
Intercontinental with Europe (40%)						
BE (PB per Month)		2,13	2,77	3,51	4,20	4,52
ASQ (PB per Month)		0,71	1,63	3,37	6,57	12,23

TABLE 3 – VIDEO COMMUNICATION – TRAFFIC EVOLUTION ESTIMATION – BUSINESS MARKET

Anticipated price level, Inter-NSP traffic - Rough Assumptions_Business					
		$/Mbs	Per PB per Month	Per PB per Month over one Year	
Intra Europe			$ Mill	$ Mill	
	BE	2	2	24	
	ASQ	4	4	48	
Intercontinental with Europe					
	BE	4	4	48	
	ASQ	10	10	120	

TABLE 4 – BUSINESS MARKET FORECASTS ON TRAFFIC EVOLUTION AND PRICE LEVEL

Inter-NSP value creation, Without and with ASQ - $ Bill. _ Business Market						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Inter-NSP revenues without ASQ - $ Bill.						
Intra-Europe (60%)	0,06	0,08	0,11	0,14	0,19	0,24
Intercontinental with Europe (40%)	0,09	0,11	0,15	0,19	0,25	0,32
Total	**0,15**	**0,20**	**0,26**	**0,33**	**0,43**	**0,56**
Inter-NSP revenues ASQ - $ Bill.						
Intra-Europe (60%)		0,13	0,22	0,37	0,62	1,04
Intercontinental with Europe (40%)		0,19	0,33	0,57	0,99	1,68
Total		**0,31**	**0,55**	**0,94**	**1,61**	**2,73**
Inter-NSP Revenues, Difference between without and with ASQ, in $ Bill.						
With ASQ - Without ASQ		0,12	0,29	0,61	1,18	2,17
Difference - % increase from without to with ASQ		60 %	113 %	183 %	273 %	385 %

TABLE 5 – INTER-NSP VALUE CREATION – BUSINESS MARKET

Consumer Market

Video Communication - Traffic evolution estimation						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Baseline Traffic evolution (Without ASQ) - Western Europe						
Traffic Growth %		35 %	35 %	35 %	35 %	35 %
Total Traffic (PB per Month)	165	222	300	405	547	739
Inter-NSP traffic (PB per Month) 20 % of total traffic	33	44	60	81	109	148
Intra-Europe (85%)	28,0	37,8	51,0	68,9	93,0	125,6
Intercontinental with Europe (15%)	4,9	6,7	9,0	12,2	16,4	22,2
Additional growth by intro of ASQ						
Growth in % of total traffic - After ASQ is introduced		38 %	40 %	42 %	44 %	46 %
Total Traffic (PB per Month)	165	227	318	452	651	950
% of Inter-NSP traffic	20 %	21 %	22 %	23 %	24 %	25 %
Traffic (PB per Month)	33	48	70	104	156	238
Intra-Europe (85%)	28,0	40,6	59,5	88,4	132,8	201,9
Intercontinental with Europe (15%)	4,9	7,2	10,5	15,6	23,4	35,6
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Ratio of ASQ traffic		10 %	19 %	28 %	37 %	46 %
Intra-Europe (85%)						
BE (PB per Month)		36,52	48,21	63,62	83,65	109,04
ASQ (PB per Month)		4,06	11,31	24,74	49,13	92,89
Intercontinental with Europe (15%)						
BE (PB per Month)		6,45	8,51	11,23	14,76	19,24
ASQ (PB per Month)		0,72	2,00	4,37	8,67	16,39

TABLE 6 – VIDEO COMMUNICATION – TRAFFIC EVOLUTION ESTIMATION – CONSUMER MARKET

Anticipated price level, Inter-NSP traffic - Rough Assumptions_Consumer					
		$/Mbs	Per PB per Month	Per PB per Month over one Year	
Intra Europe			$ Mill	$ Mill	
	BE	2	2	24	
	ASQ	3	3	36	
Intercontinental with Europe					
	BE	4	4	48	
	ASQ	7	7	84	

TABLE 7 – CONSUMER MARKET FORECASTS ON TRAFFIC EVOLUTION AND PRICE LEVEL

Inter-NSP value creation, Without and with ASQ - $ Bill. _ Consumer Market						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Inter-NSP revenues without ASQ - $ Bill.						
Intra-Europe (85%)	0,67	0,91	1,23	1,65	2,23	3,01
Intercontinental with Europe (15%)	0,24	0,32	0,43	0,58	0,79	1,06
Total	**0,91**	**1,23**	**1,66**	**2,24**	**3,02**	**4,08**
Inter-NSP revenues ASQ - $ Bill.						
Intra-Europe (85%)		1,02	1,56	2,42	3,78	5,96
Intercontinental with Europe (15%)		0,37	0,58	0,91	1,44	2,30
Total		**1,39**	**2,14**	**3,32**	**5,21**	**8,26**
Inter-NSP Revenues, Difference between without and with ASQ, in $ Bill.						
With ASQ - Without ASQ		0,16	0,48	1,09	2,19	4,18
Difference - % increase from without to with ASQ		13 %	29 %	49 %	73 %	103 %

TABLE 8 – INTER-NSP VALUE CREATION – CONSUMER MARKET

Sensitivity Analysis of Results

The dimensioning multiplier for taking into consideration the busy hour traffic as compared with the average traffic is a critical number. Changing it will create a significant difference, although the impact is linear with this multiplying factor. Moreover the changes in price levels are another critical issue.

Consider the following price level decrease (From - To):

		$/Mbs			$/Mbs
Intra Europe			Intra Europe		
	BE	2		BE	1,5
	ASQ	4		ASQ	2
Intercontinental with Europe			Intercontinental with Europe		
	BE	4		BE	3
	ASQ	10		ASQ	5

TABLE 9 – PRICE LEVEL SCENARIOS

This will cause a similar decrease in inter-NSP value creation.

Decreasing the growth rate for the ASQ case with instead a linear increase, we get a value creation decrease for the ASQ case.

In summary, we see indications on value ranges of revenue generation in the end customer segment or value creation in the inter-NSP space. While the effect of ASQ can be significant in the end customer

segment the large effect is in the inter-NSP space. **This is an indication that the ASQ interconnect services can help improving the ROI in particular for the NSPs and hence put them in a position to invest and build out their networks to meet the added demand resulting from introducing and offering ASQ services**.

2.2.2.2. Broadband HD Voice

Market Definition

Despite the advent of data service, traditional PSTN voice services remain very profitable. Alternative operators also provide voice services over the Internet Protocol. In addition to Operators, OTT players also compete on the provision of voice services (e.g. Skype). For the end users voice is the most personalized way of communicating, while for the operators it is an important source of revenue. Consumer preferences indicate that, even if the relative market share for voice decreases over time, revenues will remain constant. In addition, studies show that users appreciate the personal nature of voice communication, and believe it offers a more familiar and emotional connection to another person as compared with text messaging, e-mail or social networking [Ericsonn11].

The same whitepaper argues that high-definition voice is a crucial next step in the voice communication technology and business. One factor in particular supports the operator business case for broadband HD voice: the user acceptance of the technology. The 76% of the users that experience this service expressed their interest in adopting it as compared to the traditional VoIP or PSTN voice service. Broadband HD voice results in better quality, more natural sound and improved intelligibility and voice recognition. The improved user experience encourages subscribers to make more calls, and the average call duration tends to be longer. One study showed 96% of HD voice users were either very satisfied or quite satisfied with the service, and 21% claimed their calls lasted longer.

The benefits of clear, high-quality voice communication are even more tangible for enterprise users, who have been quick to recognize the potential impact of HD voice in business-critical areas such as conference calls and the fast-growing voice-recognition-services market, where better voice quality can lead to improved efficiency, reduced costs and a more productive working environment. From an operator perspective, enterprise demand is one of the strongest pillars of the business case for HD voice. Once convinced of the merits of a technology, enterprises tend to buy it in bulk, and it is relatively straightforward to introduce HD-voice-capable fixed or mobile devices on a departmental or organizational scale. Enterprise users tend to spend more than private subscribers and operators can differentiate themselves by including HD voice in their enterprise packages.

The arrival of OTT players offering free voice services has resulted in greater urgency to improve voice services. The business case for HD voice services lies on four key areas: users make more and longer calls when they have access to the technology, operator offerings can keep pace with OTT services, enterprises can benefit from better voice quality and the technology supports mobility.

HD-voice services have been launched on fixed and cellular 2G and 3G networks, as well as LTE (e.g. see subsection 2.2.2.2 summarizing the major trends of [Ericsonn11] as well as: [Segan11] [Kretkowski07] [UK_Broadband] [Orange09] [AudioCodes] [HostMyCalls] [VoIPdistri].

HD voice can be a valuable offering for all networks, and can play a key role in the evolution of GSM, WCDMA, LTE, CDMA and fixed networks. It works best as an ecosystem where subscribers can make high-quality voice calls from wherever they are to any other location. This comprises a market opportunity for ETICS.

Quantification Methodology and Hypotheses

The main sources from which we collected data and information used in our quantification analysis are the following:

- Market surveys and business reports and product brochures.
- Telegeography.
- The Organization for Economic Cooperation and Development, OECD, web site.
- Articles or quotes from executives in the Internet market, which are published online.
- Specialized Internet blogs.
- Industry white papers.
- Voice market business analysis reports.

These data have been used to estimate the overall VoIP service market features, including its size, growth rate and revenue attained. The methodology used for the market quantification analysis can be summarized as follows:

- Firstly we have used the aforementioned data that report the users' willingness to use (and pay for) broadband HD voice services, which demonstrate that such services do comprise a portion of the market.
- Then we use the most conservative estimates regarding the VoIP market size: this comprises the basis of the quantification, thus being conservative in our estimates and projections.
- Subsequently, on top of this number, we elaborate on different scenarios regarding the portion of the HD voice services revenue over the global VoIP services market.

Finally we derive the quantification results, which provide insight of the market potential of such services for the ETICS solution.

As-Is Market Value Quantification

Worldwide VoIP Revenue (as-is) [Mobileeurope11]:

- $6 billion or **€4.5 billion** (2015).

The business mobile VoIP users are estimated to increase tenfold over the next five years.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Worldwide VoIP Services Revenue range: €45-€225 million (2017).

Conservative assumptions:

- The considered market is the global VoIP voice services market.
- HD broadband voice services are supported by ETICS ASQ as a percentage of the overall VoIP market.
- All possible types of customers, residential, small business or businesses are considered.
- The market serves all types of stakeholders, including Carriers, OTT, End users, and Business users.

- The introduction of ETICS results in growth for the demand for HD voice services.
- ETICS could only extract a portion of the overall revenue from the roaming and multinational HD voice sessions.

ETICS Market Share and Revenues

Worldwide VoIP services estimated market share (to-be):

- 25% (2017).

Worldwide VoIP services estimated revenues range (to-be):

- €11.25-€56.25 million (2017).

Sensitivity Analysis of Results

Considering the variation in the to-be market the adoption of the ETICS technology also by mobile operators, 3 scenarios emerge:

ETICS market value range [11.25, 56.25] € million			
Scenario	Best [75% share]	Medium [30% share]	Moderate [5% share]
ETICS revenue range	[8.4, 42.2]	[3.4, 17]	[0.6, 2.8]

TABLE 10 – SCENARIOS ON MARKET VALUE RANGE

Overall, this is a market niche whose size will be crucially affected by the capacity of ETICS to serve as the major interconnection solution in the mobile telephony industry.

In the case that the ETICS/SEFA manages to be a competitive/complementary solution to IPX-IMS solutions, the added value and respective market size and growth will be more significant. In case it remains a solution oriented to fixed networks, the premium HD voice services will most likely be adopted as a complementary solution for business users.

2.2.2.3. Social Networking Triggered Rich Multimedia Communication

Market Definition

In order to define the social networking triggered rich multimedia market the Three Dimensional Business Definition framework from Harvard Professor Derek F. Abell will be applied. Derek Abell's model [Nijssen01] analyses the market according to three dimensions: the first dimension relates to the customer groups or segments that can be identified in the market, the second addresses these customers' needs and the third identifies the alternative technologies available to satisfy those needs.

Customers

- Final users who wish to connect to other people via the Internet

Needs

- Showcase one's personal identity [Kabani10]
- Connect with others, build relationships [Kabani10]
- Join interest groups, belong to the community [Kabani10]
- Have fun and excitement [ISG11]

- Be entertained and relieve stress [ISG11]
- Enjoy the competitive spirit [ISG11]

Technologies

A social networking service is an online service, platform, or site that focuses on building and reflecting of social networks or social relations among people. They can share interests and/or activities and people with similar interests, backgrounds or activities make their own communities. A social network service consists of a representation of each user (often a profile), his/her social links, and a variety of additional services [Boyd07].

In order to social networking services, platforms like Facebook use rich multimedia to promote users' interactions and entertainment. People can share comments, photos, videos and other links, as well as chat with friends, play online games, take quizzes, listen to music, join communities, etc. Considering these different functionalities available on social networks, some generate more data traffic than others, and, therefore, are more prone to be affected by the Internet connection quality. Since video and social gaming have higher data traffic rates than text or static image, the market quantification will focus on these two components of rich multimedia on social network environment.

In addition to this, video sharing websites, such as YouTube and Vimeo, are platforms where a fast growing amount of user-generated content is shared and viewed all over the world. As these websites provides video streaming, they generate a lot of data traffic and the user's quality of experience depends on the Internet connection performance.

Finally, a different social service to connect with other people through the Internet is represented by Skype, which is the biggest company to offer VoIP and video calls. This kind of service is highly dependable on connection quality and because of this is relevant to this market quantification.

Revenue Model

There are different revenue modes being used by the companies in this market, the three cited below are the main types:

- Advertising
- Transaction fees
- Subscription

The most common revenue model is the advertising. This model is the main revenue stream for social networks and video sharing websites. Facebook, for example, earns 85% from ads and continuously tries to create newer and more appealing forms of advertising in order to increase value to its advertisers and as a result grow its own revenue. Facebook has introduced new ad formats, for example, Sponsored Stories ad and the "Comment" ad, all leveraged by the social aspect of the platform. Apart from regular banner ads, Facebook also uses video advertising, such as Facebook's official "Sponsored Video" unit, in-banner display ads within apps, interstitials within games and apps and virtual currency ads within games, the latter having better performance than other formats [TubeMogul10]. YouTube now offers several types of ads, including display ads on its home page and on the video pages, ads that promote videos and ads that run in the video stream or pop up on the bottom of a video [Miller10].

Besides advertising, revenues can also come from transaction fees, which are incurred when users purchase digital goods and services from the platform provider or from a third party content provider, such as game

developers and movie producers. Transaction fees are the most important source of money for social gaming developers and are also applied by Skype. While social gaming developers earn from selling virtual goods, Skype charges for services other than Skype-to-Skype calls, such as mobile and landline calls (Skype-out), in a pay as you go model.

Finally, the last model is subscription, which is employed by Skype. This model implies paying a fixed monthly rate that allows users to have access to a set of pre-determined services for the period.

Geographical Definition

The geographical scope of this analysis will be defined as global, as the key players examined have worldwide presence.

Quantification Methodology and Hypotheses

The data and information used were collected from secondary sources, such as presentations featuring market value and growth trends, reports from international institutions and industry news.

The market to be quantified comprises four kinds of companies. Firstly, social gaming providers, which can have their own platform to reach the final users or, instead, operate in a third party platform, such as the social network Facebook. The market quantification will take into account the total revenues from both game and platform providers. For instance, for each transaction made during a Zynga's game on Facebook, Zynga gets 70% of the fee paid by the users and 30% of it goes to Facebook. All game developers that work through Facebook's interface use this basis, however, other companies, such as the two Japanese Gree and DeNA, have their own social gaming platforms, and therefore, retain all revenues.

There were a few sources of data regarding the social gaming market and its forecast, which differed significantly from each other. Although the information available did not specify the boundaries of each study it was concluded that some considered only the game developers' side, while one of them also included revenue from the platforms' side, and, therefore, showed distinctively higher values compared to the rest. The more comprehensive approach was chosen for the following sections.

The second market refers to video sharing website like YouTube. The third and fourth segments are made from both social networks and VoIP providers, represented by Facebook and Skype, respectively. Since these two companies are leaders in their segments, they will be used as a proxy for their respective market quantification.

The overall market was estimated as the aggregation of these four market segments.

As-Is Market Value Quantification

Since the market is split into four different parts, for 2011 the total value is the resulting sum of the following revenues:

- **Social gaming providers**: $4.90 billion [Cohen10] according to Viximo's estimation;
- **Video sharing websites**: $2.95 billion according to a conservative analysis based on Citi Investment Research and Analysis [Schonfeld11] and comScore [Richmond11];
- **Social Networks**: $54.8 million derived from the estimated time American users spend watching video on the Facebook social platform [Fac11] [SEC12] [Nielsen11] [ComScore11];
- **VoIP providers**: $1.03 billion estimated revenue based on Skype turnover.

2011	Social Gaming	Video Sharing	Video - Social Networks	Video and Voice Calls	Total
$, billions	4.90	2.95	0.05	1.03	8.94
€, billions	**3.72**	**2.24**	**0.04**	**0.78**	**6.79**

TABLE 11 – REVENUES PER MARKET SEGMENT

The result is $8.94 billion. Using an exchange rate of 1.00 USD = 0.76 EUR it equals to €6.79 billion.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Considering that ETICS ASQ can boost the world's social gaming market (currently worth $4.9 billion) making it grow by 5% (that is, at the same rate of Mobage, a leading Japanese mobile social gaming platform considered as a proxy due to its performance), ETICS would potentially raise an extra value of $573 million. Adding this value to the $7.4 billion forecast, the social gaming market size should approximately reach$8.0 billion. **It is also assumed that ETICS could incite the video sharing market to grow at a CAGR of 28% for the next two years**. In this manner, this market would be worth $4.8 billion. Furthermore, **assuming that ETICS can achieve 10% of total ad expenses in social networks**, the future market for rich multimedia will be $1.1 billion. Finally**, it is considered that ETICS will trigger Skype to grow at a 20% CAGR,** reaching a value of $1.5 billion.

The market value ETICS ASQ is given by the addition of all four contributions and it will be $15.4 billion. In euros it is equivalent to €11.7 billion.

To-Be Market	Social Gaming	Video Sharing	Social Network	Video and Voice Calls	Total
$, billions	8.0	4.8	1.1	1.5	15.4
€, billions	**6.1**	**3.7**	**0.8**	**1.1**	**11.7**

TABLE 12 – TO-BE MARKET VALUE

Market Share and Revenues

Summing up the revenues from each market segment the total revenue for players adopting ETICS solution is $428.5 million. Converting it to euros, the value becomes €325.7 million.

ETICS Revenue	Social Gaming	Video Sharing	Social Network	Video and Voice Calls	Total Revenue
$, millions	147.3	53.0	50.0	178.2[1]	428.5
€, millions	**111.9**	**40.3**	**38.0**	**135.4**	**325.7**

TABLE 13 – EXPECTED REVENUE FOR PLAYERS ADOPTING AND PARTICIPATING IN ETICS

Assumptions:

- ETICS partners are able to penetrate in 50% of single market major players' operations and receive 5% of their revenues;
- ETICS partners are able to get the 25% users' expense within Skype.

Sensitivity Analysis of Results

The considered variations, to define the possible scenarios, are different for every part of the market:

- Social gaming: +/- 3% of the ETICS impact on the to-be market;

[1] This value is more conservative than the one indicated in Section 2.2.3.2 (Broadband HD Voice), Table 10, as it does not imply the introduction of HD services, but only as-is VoIP consumer services.

- Video sharing: +/- 7% on the estimated market growth rate;
- Social network: +/- 5% on the penetration on total revenues;
- Video and voice calls: +/- 5% on the estimated market growth.

Aggregating the four segments for the pessimistic, base and optimistic cases, the to-be market can vary as follows.

Total	Pessimistic	Base Scenario	Optimistic
To-Be Market - $, billions	13.9	15.4	17.0
To-Be Market - €, billions	**10.5**	**11.7**	**12.9**

TABLE 14 – SENSITIVITY ANALYSIS OF THE TOTAL TO-BE MARKET

However, not only the to-be market quantification was based on assumptions, but also the ETICS market share and revenues. ETICS penetration on the top three players' operations could be better or worse than 50%.

Adding all ETICS revenues for the pessimistic, base and optimistic cases, the total results in the three different scenarios are shown below.

Total	Pessimistic	Base Scenario	Optimistic
ETICS Revenues - $, millions	255.4	428.5	608.2
ETICS Revenues - €, millions	**194.1**	**325.7**	**462.2**

TABLE 15 – SENSITIVITY ANALYSIS OF THE TOTAL ETICS' REVENUE

It is also important to assess the influence each assumption has on the quantification process. Each variable was varied by 10% alone, while all others remained the same as in the base scenario. In this way, it is possible to see the individual impact of them on the final result.

	ETICS' Impact on Social Gaming To-be Market	Video Sharing To-Be Market	Rich Media Ads' Share	Video and voice calls's CAGR	ETICS' Penetration on Social Gaming	ETICS' Penetration on Video Sharing	ETICS' Penetration on Video and Voice Calls	Total impact all variables
Impact on ETICS Partners' Revenue (10% Change)	0.67%	0.62%	1.17%	4.34%	2.77%	1.24%	2.92%	13.78%

TABLE 16 – ASSUMPTIONS' IMPACT ON THE QUANTIFICATION PROCESS

The most important assumptions, with higher impact on the quantification, were the ones concerning the video and voice calls and also the ETICS' penetration on the social gaming market. The assumed value for Skype's CAGR was used to predict the amount of new paying users ETICS solution would create. These paying users have direct effect on ETICS partner's revenue, since they will pay a premium fee for better QoS, and show the heaviest influence on the market quantification's final result. Besides that, assumptions regarding ETICS' penetration directly impact on the natural markets for social gaming and video and voice calls, which comprise more than 50% of the total to-be market.

2.2.2.4. Multimedia Applications Solutions

Market Definition

It will be interesting to look globally at the multimedia market and its growth; in particular the following service taxonomy is utilized from the source data provided by IDC [IDC12].

Business Area	Segments	Services	Definition
MULTIMEDIA APPLICATION SOLUTIONS	Mob TV Multimedia Applications & Integration	Mob TV Multimedia Applications Consulting & Integration	Consulting, planning, design, custom design and engineering, and integration of Mob TV multimedia applications *and multiscreen*
		Mob TV Multimedia Middleware	Software & platforms associated Mob TV *or multiscreen* multimedia middleware solutions
		Mob TV Multimedia Product-attached services: Installation and Maintenance	Installation & maintenance including sw & platform upgrades/support associated with Mob TV */multiscreen* multimedia solutions
	IPTV Multimedia Applications & Integration	IPTV Multimedia Applications Consulting & Integration	Consulting, planning, design, custom design and engineering, and integration of IPTV/*(and evolving managed networks)* multimedia applications
		IPTV Multimedia Middleware	Software & platforms associated IPTV *(and evolving managed networks)* multimedia middleware solutions
		IPTV Multimedia Product-attached services: Installation and Maintenance	Installation & maintenance including sw & platform upgrades/support associated with IPTV *(and evolving managed networks)* multimedia solutions
	Multiscreen Multimedia	Multiscreen Multimedia	A platform that allows to extend reach to TV, PC and Mobile with Multi-Screen Multimedia Services
	Cable TV Multimedia	Cable TV Multimedia	Services supporting the build-out of infrastructure required to provide video services via IPTV technologies to television sets.

TABLE 17 – BUSINESS DEFINITION PER SEGMENT

The table above identifies the possible business services for each segment of the multimedia application solutions. The multimedia market is not presented in relation to the QoS aspects, which may need a specific analysis. However, **within the global multimedia market it is envisaged that a part of it can address QoS needs and create a market for QoS enabled services for multimedia**. This percentage is not yet identified in this analysis.

This business is mainly oriented to the market of system integration & providers and, therefore, indirectly linked to NSP/OTT businesses.

The geographical scope of this analysis will be worldwide, with specific data for Europe, Americas, EMEA and APAC.

Finally, the report is targeting the Carrier's market, therefore, the customer community served is both residential and enterprise, but strongly oriented to residential customers.

Quantification Methodology and Hypotheses

The methodology adopted is to address a specific market segment of multimedia services and to review existing market growth forecast until 2016, organizing them per market areas, in order to identify key aspects and trends capable to justify new technologies for the collaboration among actors on ASQ services.

To be noticed that, due to the nature of E2E services, any geographic areas with apparently low growth might be compensated by crossed areas having major growth. Therefore, the worldwide market trend is the reference one for the ETICS.

As-Is Market Value Quantification

The worldwide market is presented in the following table.

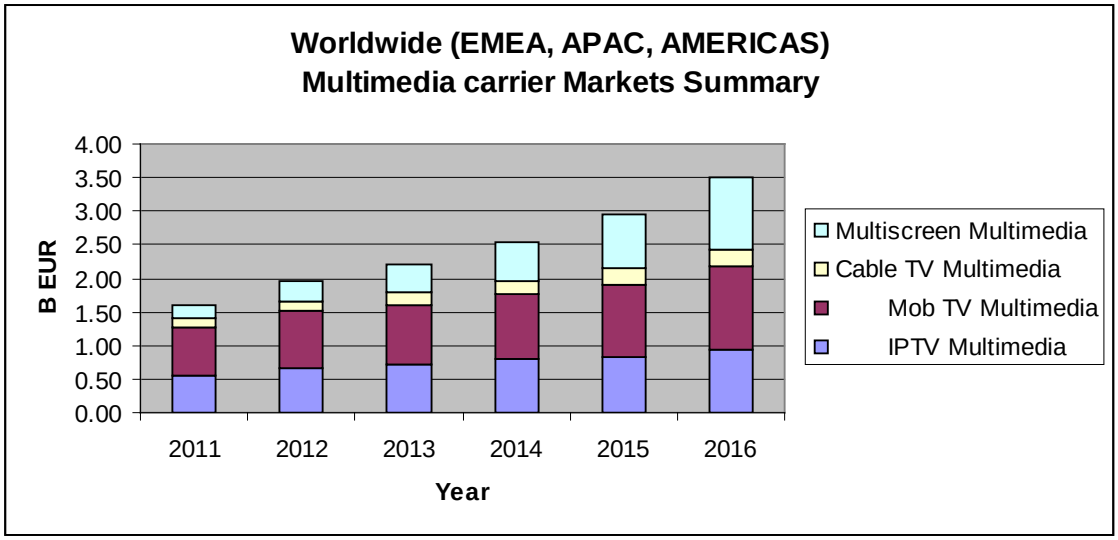


TABLE 18 – WORLDWIDE MULTIMEDIA CARRIER MARKETS SUMMARY

The consumption's behaviour is very different in each region: IPTV is the dominant segment in both EMEA (45%) and the Americas (38%) today, while APAC is led by mob TV (64%): this phenomenon is related to different penetration rates existing for fixed versus mobile technologies in different regions, as well as to different consumer behaviours.

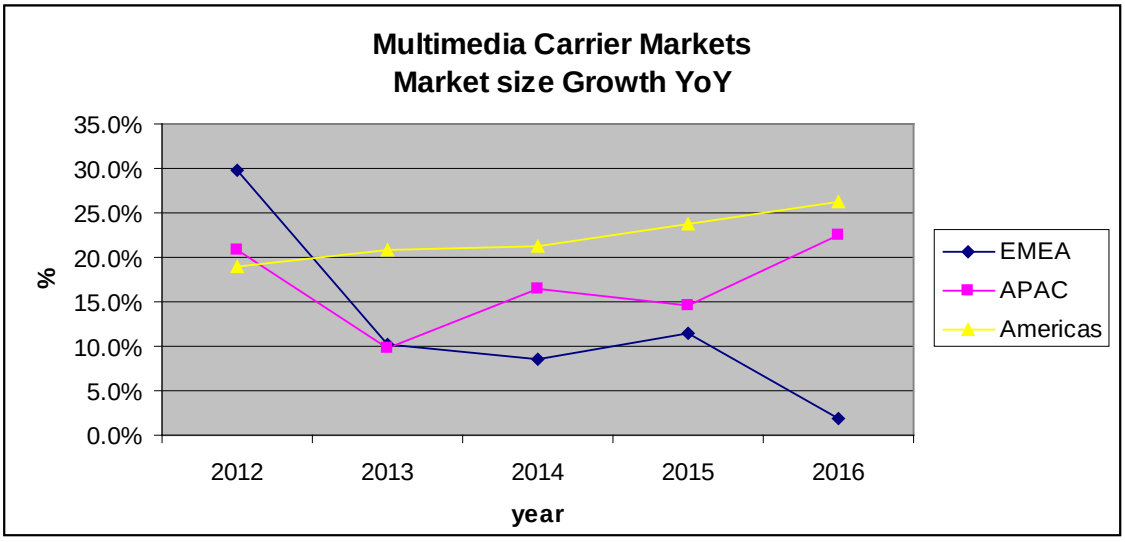


TABLE 19 – MULTIMEDIA CARRIER MARKETS GROWTH

To-Be Market Value Quantification after the Introduction of ETICS ASQ

The total IP market (to be):

- €8.51 billion (2013).

Relative IP/MPLS market (to be):

- €5.9 billion (2013).

About 70% of the IP market will be for MPLS (QoS) in 2013.

Applying the same ratio to the Multimedia Carrier Services, equal to €2.21 billion, the MPLS served market will be €1.55 billion (2013) worldwide.

ETICS Market Share and Revenues

ETICS market share and revenues will be based on the likelihood that end users pay a premium price for receiving higher QoS in video related services. According to the examination of the current demand-price elasticity for QoS services, 15% to 20% of subscribers expressed a strong interest and willingness to pay [Brunetti11]. Thus, following a conservative approach, the expected market share will be equal to 15%. Considering a value of the to-be market fixed to €1.55 billion, ETICS would be able to get €232.1 million.

Sensitivity Analysis of Results

The sensitivity analysis refers to the two main assumption made for the calculation of the market values:

- The correlation of the ratio of the multimedia market (QoS oriented) to the MPLS within the IP market;
- ETICS' penetration was determined as 15%.

Varying the values of these hypotheses, both the to-be market and ETICS revenues will change.

To-Be Market	60%	70%	80%
€, billions	1.33	1.55	1.77

TABLE 20 – SENSITIVITY ANALYSIS OF THE TO-BE MARKET

ETICS Revenues	10%	15%	20%
€, millions	132.6	232.1	353.6

TABLE 21 – SENSITIVITY ANALYSIS OF ETICS REVENUES

Both assumptions direct impact on the final result. However, the impact of an equal variation in both hypotheses' values at the same time is higher for the optimistic scenario than for the pessimistic, since their values are multiplied, instead of summed.

2.2.3. OFF-NET (PREMIUM) CONTENT DELIVERY

2.2.3.1. Without CDN

Market Definition

Prior to proceeding with the market quantification, we briefly define the basic terms and market under study.

Off-net content delivery denotes the delivery of content to the end users of a certain network whose origin resides outside that network's domain. Thus, this is content which is originated outside the customer's serving NSP and delivered by means of inter-NSP connectivity.

The term *premium* denotes that these services are of high quality and differentiated by the majority of best-effort content.

Also, for the market quantification of this section, we assume that this market is limited to the services that are provisioned without the presence of CDNs as seen from the inter-NSP perspective. That is, there is no

CDN federation or CDN interconnection involved, nor any partner CDN on-net co-location making the actual content source on-net. However, the content delivery source may be from a CDN but this is not of any relevance as seen from the inter-NSP perspective.

Having defined the basic terminology, we now proceed to define the services where this market quantification will be focused:

Premium video: According to [Nielsen11], HDTV is improving the TV viewing experience for as many as 30% of online customers globally. 3DTV is expected to have an impact on 12% of global online customers. Moreover, one in five end users is expected to own a TV set with Internet connection in the next 5 years. It is also expected to be combined and bundled with social networking services.

The major problem with CDNs is that "*global CDNs cannot offer any performance or capacity guarantee. Simply because they do not control the last mile. Global CDNs kind of 'dump' their traffic over the fence into ISP networks and then assumes that the ISP has enough capacity to transport HD video, radio and TV to the viewer. Global CDNs don't really control delivery, they deliver blind. Shoot and forget. It's best effort*" [JetStream11]. Thus, for both live video streaming and non real-time video that can be cached by existing CDNs, there are current and emerging unmet market needs that could be served by the ETICS solution.

This is complementary to the current efforts in the business to apply some sophistication by means of adaptive streaming combined with some traffic isolation and proprietary prioritization platforms such as [SecureMedia11]. Overall, real-time premium video comprises an attractive service for the off-net without CDN market.

Mobile premium content: Mobile video is already used by 11% of global online customers, rendering this market a highly dynamic and profitable market segment. Mobile premium content is used here in the same way as the previous category to refer to the provisioning of services with premium quality and is thus not limited to exclusive premium content for which only limited access is allowed.

We use these two market services for the quantification due to the explosive growth of video traffic [Cisco11]; video traffic is expected to quadruple by 2015. Both these services have significant end user demand and customers already purchase such services [OCEAN10]. Therefore, we focus on the niche services of this market that provide the best value for ETICS and whose market potential is indisputable.

Quantification Methodology and Hypotheses

The main sources from which we collected data and information used in our quantification analysis can be classified to the following categories:

- Market surveys and business reports;
- Related product brochures;
- Articles or quotes from executives in the Internet market, which are published online;
- Specialized Internet blogs;
- Industry white papers;
- Business analysis and market reports.

The precise references used as the major source of information are provided as the ultimate subsection of the present market quantification section.

These data have been used to estimate the overall market features, the prominent services of interest (i.e. those that mostly contribute to the revenue attained in this market) the respective market size and services growth rate and the revenue attained.

The methodology used for the market quantification analysis can be summarized as follows:

- Firstly, we have used the aforementioned data that report the prominent services that are popular for the users, demonstrating that users are indeed willing to purchase (and in fact some are already purchasing) such services. To this end, we provide data from multiple sources demonstrating that such services do comprise a portion of the market and that the growth and potential of these services is high.
- Then, we use the most conservative estimates regarding the overall market size and the candidate services that compose the market: this comprises the basis of the quantification, thus being conservative in our estimates and projections.
- Subsequently, on top of this number we assume the percentage of those services that could be provisioned without (federation of) CDNs undertaking the premium content delivery role, thus deliberately ignoring services where CDNs constitute the standard way of provisioning content transport services today.
- We perform a sensitivity analysis on the revenue that could be attained under either optimistic or pessimistic market scenarios. This reflects the potential adoption of ETICS as a major or respectively minor solution for the efficient provisioning of off-net premium content delivery services without CDNs.
- Finally, we derive the quantification results, which provide insight of the market potential of such services for the ETICS solution.

As-Is Market Value Quantification

Worldwide premium content delivery without CDN Revenue (as-is), based on Cisco data [Cisco11]:

- $150 million, or **€112 million** (2013);
- $224 million or **€168 million** (2015).

We use the (€112 million, €168 million) pair of values as the basis of our quantification in order to capture the overall video content delivery market evolution in the [2013, 2015] interval. This is the interval when ETICS is first rolled out upon the completion of the project and with an added two-year period where ETICS can be made a mature and commercially available market solution.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Worldwide premium content delivery without CDN Revenue (to-be) according to Cisco and using conservative estimates:

- $164 million, or **€123 million** (2013);
- $246 million or **€185 million** (2015).

We assume that the introduction of ETICS and its ASQ approach would result in a significant growth for the demand for off-net premium video services, which has been conservatively estimated in a 10% increase on the previous data.

Market Share and Revenues

Worldwide estimated premium content delivery without CDN ETICS market share (to-be):

- 20% (2013-2015).

Worldwide estimated premium content delivery without CDN ETICS revenues (to-be):

- €25 million (2013);
- €37 million (2015).

Conservative assumption:

- ETICS will be rolled out by 2015 from major European operators, covering mostly the EMEA market, with limited presence in America and Asia.

Sensitivity Analysis of Results

In order to further constraint our results, we perform a sensitivity analysis assuming that the ETICS solution will be able to:

a) **Pessimistic**: ETICS fails to become the dominant solution, it has limited impact on this market and the market share it accumulates is extremely small, i.e. 10%.

b) **Baseline**: Materialize the entire value reported in the previous section. This is due to the fact that ETICS becomes the dominant solution for off-net content delivery services in the EMEA region and the market growth rate remains as reported in the previous sections.

c) **Optimistic**: ETICS manages to expand to other regions and/or is used widely for additional off net content delivery services that are not captured in this quantification. We set a high value, i.e. 50%, on top of the current estimate in order to capture the most beneficial for ETICS scenario.

This leads to our final quantification results, which are presented in the *TABLE 22*:

Scenario:	Pessimistic	Baseline	Optimistic
ETICS revenue (€, million):	[2.5, 3.7]	[25, 37]	[38, 56]

TABLE 22 – ETICS MARKET SHARE AFTER STEP 5: APPROXIMATELY (€25, €37) MILLION IN 2013 AND 2015

2.2.3.2. CDN – Market Overview

Market Definition

The present section considers the international CDN market and aims at quantifying its size and development. Figures and forecasts presented here may serve as an overview for the CDN market, whose potential of interest for ETICS is further addressed in the next Section 2.2.3.3.

The boundaries of the analysis are as follows. We consider:

- all CDNs in international market;
- all existing CDNs independently of location;
- all possible types of CDNs: on-net, off-net, pure-play and non pure-play CDNs, CDN management platforms.

As the present analysis is not limited to any country and due to the global nature of Internet, it has a global scope.

Quantification Methodology and Hypotheses

This section introduces the sources of the data and the methodology used for the analysis accomplished.

The main sources used in the present quantification analysis are as follows:

- market surveys, articles published online (technical magazines, news, etc.) [AccuStream] [AccuStreama] [AccuStreamb] [Frost&Sullivan] [Labovitz11] [Rayburn11a] [Rayburn11c];
- web-pages of CDNs [Cisco];
- web-pages of governmental organizations.

As-Is Market Value Quantification

The global market value of the CDN market is estimated in $545.5 million (2010) [Frost&Sullivan10].

To-Be Market Value Quantification after the Introduction of ETICS ASQ

The following images show the estimations for the to-be market values.

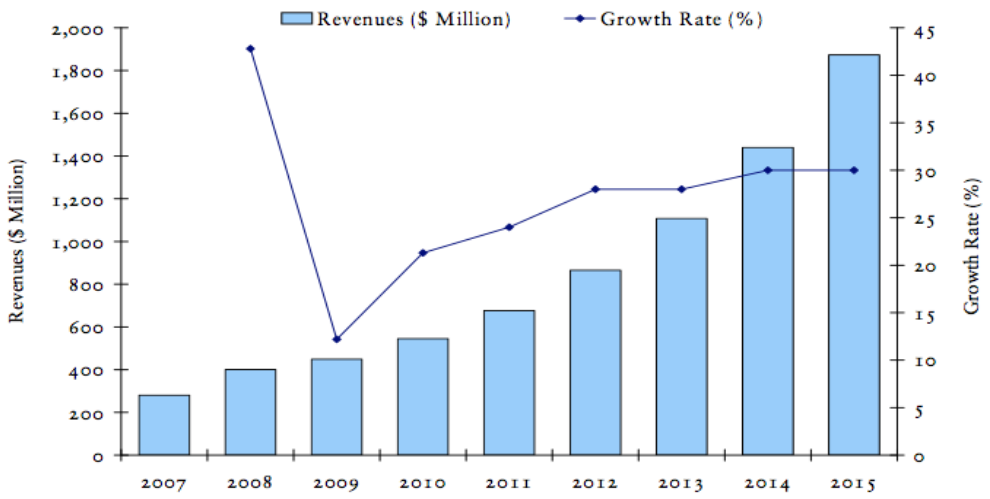
Video Content Delivery Networks Market: Revenue Forecasts (World), 2007-2015

Year	Revenues ($ Million)	Revenue Growth Rate (%)
2007	280.6	---
2008	400.7	42.8
2009	449.6	12.2
2010	545.5	21.3
2011	676.4	24.0
2012	865.8	28.0
2013	1,108.2	28.0
2014	1,440.7	30.0
2015	1,872.9	30.0
Compound Annual Growth Rate (2010-2015): 28.0%		

Note: All figures are rounded; the base year is 2010. Source: Frost & Sullivan

TABLE 23 – REVENUE FORECAST IN VIDEO CDN MARKET [FROST&SULLIVAN]

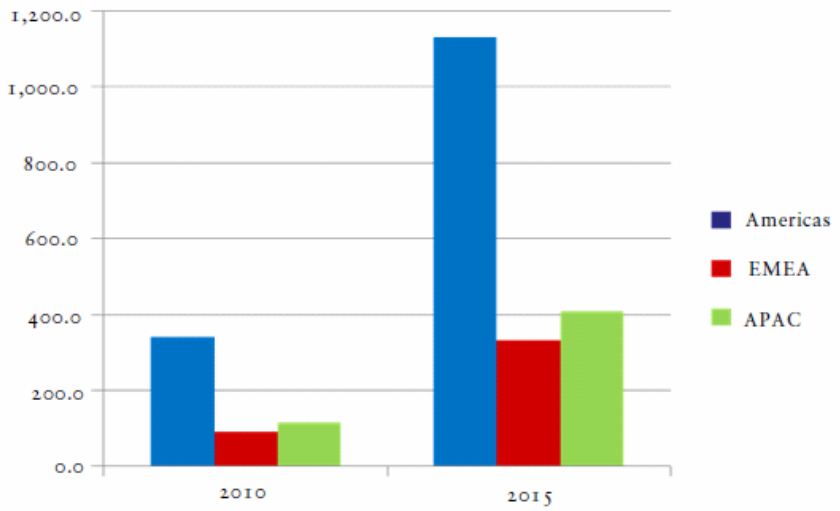
Video Content Delivery Networks Market: Revenue Forecasts (World), 2007-2015



Note: All figures are rounded; the base year is 2010. Source: Frost & Sullivan

FIGURE 1 – FORECAST IN VIDEO CDN MARKET [FROST&SULLIVAN]

Video Content Delivery Networks Market: Video CDN Revenue Estimates Across Regions (World), 2010 and 2015



Source: Frost & Sullivan

FIGURE 2 – REVENUE FORECASTS IN VIDEO CDN MARKET ACROSS REGIONS [FROST&SULLIVAN]

Measurement Name	Measurement	Trend
Market age	Growth stage	---
Revenues (2010)	$545.5 million	Increasing
Potential revenues (2015)	$1872.9 million	Increasing
Base year market growth rate (2010)	21.3%	Increasing
Forecast period market growth rate (CAGR)	28.0%	Increasing
Price range	$0.15 to $2.0 (per GB)	Decreasing
Price sensitivity	High	Stable
Competitors (active market competitors in base year)	15+	Decreasing
Companies entering the market (2008-2010)	7+	Increasing
Companies exiting the market (2008-2010)	3+	Increasing
Degree of competition	High	Increasing
Customer satisfaction	Medium	Stable
Customer loyalty	Medium	Decreasing
Market concentration (percent of base year market controlled by top three competitors)	49.6%	Decreasing

Note: All figures are rounded; the base year is 2010. Source: Frost & Sullivan

TABLE 24 – MEASUREMENT AND TRENDS [FROST&SULLIVAN]

ETICS Market Share and Revenues

The picture below shows the key players in the international CDN market and reports their maturity and competitiveness (see Figure below). They can be divided into three different clusters:

- Pure-play CDNs (e.g. Akamai, Limelight Networks…);
- Non pure-play CDNs (NSPs/carriers) (e.g. Internap, NTT communications…);
- CDN management platforms/transparent caching platforms.

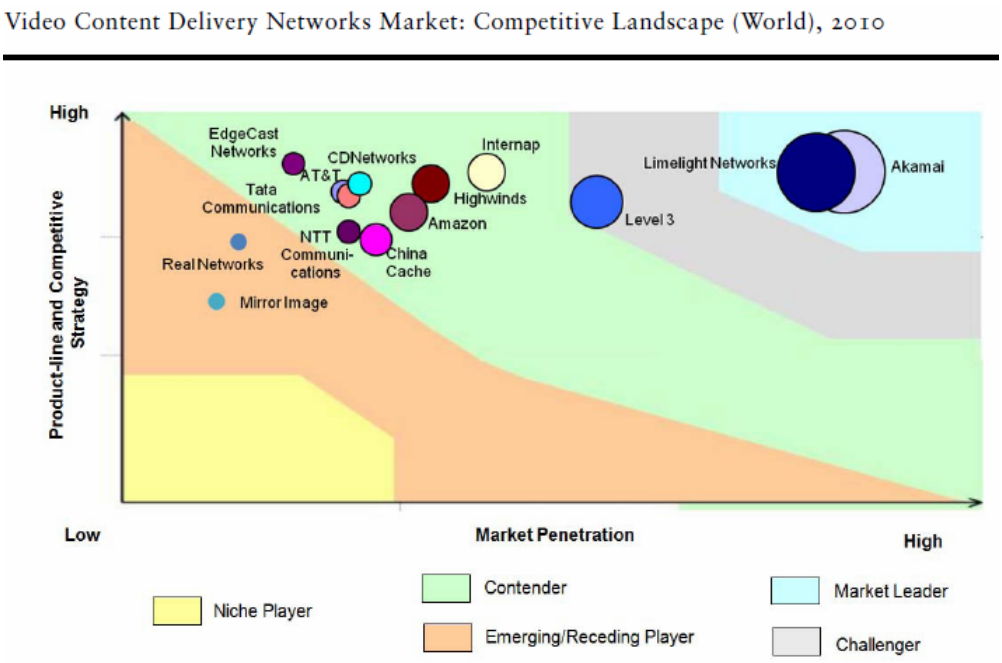


FIGURE 3 – VIDEO CDN MARKET: WORLD COMPETITIVE LANDSCAPE, 2010 [FROST&SULLIVAN]

The degree of competition in the CDN market is high and still increasing. There is a small group of market leaders that account for the largest part of the revenues. Market concentration is almost 50% [Frost&Sullivan] they are followed by single challengers, who are trying to fight for market share, and a huge group of emerging players. The increasing competition and a big quantity of market participants lead to the medium but stable customer satisfaction and decreasing customer loyalty.

2.2.3.3. With CDN

Market Definition

In order to define the premium content delivery with CDN market the Three Dimensional Business Definition framework from Harvard Professor Derek F. Abell will be applied [Nijssen01], which defines a market or business area in terms of customers, customers' needs and technologies.

Customers

- Over-the-top (OTT) content providers

Needs [Pathan07]

- Improve the service quality experienced by the users while accessing their contents
- Provide users with assured performance even when data traffic and number of users increase
- Have the content delivered with security, protected against unauthorized access and modification
- Maximize reliability of the service, responsiveness to possible outages and performance, typically the response time perceived by the end users.

Technologies

Content Delivery Networks (CDN) provide better performance through caching or replicating content over some mirrored Web servers, also called surrogate servers, which are strategically placed at various locations in order to reach proximity to the users. When clients make a request, they are redirected to the nearest

surrogate that is responsible for delivering the requested content [Pathan07]. Server's nearness is based on expected latency, which is determined by geographical proximity, server load and network conditions. Once CDNs deliver content from the edge of the Internet, they are able to speed content delivery, circumvent bottlenecks and provide protection from sudden traffic surges that can bring servers down. In addition, replication of content across delivery locations improves the availability of content, especially during sudden surges in demand [Hosanagar08].

CDN players distribute all content formats (web pages, static content), including different forms of video and content, such as, business applications and software, gaming, mobile services and music. Video is the most dominant portion of CDN spending, with an average share of 43% according to ATLANTIC-ACM (2011). Given its importance and the fact that video delivery is affected by interconnection quality, this market quantification will focus only on video delivery from OTT providers.

Revenue Model

There are two revenue modes being used by the companies in this market:

- Volume-based
- Bandwidth pricing

The pricing model based on the volume of GB delivered used to be the most common among customers hiring CDNs for video delivery [Rayburn07]. This revenue model consists of paying for the amount of GB delivered over the course of a month and the fee charged for a unit of GB usually drops as total volume increases. Back in 2009 roughly 80% of the content owners had contracts based on per GB delivered pricing [Rayburn11c].

However another way of charging for video delivery, based on a per-Mbps sustained model, is increasing. This bandwidth pricing model charges for the volume of traffic pushed at a given time instead of total bits consumed. The charge is based on the 95th percentile of the customer's peak traffic. Nowadays about 60% of contracts are priced on a per Mbps basis [Rayburn11c].

The leading players in this market are Akamai, which has about 60% of market share, Limelight Networks, Level 3 and EdgeCast.

Geographical Definition

Since main players have global access, the quantification process will consider the worldwide market.

Quantification Methodology and Hypotheses

The data and information used were collected from secondary sources, such as presentations featuring market value and growth trends, reports from international institutions, industry news.

Values for the as-is market quantification and for the natural growth on the to-be market analysis were retrieved from projections made by Frost & Sullivan [Frost&Sullivan], a business research and consulting firm. In 2011 the company has released its 2010 CDN report, as well as some extra data presented during the Content Delivery Summit 2011. However, their forecasts differ a little from others. Since the first reports information about 2010 and was published in February 2011 and the latter was presented in May 2011, it will be considered that the most recent available data should be more realistic, and, therefore, will be used in the next sections.

As-Is Market Value Quantification

Worldwide video CDN market (as-is) [Frost&Sullivan]:

- $752.8 million or **€572.1 million** (2011).

To-Be Market Value Quantification after the Introduction of ETICS ASQ

By the end of 2013 the future video CDN market is expected to reach almost $1.5 billion, showing a CAGR of 40% (Frost & Sullivan, 2011).

In addition to this, ETICS ASQ should drive a further growth in this market, since an improvement in quality provided by ETICS solution could potentially impact on those consumers not currently satisfied with the services.

A survey conducted by Open ContEnt Aware Networks (OCEAN) showed that 4.6% of current consumers were "very unsatisfied", while 21.5% were "unsatisfied" regarding the quality of service of online videos. ETICS will push the future market ($1.5 billion) to an additional 10.0% growth by achieving part of the unsatisfied users and inciting them to consume more.

Worldwide video CDN market (to-be) [Frost&Sullivan]:

- $1.63 billion or **€1.24 billion** (2013).

Market Share and Revenues

ETICS' revenue would fall into the range:

- From $68.4 million, or **€52 million**, in case the increased market value will be split between well-established traditional CDNs (Akamai, Limelight and Level 3) and ETICS' players;
- To $178.1 million, or **€135.3 million**, in case ETICS would be able to absorb all increased demand and gain market share in the existing CDN ecosystem.

Sensitivity Analysis of Results

The sensitivity analysis of the hypotheses adopted, both in the to-be market and in ETICS market share estimations, considers a base scenario in which ETICS would push a 10.0% growth.

It will be varied to 7.5% and 12.5% for pessimistic and optimistic scenarios, respectively.

The optimistic case encompasses the total market's increase and a further market share in the current market. This share was 2% in the base scenario and will be 4% for the optimistic limit in this analysis.

ETICS Revenues	Pessimistic	Base	Optimistic
€, millions	38.1	52.0 to 135.3	186.1

TABLE 25 – SENSITIVITY ANALYSIS

2.2.4. INTER-PROVIDER ASQ CONNECTIVITY FOR BUSINESS CUSTOMERS

2.2.4.1. Virtual Private Network (VPN)

Market Definition

In order to define the Virtual Private Network (VPN) market, Abell's model is employed, which refers to customers, needs and technologies to set market boundaries.

Customers

- Business customers, enterprises

Needs

- Fast, secure and reliable way to share information across computer networks
- Services available from any location anytime
- Connection with remote sites, partners and customers, regardless of access differences and geographic distances
- Expanded business reach (national and international), scalability
- Bandwidth hungry and mission-critical ICT applications anywhere
- Application assurance
- Virtualized data centers

Technologies

A Virtual Private Network (VPN) is a private network that uses a public network (a carrier's network or the Internet) to provide remote offices or individual users with secure access to their organization's network. VPNs often secure data with firewall and encryption technologies to prevent disclosure of private information to unauthorized parties.

There are three important VPN technologies: trusted VPNs, secure VPNs, and hybrid VPNs. In trusted VPNs, customers use private circuits leased from a trusted communications provider, which assures them that the circuits are exclusive. Trusted VPNs ensure integrity and privacy of data transfers but do not provide any encryption capabilities. Therefore, customers are able to have their own IP addressing and their own security policies.

Secure VPNs, on the other hand, require traffic to be encrypted and authenticated and are most important when communication occurs across an infrastructure that is not trusted (e.g. over the public Internet). Finally, it is also possible to use a secure VPN over a trusted VPN, and it is called a hybrid VPN.

While secure VPNs are used by companies that want to ensure security of their sensitive information transmission, companies who use trusted VPNs do so because they want to know that their data is moving over a set of paths that has specified properties and is controlled by one ISP or a trusted confederation of ISPs.

Technologies used in each kind of VPN are shown below:

Trusted VPN: ATM circuits, frame-relay circuits and Multiprotocol Label Switching (MPLS).

Secure VPN: IPsec with encryption (most dominant), IPsec with Layer 2 Tunneling Protocol (L2TP), SSL 3.0 or Transport Layer Security (TLS) with encryption, Layer Two Forwarding (L2F) or Point-to-Point Tunneling Protocol (PPTP).

Nowadays, IP VPN services, which includes MPLS based IP VPNs and IPsec VPNs, have become the preferred network choice for enterprises requiring QoS and SLAs [Researchandmarket10].

Revenue Model

The revenue model used in the IP VPN market is the port charge, a monthly recurring charge for VPN connectivity. Prices vary according to the bandwidth speeds to access VPNs.

Geographical Definition

The quantification process will consider the worldwide market.

Quantification Methodology and Hypotheses

The data and information used were collected from secondary sources, such as presentations featuring market value and growth trends, reports from international institutions, industry news.

Although both MPLS and IPsec VPNs are deployed by companies requiring QoS and SLAs [Researchandmarket10], this analysis will be carried out based exclusively on the MPLS VPN market. This approach was chosen because data publicly available regarding the whole IP VPN forecast do not provide detailed information about the market coverage and therefore, it is not possible to be certain if the values comprise only NSP revenues (ETICS' target) or also non-NSP revenues. MPLS IP VPN services, on the other hand, surely need a provider to be performed.

The to-be market will only consider the expected growth for the MPLS VPN market without ETICS introduction, because it is hard to predict if or how ETICS solution will be able to incite an additional market growth. Evidences suggest that customers are satisfied with the present connection capacities. TeleGeography, a telecommunications market research and consulting firm, states that although carriers continue to expand their offering of high capacity IP VPN ports, customer demand remains strongest for connections under 10Mbps. According to new data from TeleGeography's Enterprise Network Pricing Service, 88% of ports sold by carriers between Q1 2011 and Q1 2012 were 10Mbps or less. 54% of ports sold in the developed markets of North America, Europe, and Asia were less than 2Mbps, while 34% were between 2Mbps and 10Mbps [TeleGeography12].

As-Is Market Value Quantification

Worldwide MPLS IP VPN Service Revenue (as-is) [Alcatel-Lucent09a]:

- $18.7 billion (2012), which, in euros, is equivalent to **€14.2 billion** (2012);

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Worldwide MPLS IP VPN Service Revenue (to-be) [Alcatel-Lucent09a]:

- $20.1 billion, or **€15.3 billion** (2013);
- $21.6 billion or **€16.4 billion** (2014).

Market Share and Revenues

Worldwide MPLS IP VPN Service ETICS market share (to-be):

- 24% (2013).

Worldwide MPLS IP VPN Service ETICS revenues (to-be) , value range:

- $4.8 to $5.2 billion or **€3.7 to €3.9 billion** (2013).

Conservative assumptions, since:

- **Only 80% (instead of the full 100%) of the additional 30% of the market , grown thanks to the promise of an ASQ connectivity, would be won over by ETICS VPN offer**;

- **No extra-fee charged by ETICS suppliers for the provisioning of ASQ connectivity is considered (though such higher price set for a differentiated service than current VPNs is expectable and logic).** This latter strongly conservative assumption depends on the difficulty to estimate the premium extra-fee for purchasing ASQ VPN services, which depends on demand-offer balancing as well as on customers' willingness to pay: **such choice results in underestimating ETICS VPN's market actual potential, thus making this quantification process even more reliable and sound.**

Sensitivity Analysis of Results

A sensitivity analysis will be carried out in order to see how the to-be market estimation and ETICS market share assumption can influence ETICS revenues.

First, considering a +/- 15% variation in the to-be market, 3 scenarios emerge:

To-Be Market	Pessimistic	Base Scenario	Optimistic
€, billions	13.0 to 14.0	15.3 to 16.4	17.6 to 18.9

TABLE 26 – SENSITIVITY ANALYSIS OF THE TOTAL TO-BE MARKET

The pessimistic scenario, however, is considerably pessimistic as it takes away a further 15% to an already conservative estimation of the to-be market, and, therefore, is unlikely to occur. Moreover, if ETICS really boosts any market growth, then the to-be market will be higher than the baseline, set as the natural growth without ASQ, and closer to the optimistic scenario.

Then, ETICS market share was varied in the optimistic case to reach the maximum bound (+30%) and in the pessimistic case to achieve only 60% rather than 80% (base case) of it. The impact on ETICS revenues is shown below.

ETICS	Pessimistic	Base Scenario	Optimistic
Market Share	18%	24%	30%
Revenues (€, billions)	**2.3 to 2.5**	**3.7 to 3.9**	**5.3 to 5.7**

TABLE 27 – SENSITIVITY ANALYSIS OF ETICS REVENUES

2.2.5. CONSUMER CLOUD SERVICES

2.2.5.1. Gaming as a Service

Market Definition

As in several previous studies on market quantification, Game-as-a-Service (GaaS) is defined through the traditional Abell's model [Nijssen01], which focuses on customers, customers' needs, and available technologies as key dimensions for setting a business area's boundaries.

Customers

- End users who have electronic devices that enable Internet connection at sufficient speed

Needs

- Entertainment and fun
- Games available to be played on different platforms, such as PCs, tablets, laptops, TVs and mobile phones

- Real-time multiplayer game interactions
- Access to games without the need of a video game console
- The end users' hardware capabilities do not affect game performance or quality of experience
- Accessibility to a broad range of games
- No maintenance required
- Game upgrades can be obtained without additional expenses for the users

Technologies

In order to satisfy the abovementioned needs, two different online services are available.

Firstly, there are the browser games, which are played over the Internet using just a web browser. Hence, they are portable and can be played on multiple different devices or web browsers. Furthermore, they run isolated from the user's hardware and do not require any client software to be installed apart from the web browser, which is the case of client-based games. In contrast to browser games, client-based games (also called downloadable games) are executed on the user's machine, once the user needs to install client software that connects to the game server.

Finally recent technologies, such as cloud computing, enabled the development of a new type of online gaming that allows direct and on-demand streaming of games onto a computer. This new form of game, called Cloud Gaming refers to the providing of online games to end consumers through a Cloud Computing Provider, whose function is to supply Game Providers with hosting and storage capabilities. In this way, the game content resides on a company server rather than on the end user's device, and the server, which is accessed from a thin client installed in the player's computer, runs all the processing needs. Since the game is executed by the server, the game's performance is independent of the capabilities of user's device as the latter only receives the audio-visual output stream of the game, however the performance is heavily affected by the network connection capabilities. Therefore cloud gaming can be accessed from different devices with Internet connection without requiring a specific console, reducing costs and increasing its accessibility.

Although both browser and cloud games are similar, in the sense that they are portable to many electronic devices and do not require local execution, they are not identical. While browser games are relatively low-bandwidth, cloud gaming consumes much more data, since it offers popular games of higher quality which are typically played on consoles or downloaded to a PC. For example, the cloud gaming platform Onlive partners with top game publishers such as Take-Two, Ubisoft and THQ, and its competitor Gaikai has partnerships with Electronic Arts and Sega. However, technologies such as cloud computing (or gaming ecosystem) are still only partially defined, and the number of titles ported to the cloud gaming format is currently very limited. On the other hand browser games are usually developed (by companies like Bigpoint and Gameforge) as stand-alone games to be played through the Internet.

Revenue Model

There are different revenue models being used by the companies in this market:

- Subscription
- Revenue sharing system

- In-game advertising
- Virtual item sales
- Subscription tiers

Some cloud gaming providers use subscription, a monthly fee that gives users access to some or all games available on their platforms. Important cloud gaming companies such as Onlive, Playcast and G-Cluster use this revenue model. However, Onlive and G-Cluster do not run business only on subscription base, in fact they also rent or sell access to a single game, for an additional price. Gaikai, on the other hand, uses a model based on a revenue sharing system between developers, publishers, retailers and affiliates, and does not charge anything to the players. In particular this revenue-sharing model consists of charging publishers and developers for providing online demos of their games, online retailers for the network time to run demos on their websites, but it shares the revenues with affiliates that are websites which have traffic interested in buying games and therefore they are urged to host the demos.

In addition to cloud gaming, also client-based games apply the subscription model. They charge users for the connection to allow multiplayer interactions. Nevertheless not all client-games require payment: some are free to play and users can download the game software for free (e.g. Dofus). Other possible cases are when gamers are charged for the client but not for the connection (e.g. Guild of Wars) or charged for both (e.g. World of Warcraft). Finally free games offer also the opportunity to have an enhanced experience paying for the connection (e.g. Dofus) or for the client (e.g. any Android game).

Browser games are usually free-to-play and rely on revenues from in-game advertising, virtual item sales and subscription tiers. Subscription tiers, differently from the subscription model applied by some cloud gaming providers, give users access to premium features or extra game content not available for the regular gamers, who play for free. Some big players in the browser-based space are: Bigpoint, Gameforge, Nexon, Wooga, Zynga, Innogames, Jagex and Artix Entertainment.

Geographical Definition

Since browser-based and cloud-based games, considered together, are played all over the world, the market estimation will have a global scale.

Quantification Methodology and Hypotheses

The data and information were collected from secondary sources such as presentations featuring market value and growth trends, reports from international institutions, industry news.

The cloud gaming segment is hard to be quantified individually for the reason that it is a developing market with a small number of players and therefore numerical data regarding revenues are not publicly available yet. On the other hand browser and client games constitute an established segment that comprises a huge number of large and small companies spread all over the world, which is too complex to be estimated by an approximation of players' market shares, and there is no specific information about these segments alone. For these reasons the market quantification will not come from the aggregation of quantifications performed on the segments separately, instead the overall online-game market-size-forecast by DFC Intelligence will be used to estimate the game-as-a-service market.

As-Is Market Value Quantification

Worldwide online games (for both PC and consoles) Revenue (as-is) [Brightman11]:

- $15.7 billion, or **€11.7 billion** (2010);

It includes revenues from subscriptions, online usage, online advertising in games and digital downloads.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Worldwide Gaming as a Service market value [Brightman11]:

To-Be Market	GoD - IPTVs	GoD - Smart TVs	Shift to the Cloud	Natural Growth	Total
$, billions	0.86	2.21	2.25	23.64	28.96
€, billions	**0.65**	**1.68**	**1.71**	**17.96**	**22.01**

TABLE 28 – GAAS TO-BE MARKET VALUE

The calculation considers the sum of the values related to the different sectors that constitutes the market, excluding only the gaming on smartphones since the corresponding market growth is hard to quantify.

Market Share and Revenues

Worldwide Gaming as a Service [Cisco10] [Newzoo11]:

($, billions)	Total	Penetration	ETICS' Participation
Natural Market	23.64	20%	4.71
ETICS Growth	5.32	100%	5.32
Total	-	-	10.03

TABLE 29 – GAAS ETICS MARKET SHARE

ETICS Market (dollars)	ETICS Market (euros)	ETICS Revenues (euros)
$10.0 billion	**€7.6 billion**	**€381.3 million**

TABLE 30 – GAAS ETICS MARKET REVENUES

TICS players will not receive the absolute revenue. Instead, they will be able to apply a premium price for advanced network services and gain a little portion of the GaaS market supported by ETICS solutions, for instance, 5%. Therefore, assigning this percentage to ETICS players, their revenue would be **€381.3 million**.

Conservative assumptions:

- Only the network service, that could be improved by ETICS, has been taken into account;
- The market share in the MMO market has been used as a proxy for ETICS' penetration in the whole GaaS market.

Sensitivity Analysis of Results

First, considering the variations of the three parameters (GoD's Penetration on IPTVs, GoD's Penetration on Smart TVs and Games Software's Shift to the Cloud) used to calculate the to-be market, 3 scenarios emerge:

($, billions)	Pessimistic	Base Scenario	Optimistic
To-Be Market – Total ETICS	2.72	5.32	7.92

TABLE 31 – SCENARIO ANALYSIS ON GAAS PENETRATIONS

Then, ETICS' share of the natural GaaS market ($23.64 billion) can also change. The impact on ETICS revenues is shown below.

ETICS' Market Share	12%	20%	28%
ETICS Served Market ($, billions)	5.6	10.0	14.5
ETICS Partner's Revenue ($, millions)	277.3	501.7	726.0
ETICS Partner's Revenue (€, millions)	**210.7**	**381.3**	**551.8**

TABLE 32 – SCENARIO ANALYSIS ON GAAS MARKET SHARE

The whole analysis considered only the network service, but ETICS could also become a provider of GaaS platform, which would increase its market share. This opportunity is represented by the optimistic scenario.

The impact of a 10% change in each assumption on the final result of this market quantification is showed below.

10% Change in	GoD's Penetration on IPTVs	GoD's Penetration on Smart TVs	Games Software's Shift to the Cloud	ETICS' Market Share
Impact on ETICS Partners' Revenue	0.86%	2.20%	2.24%	4.70%

TABLE 33 – ASSUMPTIONS' IMPACT ON THE QUANTIFICATION PROCESS

ETICS' market share has the greatest influence on the results, however, since it is probable that two or more values change, the assumptions made regarding the new market pushed by ETICS combined have higher impact.

2.2.6. Overall ETICS Markets Quantification

2.2.6.1. Global Market for All ETICS-Related Services

Definition and Methodology

In this section, we project the key results of the representative market quantification for Israel (see Section 9.2.5) to a global scope. This is done by minding the same assumptions and boundaries, while considering data estimations for the global market. Deviations arise from the different availability of information for the global scope, which is mainly based on secondary sources.

Such contribution, based total IP traffic trends projections as an alternative method, will serve as a control and verification value for the overall market quantification obtained from the integration of all stand-alone markets (which is performed in the next Section 2.2.6.2).

The remainder of this section starts with a deeper look at global traffic forecasts being further on used for arguing the ETICS market. On an abstract level, the ETICS market may be seen as being most influenced by data volumes, which hence serve as central point of investigation. Thus, the following line of argumentation extracts the relevant share of Best-Efforts traffic in order to provide a basis for arguing a future ASQ market relevant to ETICS. Please note that following from a rational reasoning of NSPs, we assume that the revenue for network services must be raised by the introduction of ETICS – hence the following numbers constitute the lower bounds for the ETICS market which, do not explicitly model the quality-service-centric revenue growths. For service specific market estimations we kindly refer to the dedicated sections.

Traffic Volume Quantification

Based on the forecast given by [Cisco11] the development of global IP traffic is sketched in *TABLE 34*. This illustrates a continuation of the tremendous traffic growth of the last years until 2015 with a CAGR of 32%. An overall volume of circa 1 ZB is being anticipated for 2015, hence the traffic more nearly quadruples between 2010 and 2015.

	2010	2011	2012	2013	2014	2015
Month (EB)	20.151	28.023	37.603	49.420	63.267	80.456
Year (EB)	241.912	335.276	451.235	593.04	747.204	965.472

TABLE 34 – IP TRAFFIC FORECAST [Cisco11]

Besides that, the mobile data traffic's relative share of the overall IP traffic has been growing intensively since 2010 (see *TABLE 35*) [Cisco11]. Ultimately, the mobile data traffic may constitute the majority of the total global IP traffic in 2015, while fixed line Internet services will still have a CAGR of 18.4%. Consequently, Internet challenges may be strongly motivated by the shift towards mobile Internet service usages.

	2010	2011	2012	2013	2014	2015
Mobile	37%	40.4%*	43.8%*	47.2%*	50.6%*	54%
Fixed	63%	59.6%*	56.2%*	52.8%*	49.4%*	46%

TABLE 35 – SHARE OF MOBILE AND WIRED IP TRAFFIC IN PER CENT (* LINEARLY INTERPOLATED)

This shift from fixed to mobile traffic is further supported by the estimations of Mason Research [Lavender10] – information shared by Nokia Siemens Networks – which foresee an even stronger data volume increase tendency for the mobile broadband services in the next years. Subsequently, will focus on the traffic figures provided by [Cisco11] in order to capture the overall global IP traffic growth estimations from a single source following a single analysis methodology.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Based on the traffic forecasts provided in the previous section, we will analyse the global to-be market of ETICS in respect to today's Best-effort services. Similar to the Israeli analysis, we will formulate the ETICS market boundaries from a consumer and a supplier point of view. This section concludes with a detailed summary of expected ETICS market revenues from 2013 to 2015.

ETICS Market Quantification from the Supply Side

Similar to the case of Israel, we refer to aware-charging application strategy being globally applied by 32% of the suppliers in order to analyse the supplier-side perspective. Conversely, we assume that this affects 32% of the overall market being expressed by volume and the related revenue figures. Hence, the supply-side ETICS market covers the following shares of the global IP market:

	2010	2011	2012	2013	2014	2015
Supply-side market (EB)	77.412	107.288	144.395	189.772	239.105	308.951

TABLE 36 – YEARLY SUPPLY-SIDE ETICS MARKET

The supplier-side market, hence, ranges from 77 EB in 2010 to about 309 EB in 2015. Please note that we have assumed that this share of interested suppliers stays constant over the time.

ETICS Market Quantification from the Demand Side

Similar to the case of Israel, traffic resulting from the usage of video services (HDTV adoption) also seems to grow most intensively on the global level. This is especially interesting as video and audio transmissions are often stated as QoS-sensitive [Odlyzko99] [Tuffin03]. Accordingly, we project the data from the European digital satellite HDTV adoption rate (see Section 9.2.5) to the global situation by assuming similar developments in the rest of the world. Hence, we assume that 27% of the IP traffic is dedicated to such services, which yields a traffic volume of 260.677 EB in 2015 (please note that we assumed that the traffic share remains constant over the investigated timespan) – where the rate of 27% has been held stationary in this time period.

	2010	2011	2012	2013	2014	2015
Consumer-side market (EB)	65.32	90.525	121.833	160.121	201.745	260.677

TABLE 37 – YEARLY ETICS CONSUMER MARKET

In contrast Voice over IP (VOIP) services, e.g. Skype, only take a smaller portion of the overall global traffic. This may be explained by low data consumption of VOIP services, e.g. the per-minute consumption of Skype typically lies between 1MB and 3MB [Skype]. Although Skype has been very successful in single markets – 1.9% of the North American traffic in 2010 [Sandovine10] – the effect on the global traffic seems to remain limited in the next years [Cisco11] – see *TABLE 38* for a calculation of traffic shares of all VOIP services.

	2010	2011	2012	2013	2014	2015
Share of Traffic	0.6845%	0.5261%	0.4069%	0.3177%	0.2569%	0.2088%

TABLE 38 – VOIP SHARE OF GLOBAL IP TRAFFIC

VOIP's global share of the global IP traffic will obviously decrease in the next years, similar to the development from 2010 to 2011. These figures, however, may conflict with the revenue-side success of VOIP during the last years, e.g. [Infonetics11] estimates the overall VOIP market to be about $49.8bn in 2010 and $74.5bn in 2015. By applying a linear interpolation, we hence highlight the yearly development of the VOIP market from 210 to 2015 in *TABLE 39*.

	2010	2011	2012	2013	2014	2015
VOIP market	$49.8bn	$54.74bn*	$58.68bn*	$64.62bn*	$69.56bn*	$74.5bn*

TABLE 39 – YEARLY VOIP SHARE OF GLOBAL IP TRAFFIC (* LINEARLY INTERPOLATED)

This divergence between revenue and traffic shares may be explained by different pricing of voice and data traffic – hence successful practice of price discrimination. On the other hand, the VOIP revenue figures may realistically only partially be composed by Internet services (the transport costs for a VOIP service) – especially in the case of P2P VOIP services like Skype the revenue figures do not reflect Internet transport fees for the communication between clients. Thus, the revenue figures of *TABLE 39* cannot be directly broken down to network service revenue data, due to the absence of corresponding data. Hence, our analysis will – similar to the Israeli case – focus on the previously discussed HDTV volume information for sketching consumer demands.

Overall Market and Revenue

Subsequently, we summarize available forecast of the overall Internet access market and compare them among each other. A forecast for the overall revenue development of Internet services is provided in [MarketLine11], where the revenue ranges from $236bn in 2010 to $333.5bn in 2015. By linking this information with the traffic volume forecasts of [Cisco11], we provide linearly interpolated prices per GB as depicted in *TABLE 40* In particular, we see a price per GB (similar to the case of the USA) of approximately one dollar per GB of delivered data. This linearly decreases to $0.35 in 2015, which may be seen as pessimistic forecast.

	2010	2011	2012	2013	2014	2015
Revenue (bn) [MarketLine11]	$238.3	$257.34*	$276.38*	$295.42*	$314.46*	$333.5
Price per GB	$0.99	$0.77	$0.61	$0.5	$0.42	$0.35

TABLE 40 – GLOBAL INTERNET SERVICE REVENUES (* LINEARLY INTERPOLATED)

In order to validate this information, we will compare this information with independent studies from the mobile and fixed line Internet service point of view. In particular [ABI12] claims the fixed line revenues will range between $178bn in 2010 and $217bn in 2016 (see *TABLE 41*). Thus, the fixed line revenue growth seems to be very limited, although the traffic volume is supposed to grow intensively – according the overall traffic growth and the share of mobile traffic stated by [Cisco11].

	2010	2011	2012	2013	2014	2015	2016
Revenue (bn) [ABI12]	$178	$184.5*	$191*	$197.5*	$204*	$210.5*	$217

TABLE 41 – GLOBAL MOBILE INTERNET SERVICE REVENUES (* LINEARLY INTERPOLATED)

Naturally, these results do not encompass the mobile data traffic sector, which will still grow intensively in the next years [Cisco11]. For the mobile data traffic we hence refer to the revenue per gigabyte and traffic forecasts provided by [Lavender10], which allow the prediction of a mobile data traffic market of approximately $48bn in 2010, which will further increase above $110bn in 2015 (based on strongly increasing mobile data volumes being opposed by rapidly falling prices per provisioned GB). Additionally, regional revenue predictions provided in [Tellabs] seem to further support this analysis, which further draws the attention to a decreasing profitability of mobile data services in the next years. Combining the mobile and fixed line revenues, we hence receive similar results to the forecast of [MarketLine11]. Consequently, we will stick to the data provided by [MarketLine11] in order to focus on a single analysis method.

Interrelating the results from the consumer-side and the supplier-side market, we yield the following shares of traffic and revenues being relevant to the ETICS market; the year 2013 is considered to be the first year of ETICS offer launch, hence in terms of revenue calculation all previous years are ignored.

	2010	2011	2012	2013/Year 1	2014/Year 2	2015/Year 3
Consumer-side market	65.32	90.525	121.833	160.121	201.745	260,677
Supply-side market	77.412	107.288	144.395	189.772	239.105	308.951
Consolidated volume estimate	71.366	98.91	133.114	174,947	220,425	234,814
Consolidated revenue estimate	--	--	--	$87.15bn / €65.36bn	$92.77bn / €69.58bn	$98.38bn / €73.79bn

TABLE 42 – YEARLY OVERALL ETICS MARKET VOLUME ESTIMATES IN EB (0.75 EURO = 1 USD EXCHANGE RATE)

ETICS Market Share & Revenues

Based on the formulation of the realistic bounds of the markets, in this section we consider various penetration rates in order to estimate the establishment and evolution of the ETICS market more appropriately, i.e. analysing the ETICS market penetration. Please, note that due to the lack of reliable information on the global market growth beyond 2015 (Year 3), the global view does not contain Year 4 and Year 5 as provided for the case of Israel.

	2013/Year 1	2014/Year 2	2015/Year 3
Penetration rate	5%	10%	15%
ETICS-controlled bandwidth (in EB/year)	8.75	22.04	42.72
ETICS annual market	$4.36bn / €3.27bn	$9.28bn / €6.96bn	$14.76bn / €11.07bn

TABLE 43 – 3-YEARS RAMP-UP OF THE GLOBAL ETICS MARKET

TABLE *43* highlights that the ETICS-controlled bandwidth would strongly increase following the assumed penetration pattern until 2015. This is mainly caused by the strong global growth of IP traffic with video services as one of the key drivers [Cisco11]. In addition, the strong growth of mobile Internet traffic also extraordinarily contributes to this increase. Hence, the global ETICS annual market could have a strong growth in the first three years.

Sensitivity Analysis of Results

We are further investigating the sensitivity of our forecasts to the assumed penetration pattern. Previously we have assumed that 5% can be additionally gained from ETICS's potential market each year, which may under- or overestimate the actual development. Hence, in the following we are looking at the example of a 10% increase per year:

	2013/Year 1	2014/Year 2	2015/Year 3
Penetration rate	10%	20%	30%
ETICS-controlled bandwidth (in EB/year)	17.5	44.08	85.44
ETICS annual market	$8.72bn / €6.54bn	$18.56bn / €13.92bn	$29.52bn / €22.14bn

TABLE 44 – SENSITIVITY ANALYSIS OF THE TOTAL TO-BE MARKET

In turn, an increased market penetration growth of 10% per year (twice as high as originally assumed) will lead to a €11.07bn higher revenue in the third year. Hence, the change is directly proportional to the penetration rate changes.

Conversely, modifying the assumption of the consumer- and suppler-side ETICS market shares (average of 29.5%), e.g. by 5%, does also lead to proportional change of the revenues as sketched above.

Finally, we are looking at ETICS's sensitivity to delaying its market entrance by one year, as shown in *TABLE 45*.

	2014/Year 1	2015/Year 2
Penetration rate	5%	10%
ETICS-controlled bandwidth (in EB/year)	11.02	28.48
ETICS annual market	$4.64bn / €3.48bn	$9.84bn / €7.38bn

TABLE 45 – ETICS MARKET PENETRATION WITH A MARKET ENTRANCE DELAY OF ONE YEAR

Based on this modification the revenue decreases by two thirds in 2015, which highlights the high revenue-sensitivity to market entrance delays. This explained by the strong volume growth of Internet services in the coming years, which provides a leverage factor for the revenue figures. As there is risk that ETICS's ASQ goods may neither be fully standardized nor implemented in 2013, a delay may be nevertheless a relevant case to be considered.

There may naturally also be a divergence of predicted traffics growth rates, e.g. [Cisco11], and the actual traffic increase between Year 1 and Year 3 of ETICS. Among other reasons, a more flat traffic curve than predicted could result from decreasing network qualities, if decreasing profitability (as suggested by [Tellabs]) does not provide sufficient return of investments for new generation networks any more.

Further revenue deviations may arise from the effect of non-volume-intensive traffic, as sketched in the example of VOIP that could influence the revenue by $74.5bn in 2015. Moreover, quality, regional, or service specific price differentiation enabled or supported by ETICS may also have a strong influence on the Internet service revenues in the future, which cannot be modelled on the basis of Best-Effort traffic information. Hence, for detailed service-specific investigations we kindly refer to the dedicated sections, which better capture the potential of ETICS to grow the market beyond data-only delivery.

2.2.6.2. Integration of Market Quantifications

In order to provide an overall estimation of the global market for ETICS ASQ solution, all markets individually quantified in the previous sections are now be integrated.

As anticipated in the previous sections, these quantification processes dealt with a number of difficulties and potential limitations, due to the following aspects:

- availability and reliability of data, which were mainly gathered from secondary sources, and were hardly retrievable for emerging businesses;
- to increase reliability and rigour, data were collected from multiple sources, which were ultimately to be made consistent with one another;

- different methodologies employed, while providing a multifaceted perspective to the analysis (and often serving as a control or verification method, as in the case of IP traffic trends as a proxy for market growth and value), were to be merged and aligned;
- some overlapping among market boundaries (e.g. Video Communication, HD Voice communication, Social Networking Triggered Rich Multimedia Communication and Multimedia Applications Solutions);
- contributing partners approached the evaluation studies with diverse backgrounds and expertise, often not lying in the market research domain.

Nonetheless, both the stand-alone studies and the present overall integration are characterized by a scrupulous attention paid to the collection of reasonable hypotheses, assumptions and information which could indeed represent ETICS actual deployment conditions. Such approach led to the provisioning of an outcome on the global ETICS market which is claimed to be significant and useful.

The table below displays the distinct markets with their respective to-be market values, ETICS market shares and ETICS revenues.

An important remark to be made is that the game-as-a-service and the social networking triggered rich multimedia communication markets partially overlap. The former takes into account PC and console online games, while the latter comprises both PC and mobile social gaming. Therefore, PC social gaming is covered by the two markets quantifications and should be subtracted from one of them. This was done by eliminating all revenues raised by PC social games from the social networking triggered rich multimedia communication market.

Market	To-Be Market (€, billions)		ETICS Market Share (%)		ETICS Revenues (€, millions)	
	Lower	Upper	Lower	Upper	Lower	Upper
Game-as-a-Service	22.01	22.01	34.6%	34.6%	381.3	381.3
Social Networking Triggered Rich Multimedia Communication	8.30	8.30	39.4%	39.4%	271.6	271.6
Content Delivery Network	1.24	1.24	4.2%	10.9%	52.0	135.3
Off-Net Premium Content Delivery without CDN	0.12	0.12	20.0%	20.0%	25.0	25.0
Multimedia Applications	1.55	1.55	15.0%	15.0%	232.1	232.1
Virtual Private Network	15.31	15.31	24.0%	24.0%	3.673.9	3.673.9
Video Communication	1.30	1.30	20.1%	20.1%	260.5	260.5
HD Voice	0.05	0.23	7.6%	7.6%	3.4	17.0
TOTAL	**49.87**	**50.05**	**9.8%**	**10.0%**	**4,899.8**	**4,996.7**

TABLE 46 –THE OVERALL MARKET AS AN INTEGRATION OF SPECIFIC MARKETS (VALUES REFER TO 2013, YEAR 1 OF ETICS INTRODUCTION, EXCEPT FOR GAAS, WHICH WAS CALCULATED FOR 2014 DUE TO DATA AVAILABILITY, AND HD VOICE WHICH DOES NOT SET A SPECIFIC YEAR)

According to the methodology applied by all partners, it was possible to provide either a single value or a value range for the quantifications' results. For each stand-alone contribution, different partners chose the most suitable way to present the market size and ETICS revenues. Therefore, some markets may have distinct lower and upper bounds; however, the majority was quantified by single numbers, which is represented by equal lower and upper limits in TABLE *46*.

This integration shows that the total available market for ETICS is worth about €50 billion, while ETICS overall revenues range from €4.9 to €5.0 billion. Moreover, it emerges that what contributes the most to the overall value is the VPN market, which alone accounts for approximately 75% of ETICS total revenues (notwithstanding the fact that VPN estimation was carried out in a strongly conservative manner, that is, without considering any extra-fee or premium price for ASQ). This happens, firstly, because the MPLS VPN is an established mature market that addresses huge needs of ICT and hence, companies are indeed willing to spend significantly for this service (as opposed to some high-risk niche markets with cloudy, unpredictable benefits). Secondly, since this service is directly operated by NSPs, which means that whatever market share ETICS partners can get, they will also retain all the respective revenues, unlike in other markets (such as the Game-as-a-Service), where NSPs will earn only a slight portion of the game providers' revenues. Such argument also reinforces the conclusion that business services will play a major role in ETICS evolution and sustainability from a financial perspective.

Moreover, an integrated sensitivity analysis was performed too, which takes from the stand-alone sensitivity analyses carried out in previous subsections. For each individual market, a pessimistic and an optimistic scenario were established.

As means to reach a global perspective, values from each different market should be added. Nonetheless, there is a particular case where two of these markets can possibly affect each other, negatively and/or positively. This is the case of the markets related to the premium content delivery (with and without CDN), which can develop a both competition-cooperation relationship for use cases that do not exist in the market today (e.g. where two regional CDNs with local content exist, and ETICS is used to interconnect those two CDNs to serve both areas, and possibly more[2]), as the rise of one can determine the fall of the other, and at the same time, ETICS could create an extra market, serving as a complement: that is, possibly acting as a reliable interconnection technology of CDN federations.

Some assumptions were made so as to take the above effects into consideration. The pessimistic case considered that there would be a competition among the CDN and the off-net markets, decreasing by 20% the sum of both market contributions. The optimistic case, in turn, takes into account both the competition and cooperation factors. It was set a 10% competition decrease and a 20% additional market. The following tables show the sensitivity analyses of the total premium content delivery market and the overall aggregate market.

[2] The local vs. global CDN relative efficiency, as discussed in [Del3.3], Section 2.2, is case sensitive, as it may depend on price evolution trends of bandwidth vs. storage. Global CDNs may better perform in general, though local CDNs with premium bandwidth connections may outperform global CDNs, should the latter be localized far away from the networks.

Market	ETICS Revenues (€, millions)	
	Pessimistic Scenario	Optimistic Scenario
Content Delivery Network	38.1	186.1
Off-Net Premium Content Delivery without CDN	2.5	38.0
TOTAL Premium Content Delivery	**32.5**	**242.0**

TABLE 47 – SENSITIVITY ANALYSIS OF THE TOTAL PREMIUM CONTENT DELIVERY

Market	ETICS Revenues (€, millions)	
	Pessimistic Scenario	Optimistic Scenario
Game-as-a-Service	210.7	551.8
Social Networking Triggered Rich Multimedia Communication	156.3	392.0
Premium Content Delivery (with and without CDN)	32.5	242.0
Multimedia Applications	132.6	353.6
Virtual Private Network	2.342.1	5.281.2
Video Communication	130.2	390.7
HD Voice	0.6	42.2
TOTAL	**3,045.6**	**7,477.6**

TABLE 48 – SENSITIVITY ANALYSIS OF THE OVERALL MARKET

Another methodology was also used to quantify ETICS overall market. This time, the global market for ASQ connectivity was estimated from the total IP traffic volume and the price per GB. The result of this quantification is shown below (see Section 2.2.6.1), and is here employed as a control or verification method for the aggregation outcome

2013	To-Be Market (€, billions)	ETICS Market Share (%)	ETICS Revenues (€, millions)
Global Market	65.36	5%	3,268.0

TABLE 49 – GLOBAL MARKET QUANTIFICATION FOR ALL ETICS-RELATED SERVICES

Comparing the results obtained by the two different methodologies, the first significant outcome is that the value coming from the global market quantification calculated from the total IP traffic trends lies within the range calculated through the summing up of all stand-alone market quantifications. This confirms the reliability of the overall result obtained through different methods applied in parallel.

It is also noticeable that while the aggregation method results in a lower to-be market value, €50 billion against €65 billion from the global quantification, it obtains higher ETICS revenues, in the range of €4.9 to €5.0 billion. This deviation is explained by the different assumptions made in both quantification processes, as well as by the difficulty of attaining undisputable numbers for the size of the various markets assessed, with specific reference to those that are emerging and not mature. On the one hand, the VPN market, which has the greatest share in the aggregate revenues, assumed a 24% of ETICS penetration. On the other hand, the global perspective adopted a 5% penetration in year 1 as baseline.

However, in an optimistic case, the penetration rate for the global estimation can be 10% instead of the assumed 5%, for example, and ETICS annual market will increase to €6.5 billion, which is higher than the base scenario in the integration process, but still lower than its optimistic setting. Thence, generally, the global estimation is more conservative than the other, regarding ETICS market entrance.

Finally, it is interesting to analyse the ETICS evolution in the first year after its introduction and compare the results from the two methodologies. Such trend analysis is valuable for taking into account business evolutions, as well as a foreseeable delayed market making for ETICS solutions, which may be launched no sooner than 2014. Due to data availability, forecast for the integrated market will derive from only two single markets, VPN and video communication, which, however, together represents about 80% of the total share. Yet, it is to be noted that these are not the only markets with growth potential and forecasted increase in value: other business areas are expected to experience an increase in revenues and value, and should be targeted with investments for sustaining ETICS future performance. Specifically, the more promising markets appear to be the Game as a Service/Cloud Services and Social Networking Triggered Rich Multimedia Communication.

ETICS Revenues (€, millions)	2013	2014	2015
Virtual Private Network	3.673.9	3,946.2	4,206.7
Video Communication	260.5	674.8	1,447.8
Sum VPN+Video Comm	*3.934.4*	*4,621.0*	*5,654.5*
All the Markets	**4.899.8**	**5,776.3**	**7,068.1**

TABLE 50 – 2013-2015 ETICS REVENUES FORECAST BY THE AGGREGATION METHOD (VPN MARKET IN 2015 WAS ESTIMATED FROM THE 2012-2014 LINEAR REGRESSION)

Global Forecast	2013	2014	2015
To-Be Market (€, billions)	65.36	69.58	73.79
ETICS Penetration	5%	10%	15%
ETICS Global Revenues	**3,268.0**	**6,958.0**	**11,068.5**

TABLE 51 – 2013-2015 ETICS REVENUES FORECAST BY THE GLOBAL ESTIMATION

Looking at the trends, it is seen that the global estimation, despite being conservative in defining ETICS penetration in 2013, sets an intense growth trend for the next years and by 2015 expects to reach a level of global revenues that is almost 60% higher than the aggregation estimates. This difference lies in the fact that ETICS share in the VPN market were assumed to remain constant over time, equal to 24%. This share was maintained stable during the forecast years because it is already quite high, equal to 80% of the maximum penetration ETICS could possibly get (30% of the total VPN market), providing that all VPNs are actually used for QoS reasons, which is not certain. Therefore, ETICS revenues will increase proportionally to the whole market growth.

All things considered, although the quantification processes faced difficulties, it achieved significant results.

Concerning the reliability and soundness of outcomes, they are proven by the fact that the two methodologies employed to obtain the aforementioned global values (i.e. the integration of all stand-alone quantifications on the one hand, and the value estimation from the total IP traffic volume and the price per GB), applied in parallel, offered comparable results.

Also, figures and forecasts to a large extent suggest that an ETICS ASQ offer could be commercially promising, especially for some markets (such as VPN), which are already served by NSP and can attain significant revenues, thus generating the necessary cash flow to finance the ETICS rollout and deployment to reach other new markets. In fact, some fast growing markets (e.g. Game as a Service/Cloud Services and Social Networking Triggered Rich Multimedia Communication) are now quite small and not significantly penetrated by NSPs, but can provide long term opportunities and revenues for carriers proposing an ASQ offer.

2.3. EXPECTED BUSINESS IMPACTS

Based on the market quantifications given in the previous sections, this section concentrates on related business impacts. In particular, it may be seen as a core question, if revenue or even profit levels are supposed to rise with the introduction of ETICS. We assume that ETICS is only introduced by an NSP (making it an ETICS provider), if the revenue or profit has a strong potential to grow, i.e. the NSP is individually rational.

2.3.1. REVENUE

Naturally, it may be argued that revenues are supposed to grow whenever higher priced premium offers such as by ASQ goods are introduced. However, resources which are guaranteed to the customers of ASQ goods, may on the other hand lead to disutilities for standard customers at peak times, i.e. Best-Effort customers. Hence, it may be of high relevance, if the disutilities of Best-Effort customers are overcompensated by new revenues resulting from the satisfaction of new demands. Minimalistic theoretical works like [Shetty08] (comparison of systems with one and two service classes) indicate an overall potential of growing social welfare and revenue values whenever a quality differentiation is enabled. This argument is complemented by the fact that quality guarantees as provided by ETICS may have less impact on the overall network at non-peak times yielding a leverage effect. The utilisation of the network may profit also from the capability of isolating traffic by region (as discussed in Del3.3), which may allow a better steering of advertised network goods resulting from a leveraged forecasting of available resources.

2.3.2. CUSTOMER GROUPS

The stated revenue effects need to be set into relationship to potential end user pricing options (i.e. access prices), which are influenced by the users' willingness to pay for the provisioned network quality (as discussed in [Del3.3]). From the logarithmic [Reichl10] or exponential relationship [Hossfeld08] of quality perceptions and QoS, it may also be assumed that the relationship between QoS and the end users' willingness to pay is not linearly influenced by QoS. Although this claim is nevertheless still subject to further scientific confirmation, it may be realistic to assume that the detailed effect of resource shifts between customers groups is subject to the current state of the network and market.

The end user pricing is, moreover, influenced by the possibility of a certain degree of **price discrimination** [Stole03] enabled by ASQ services (besides the quality differentiation), which may be considered as beneficial for the revenue and profit levels of NSPs [Odlyzko03], while not necessarily conflicting with the interests of end customers ([Spector12], and as anticipated by the user trials on willingness to pay in

[Del3.3] [Sackl12]). An interesting example of price discrimination could be the case of timely price discrimination (e.g. "early-bird" fees) being enabled by marketable network goods such as ASQ services. Such a mechanism could be realistically applied on the end customer level, e.g. a business customer requesting a VPN with QoS demands as early as possible in order to receive a better price, or on aggregate level between ETICS providers, i.e. moving from a volume-centric charging model to a more flexible and sophisticated scheme based on QoS, regions, resource availabilities, previous purchases, trust, etc.

2.3.3. COSTS

It can be assumed that the introduction of ASQ services, although allowing the NSPs to centre the network service provisioning on their domain's network technologies, will require some investments, e.g. PCE equipment. These efforts may be compensated on the cost level by the improved network demand **forecasting** through ASQ services being subject to certain quality, bandwidth, and regional bounds (e.g. point-to-point traffic), as resources may be even better allocated or purchases of external network resources may be delayed or cancelled. Another cost benefit could arise from the NSPs' extended abilities to **replace other costly IC technologies** like leased lines often used for quality assured enterprise services (e.g. VPN or telepresence solutions), i.e. ETICS may be a **substitute** for other existing QoS solutions. With ETICS offers varying QoS demands could be potentially provisioned across various domains on the basis of the public Internet, which may in turn facilitate the convergence to single technological solutions within a domain (potentially reducing costs from managing separate infrastructures while increasing the capacity utilisation efficiency), while retaining the technological heterogeneity of domains (limiting initial ETICS investment costs).

2.3.4. QUALITY & INVESTMENT

By increasing the revenues of NSPs (or maintaining their levels constant), it may be realistically argued that NSPs are capable of investing more in their networks or maintaining their high investments in the future–we refer to the results of [Del3.3] showing the potential benefit of well configured ASQ goods for Best-Effort and ASQ service customers. However, risks of artificial scarcities may have to be taken into account in less competitive markets with insufficient market regulation. In particular, decreasing overall qualities or Best-Effort network qualities (e.g. demand increase or shift of resources to the ASQ service segment) could be used to force users in premium offers providing qualities similar to the Best-Effort Internet today. Such factors may be ruled out by sufficient competition and smart regulation. Nevertheless, sufficient revenues for NSPs may be regarded as fundamental prerequisite for enabling or optimally facilitating investments in Next Generation Networks.

The introduction of QoS differentiation may in addition also raise the customer awareness for varying QoS levels, which may trigger the market for NSP-side purchases of aggregate ASQ network resources. Generally, the new capability of quality assurances also for the IC context may open up interesting market opportunities.

2.3.5. MARKET & COOPERATION

Based on the capability of ETICS's ASQ services to provide a **single IC offer** combining a series of ASQ segments from different NSPs, the cooperation between providers may be further leveraged. This further entails a potential through ETICS to avoid **side payments** between end customers and NSPs or among NSPs,

which may be regarded as beneficial for the overall ecosystem as further detailed in Section 5.4. The broader the availability of ASQ resources and the fairer the composition process, e.g. in a fully centralized architecture with a completely neutral technical facilitator unit, the higher may be the competition for each of the segments, as **smaller providers** may be stronger integrated. Hence, the cooperation in this case is centred on the community policy agreements as sketched in [Del4.3], and the NSPs' willingness to compete for resources.

Another paradigm shift may also be implicitly seen in the **public announcement** of prices as anticipated by the *push* models introduced in [Del4.2] and [Del4.3]. In particular, the public sharing of offer information including QoS, price, regional, topological details, etc. may be further seen as factor of market openness leading to a facilitation of market competition or on the other hand could also potentially entail some aspects of Stackelberg oligopoly issues [Stackelberg34] (the market leader may be an NSP first bringing their network resource to ETICS markets for one particular route or service category, while others may follow this example and orient their pricing levels accordingly to this offer – a more dynamic variant of the mark leader-follower concept). This openness is naturally strongly influenced by the availability of such information, which may be directly distributed to interested and trusted potential customers or centrally shared in repositories (for more information on architectural models we kindly refer to the economic analysis in ([Del3.3], Section 5) with and without mechanisms ensuring confidentiality of offers.

Broader cooperation between NSPs of varying market sizes (entailed from the deeper integration of smaller NSPs) may also yield a potential for **bypassing transit services** where applicable, i.e. potentially increasing the importance of smaller NSPs at the expense of bigger Tier-1 transit providers. Generally, a remodelling of hierarchical structures (to some extent) may be realistically followed by the agreement on composition policies and architectures.

The cooperation may also be facilitated between NSPs and InfSPs (see [Del3.3]) by enabling and better controlling **in-network caching** possibilities with ASQ goods (customized offers based on regions, QoS and bandwidth demands, etc.) – see [Del3.3]. Generally, the steering capabilities of collaboration between various actors may be improved by ASQ services, which may help to raise the **trust** in the various **supplier-customer relationships**.

Entailed from ETICS not only considering NSPs as customers of ASQ goods, but also InfSPs or other interested parties, the **role of customers** in the wholesale market of aggregate ASQ goods may undergo a serious change. In particular, the number of potential customers for QoS goods may be raised, and the **transparency of the market** may be increased. Whoever overtakes the role of a purchaser, it may be in turn realistic to assume that the purchaser requires the ASQ goods to satisfy own intrinsic business demands (e.g. InfSPs or other enterprise customers) or the demands of their end customers (e.g. Edge NSPs purchasing for their end customers). Hence, the request is probably issued by the party with the highest direct or indirect interest in the quality assured connectivity service. This anticipates the investigation of **charging regimes** like the Sending Party Pays [Bornstaedt11] principle, which may fundamentally change the nature of Internet markets.

While end-to-end QoS provisioning may be seen Edge NSP(s) centric, in future ETICS markets even other NSPs could compete for such agreements (when buying resources from the Edge NSP) – thus potentially remodelling the role of **suppliers** of quality assured services.

2.4. CONCLUSIONS, GUIDELINES AND RECOMMENDATIONS ON THE ETICS BUSINESS IMPACTS

The identification, assessment, disclosure and full understanding of business impacts are essential for a project of a remarkable size, width and expected magnitude as ETICS is.

ETICS actual implementation, market making and, ultimately, success, not only depend on business viability; the project is even meant to modify and virtuously craft the current business domain for the Internet ecosystem.

Having considered this, ETICS business impacts assessment achieved two parallel though interlocked objectives:

- **to address the economic viability and potential of an ETICS-related ASQ offer, through a detailed quantification of eight significant markets where such offer could be launched;**
- **to identify and discuss other businesswise impacts affected or being affected by the ETICS project.**

Concerning the former objective, the quantification process had to deal with some limitations (e.g. data availability and reliability; methodologies consistency; diverse expertise of evaluators), which however did not prevent from obtaining useful outcomes. According to the overall market value evaluation, **the total available market ETICS will have at hand is worth about € 50 billion**, while **ETICS overall revenues range from €4.9 to €5.0 billion already for the year 2013**. Global growth trends (at least as a lower bound, considering the exclusion of those markets that have not been explicitly quantified as not yet significant, but may still have some revenue generation potential), specifically for some markets like VPN and Video Communication, look interesting as well: **the expected revenues range for the year 2014 is €5,7-€6,9 billion, forecasted to reach a €7,1-€11,1 range for the year 2015.**

The conclusions and guidelines springing from these figures may be summarized in the list below.

- Considering that the promise of ASQ is argued to play a role in the markets under scrutiny, as it may boost market growth from the as-is to the to-be condition, **ASQ differentiation of the offer can become a core resource for ETICS providers.** It can represent a source of sustainable competitive advantage in the often crowded (though ill-differentiated) competitive spaces.
- **The forecasted figures presented can become an essential input for strategic planning and strategy making of involved stakeholders, supporting the planning process at different levels**:
    - At a Corporate level, clearly identifying the revenue generation potential for each market enables to make more rigorous choices for business portfolio management and resources allocations. The prioritization of markets in terms of revenues and net cash flows generated (e.g., high priority should be given to VPN market, as it accounts for a significant share of ETICS value) should tell decision makers where to concentrate investments and efforts;
    - At a single Business level, forecasts support the goal setting phase of the process, by selecting goals which are achievable (being consistent with the true market size) and motivating.
- **ETICS achievable market share and revenues shall be considered in an investment evaluation logic, and further coupled with providers' internal expected CAPEX – OPEX expenditures for assessing the project's financial (and not only economic) feasibility**;

With reference to the latter objective, ETICS is expected to have an impact on several business dimensions. When analysed globally, such dimensions may be well seen as strongly intertwined, even to a cause-effect level. Recommendations and guidelines with reference to these impacts concern the commitment to activate a **virtuous sequential chain of business outcomes**, as follows:

1. introduce offer differentiation through ASQ IC goods, in turn determining an increase in the ecosystem's revenues thanks to the premium price paid by interested customers;
2. exploit the subsequent formation of different customer groups characterized by heterogeneous quality expectations and willingness to pay (i.e., an increased ability for supplying players to segment the market in different clusters, direct consequence of the rise of a differentiated offer);
3. fairly consider the CAPEX and OPEX increase due to ASQ offer infrastructure, market deployment and operations, which is however compensated by cost reductions in several areas (e.g. improved network demand forecasting; substitution of other expensive IC QoS solutions);
4. reuse the increased revenues attained to invest in network infrastructure enhancement and expansion (in an incentives alignment logic), while controlling for avoiding any opportunistic behaviours in the provisioning of IC;
5. enable and leverage on providers' cooperation, shaping business models to some extent open, and focused to both technological and value network integration. Not only such openness is necessary in an environment which shares common assets and rules; it is also potentially beneficial for the whole system's welfare and sustainability.

These considerations on the business domain will be resumed and revived in Section 6, where they will be related to impacts emerging in the Socioeconomic, Legal and Net Neutrality domains.

3. ASSESSMENT OF SOCIOECONOMIC IMPACT FOR THE ETICS FRAMEWORK

3.1. METHODOLOGY FOR SOCIOECONOMIC IMPACT ASSESSMENT

The ETICS project, due to its novel technical and economic aspects, is expected to have significant socioeconomic impacts. This section presents a simple yet accurate methodology that will be used in the remainder of this chapter in order to define, describe and assess the socioeconomic impact of the ETICS project.

The methodology to be used is actually a simplification of the SESERV project methodology for assessing the socioeconomic impact of technologies, protocols and mechanisms by means of tussle analysis.

The main reasons justifying why this particular methodology has been chosen are the following:

- Tussle analysis is targeted to socioeconomic impact assessment, such as the one to be carried out in this chapter.
- It is a well-established methodology that has been already applied in various socioeconomics-related Future Internet projects.
- Its main philosophy, as introduced by Clarke, is in line with the principles of Internet, which is the scope of the ETICS project.
- It has already been applied to aspects of the ETICS project creating tangible results, also leading to joint ETICS-SESERV publications.
- The ETICS partners are already familiar with the methodology due to their collaboration with the SESERV project, so there is minimal additional overhead.

The tussles analysis methodology also attempts to highlight the potential spill-over effects of certain technology choices (or deployment of mechanisms, policies) and describe or predict the tussle outcomes. In [Del3.3] we have already introduced the main aspects of this methodology; therefore we refrain from fully describing it here. Instead, we describe below just the main steps of this methodology that will be used for the socioeconomic impact assessment of the ETICS project in this chapter. In particular, rather than elaborating on long-term tussle evolution and predict the final outcomes, we restrict our attention to identifying the main impacts without detailed elaboration and long-term predictions. This is done both for brevity and for maintaining the effort and scope of this analysis reasonable, given the scope of this deliverable.

In particular, the methodology comprises three steps, as illustrated in the following *FIGURE 4* [Kalogiros12]:

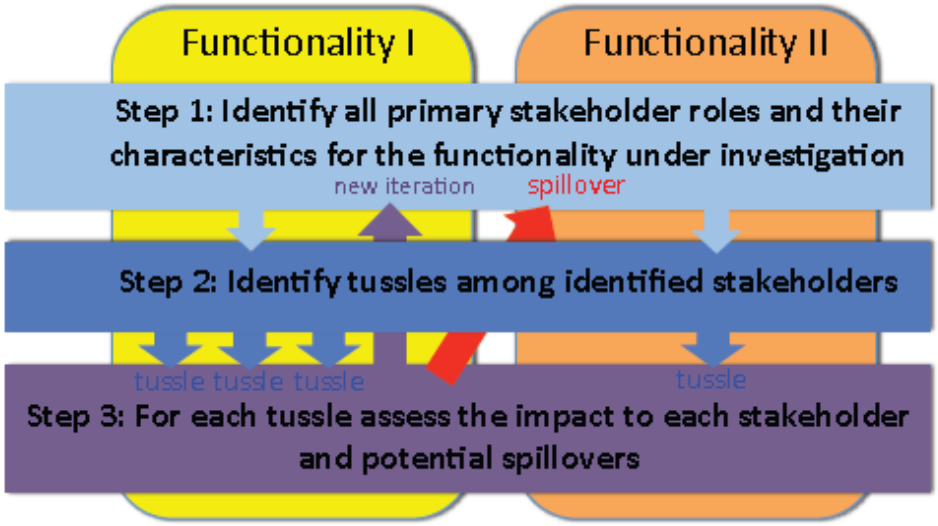


FIGURE 4 – THE 3 STEPS OF THE METHODOLOGY FOR ETICS SOCIOECONOMIC IMPACTS ASSESSMENT

Step 1 of the methodology suggests identifying and studying the properties of the most important stakeholder roles and their instances related to a protocol, a service, or an application instance. The outcome of this step is a set of stakeholders and attributes such as their population, social context (age, entity type, etc.), technology literacy and expectations, openness to risk and innovation.

Step 2 aims at identifying conflicts of interest (tussles) among the set of stakeholder instances and their relationship. After the identification task the analyst should check for potential dependencies among the tussles, which can be useful in understanding how these are interrelated (for example are some of them orthogonal, or have a cause-and-effect relationship?).

Step 3 of the methodology proposes to estimate the impact of each tussle from the perspective of each stakeholder. In the ideal scenario this is an equilibrium which will affect all stakeholders.

The SESERV project has also identified an initial set of **tussle patterns** that can help during the analysis, namely:

- **Contention**, where two or more actors compete for access to a shared resource.
- **Repurposing**, where an actor wants to use a resource for an interest or in a way not envisaged by the resource's owner.
- **Responsibility**, where an entity attempts to identify who should be accountable for an action that is against its interests when many actors are involved.
- **Control**, where two or more actors have different valuation on how a set of complementary resources should be combined.

As part of our work in this chapter, we will identify and classify the main ETICS tussles and assess the socioeconomic impact of the ETICS technology, without fully describing the tussle evolution intermediate steps. In particular, the various ETICS functionalities and mechanisms, as described in the project's architecture documents (WP2 and WP4 deliverables) will be examined and their impact and susceptibility to conflicts/tussles among the stakeholders will be identified, addressing the potential impact and implications.

3.2. ACTORS INVOLVED AND KEY ISSUES

According to the methodology described in Section 3.1, Step 1 focuses on identifying and studying the properties of the most important stakeholder roles and their instances related to a protocol, a service, or an application instance.

Assuming that the protocols, services and/or applications instances the ETICS project cope with can be led back to the notion of Internet ASQ interconnections, this section will concentrate on stakeholders belonging to the Internet interconnection marketplace.

As proposed in [Del3.2], in today's Internet marketplace, stakeholders operate within two main layers:

1. The **Infrastructure Layer** includes providers with no direct function in the consumption of Internet services such as Network Component Providers, Billing Service Providers, and Financial Service Providers
2. The **Internet Service Layer** (ISP) includes those providers that buy and sell Internet services. These include Connectivity Providers, Information Providers, and end-users. Connectivity Providers offer Internet connectivity at Layer 3 and below, and include End-User Network Provider, Access, Transit, Backbone, and Data Center Providers. Information Providers include Application Service Providers, Content Providers, Internet Retailers, Communication Service, and Market Place Providers. End-users may be classified as residential and business (small, medium, and large).

The following *TABLE 52* provides a definition of each stakeholder category involved, and shows the links between categories and subcategories [Del 3.2].

1) Infrastructure Layer: Provide supplementary services but do not necessarily participate to business transactions at the internet service layer	**Network Component Providers:**	Owns network and/or computers
	Financial Service Providers	Facilitate money transfer
	Billing Service Providers:	Offer outsourced billing services
2) Internet Service Layer (ISP): Provide and consume internet services	**Connectivity Provider:**	Provides means to forward IP packets
	Information Provider:	Provides service on top of those offered by Connectivity provider
	End-user:	consume internet service

TABLE 52 – STAKEHOLDERS IN CURRENT INTERNET MARKETPLACE [Del3.2]

Stakeholders in the infrastructure layers are neutral in what relates to the kind of services being developed by ETICS. Whether they provide network equipment or specific ancillary services, they will be committed to satisfy customer requirements. These requirements will certainly be shaped by the kind of services being provided, but the particular nature of these services will be immaterial with respect to the stakeholder

interests, and therefore no conflict will arise. As an example, network equipment vendor will be requested to provide comparable management interfaces and QoS support whatever the interconnection mode. Similarly, financial service providers will have to develop mechanisms for revenue sharing, and particular specifications may vary, but costs and complexity will be of the same magnitude.

This implies that the key stakeholders considered for the tussle analysis must be those playing at the Internet service layer. Furthermore, we will consider the three major categories: Connectivity Providers (NSPs), Information Providers (OTTs) and end-users, as a finer classification would leave too many "grey areas" (many end-users act as content providers relying on an OTT or NSP) and would be too fine-grained in many cases (most NSPs are end-user and transit providers). When a distinction becomes relevant in some of the description of some of the tussles, it will be explicitly noted.

With reference to the previously mentioned stakeholders, below a list of the major socioeconomic issues currently on going and envisioned is provided. This list mentions those existing issues the ETICS project may contribute to solve or amplify, those new issues its introduction may trigger, or both:

1. Impact on interconnection agreements strategies;
2. Impact on investments/capacity planning for Best Effort services versus ASQ services traffic;
3. Usage of ASQs as peering substitutes;
4. Pricing and revenue sharing;
5. Routing;
6. High-value application deployment and network performance;
7. Monitoring-market transparency;
8. Entry thresholds.

3.3. EXPECTED SOCIOECONOMIC IMPACTS

ETICS is associated with the following socio-economic impacts and respective tussles.

3.3.1. IMPACT ON INTERCONNECTION AGREEMENTS STRATEGIES

So far, transit and peering agreements (settlement-free or paid) are the standard interconnection agreements among NSPs. The introduction of the ASQ (Assured Service Quality) goods will have a strong impact on the potential buyers of the ASQ goods that also hold peering and transit agreements. In particular, the strategy space of the NSPs (transit and access) and InfSPs (also commonly referred to as Over-The-Top providers or OTTs for short) will be richer. This allows for *control tussles* over the nature of the ASQ interconnection services to be deployed in cases of conflicts with existing agreements. In particular, it is likely that ASQ goods serve not only as complements but also as substitutes for transit or peering agreements. Thus, there is a spill-over effect between the Best Effort (BE) and the ASQ interconnection market goods.

To this end, *repurposing* tussles may also arise: ASQ goods may be used as a way to affect BE interconnection agreements in order to get a better price or as a means of isolating a portion of the traffic

exchange with neighbours, so as to alter the existing peering ratios in order to modify the type of existing BE interconnection agreements, as long as this is beneficial for the respective stakeholder's interest.

These tussles impact both the stability and the complexity of the interconnection agreements, resulting in potentially significant socio-economic impact and spill-over effects between the ASQ and the BE markets regarding the Traffic Engineering (TE) interconnection functionality.

3.3.2. Impact on Investments/Capacity Planning for Best Effort Services Versus ASQ Services Traffic

This is a *control tussle* where the interests of an NSP and those of its users (business or residential) may collide. In particular, the interest of users receiving BE services versus those receiving ASQ services may collide. The impact of the adoption of ASQ services may be either negative or positive, depending on the long-term strategic decision to use ASQ, either as a strict complement to the BE services, or as a gradually substitution of the free BE services. The impact on the quality of the BE services received by the users is a major issue here. Though in previous deliverables (see [Del3.3]) we have provided by means of tussle analysis specific examples where ASQs do have a positive impact even on the BE services of all the stakeholders (NSPs, OTTs, end-users), it cannot be excluded that opposite cases may also arise, depending on the NSPs' strategies and constraints.

3.3.3. Usage Of ASQ as Peering Substitutes

This is a *repurposing* tussle among NSPs where there is an interesting spill-over effect between the BE and the ASQ interconnection agreements. In particular, due to the fact that peering links are susceptible to being used as a means of business stealing (see [Del3.1], [Del3.3]) it is likely that NSPs may find it more appropriate to use ASQs for providing access to portions of their networks, excluding high-value regions such as IP ranges where popular content/video servers is available for the NSP's customers, instead of establish peering. In fact, even a pair of symmetrical zero-price ASQs could serve as a limited-range "peering link", thus also resulting in *repurposing* of the use of ASQs in the BE interconnection market as well.

3.3.4. Pricing and Revenue Sharing

There is a *control* tussle among NSPs and between NSPs and InfSPs regarding pricing and revenue sharing in interdomain ASQ services. There is clearly contention among NSPs that may be involved in providing an interdomain service over the revenue sharing scheme that could be adopted; NSPs with different size, footprint and customer base have different interests on the "best" revenue sharing scheme that should be adopted. Also, there is contention between NSPs and OTTs on the compensation that NSPs should attain in order to provide good quality for the OTT traffic; this is also closely related to the Net Neutrality debate. Paid versus free peering is a current contention tussle, which is reinforced by the introduction of the ASQ goods that are sold for a price. The same applies to the revenue sharing scheme to be applied, which depending on how beneficial and fair is perceived from the various NSPs – each having a different market power, network size and product offerings – affecting their decision to cooperate under the ETICS umbrella, remain fierce competitors or adopt other opportunistic strategies with respect to their positioning in the market and product offerings.

3.3.5. ROUTING

There is a control tussle over the routing network functionality between the end user and the NSPs that carry user's traffic. This applies to both the BE and ASQ market, where the user's preferred route may not necessarily be the same as the one preferred by an NSP. The introduction of ASQ services allow for more control over the routing by the end user, since he can, to some extent, explicitly choose the route that is most preferable to him, and obtain complete control on route properties through requested QoS parameters. Also, NSPs in the interdomain ASQ market must make sure that they are capable of providing competitive offers for popular routes. Thus, there is a shift of power over routing from the NSPs to the end user. Regarding routing, a positive effect of the ETICS ASQ technology is stability: A portion of the high-value Internet traffic is carried by means of ASQs, where the path of the information flows is pre-bought and pre-decided. Due to the QoS attributes coupled with the ASQ contract and the respective monetary incentives/penalties, the potential for greedy routing behaviour of one of the NSPs in the chain or the adoption of aggressive hot potato routing is significantly mitigated.

3.3.6. HIGH-VALUE APPLICATION DEPLOYMENT AND NETWORK PERFORMANCE

Currently in the BE Internet there is a *control* tussle between the NSP and the application service developers/providers (ASP). In particular, sensitive to network performance applications, such as immersive environments or HD real-time infotainment services, require both assured and consistent network performance, so that the end user experience allows for the provision of those services to the end user in high quality, justifying the respective monetary transfers. Thus, ASPs and service developers would not like to face any uncertainty regarding the network performance, which is by definition the BE services that NSPs offer today. Consequently, there is a *control tussle* regarding the guaranteed network performance. The introduction of ETICS provides a means of resolving this conflict by means of providing ASQ services as additional choice for the customer, who (typically by means of ASPs) can purchase the guaranteed network performance that is required for them to be served efficiently. Thus, there is a positive socioeconomic impact on the interconnection market choices and the richness of services that can be developed, provisioned and made available to users, especially when additional revenues can be gained from applying them, as would be the case for business end-users (of any size, from one-person to middle-sized companies). This tussle is closely related to the monitoring-market transparency issue discussed below.

3.3.7. MONITORING-MARKET TRANSPARENCY

There is contention among the various NSPs collaborating to provide an ASQ and between those NSPs and the customers (purchasers of ASQ goods) over monitoring. NSPs want to reveal as little information as possible regarding their networks. On the other hand, the performance of the networks is implicitly revealed through the monitoring systems coupled with the ETICS ASQ goods. This is clearly in the benefit of the end user of the ASQ services. However there is also a spill-over effect in the BE market: Since ASQs are deployed as supplements to the BE Internet, whose performance must not deteriorate, it is expected that NSPs will have to gradually commit to revealing the performance of their BE services as well (currently this is only done by few technologies (aware users or groups of users and forums who maintain blogs publishing their respective findings). Thus, there is a positive spill-over regarding transparency on the network performance, the market awareness and set of well-described product choices offered in the BE and ASQ markets, which is caused by the introduction of the ETICS technology. Therefore, this is clearly a positive socioeconomic impact on the Internet ecosystem, the interconnection market and the end customer.

3.3.8. ENTRY BARRIERS AND THRESHOLDS

The ETICS proposal on ASQs can influence the entry barriers and revenue thresholds that new potential stakeholders attempt to gain from entering the business of Internet services; this corresponds to a contention tussle. End-users are clearly neutral with respect to these thresholds, as long as they are served efficiently and for a fair price, thus they will not be considered. With respect to the other two kinds of stakeholders, namely NSPs and OTTs, while these thresholds are affected by the existence of ASQ agreements in a similar way for both of them, the potential effects are different for each type of stakeholder.

Regarding NSPs, this is not a completely new scenario, as a similar situation appears today in the BE Internet for a new NSP seeking for transit or peering agreements, but the availability of the ASQ offer may well change the balance and introduce new variables in decision making. Potential new NSPs may experience a higher difficulty to find low-price agreements in a static market scenario with long-term ASQ agreements and alliances among existing NSPs. On the other hand, the possibility of finding specifically oriented ASQ agreements can help a certain NSP in gaining presence in the market niches it aims to. Depending on the status and competitiveness of the market, ASQs can rise or lower the entry thresholds for new NSPs

A similar situation can be considered when new OTTs attempt to make a differentiated offer to end-users. A common pattern in today's Internet service market is the existence of almost "natural monopolies" (if we use the old term for commodity provision) in each segment: searching, video distributing, pervasive VoIP, etc. This situation of almost global dominance is essentially caused by a networking effect: the more users a new services has, the more advantage for the rest of users in being locked to it. A newcomer must provide a disruptive difference to gain sufficient user support, and this precludes incremental innovation by competition. ASQs can help a newcomer OTT in targeting particular user communities (by geographical, professional, or any other interests) and allow it to gain sufficient initial user support. In this case, ASQs can be considered as a mechanism contributing to lower entry thresholds for new OTTs.

3.4. CONCLUSIONS, GUIDELINES AND RECOMMENDATIONS ON THE ETICS SOCIOECONOMIC IMPACT

We have provided in this section the main issues and overall status of the socioeconomic impact domain that are associated with the deployment of the ETICS quality-assured services. The main tussles among the different categories of stakeholders – keeping the taxonomy already identified in [Del3.2] – have been identified according to the chosen methodology derived by the SESERV project. **These tussles point out that there are conflicting incentives and interests in the way the ETICS technology is configured and made available in the services ecosystem.**

More in detail, the most frequent envisioned tussles concern the control over complementary resources (involving two or more actors) and the different uses of the resources that involved players may demand to the respective owners.

It is also worth emphasizing that presentation of the various socio-economic impact factors in this section is complementary to the Net Neutrality, the legal and the market quantification sections of this deliverable. In particular:

- this section (Section 3) provides a big picture on the inherent socioeconomic issues that are inherent to the deployment of ASQ services (and some of them also pertain to the existing Best Effort services), highlighting the most prominent and general issues of socioeconomic nature;
- the legal impacts discussion (Section 4) concentrates on factors which may pose either opportunities or threats to the fair and legally compliant deployment of ETICS, and whose effect is often semi-business or semi-socioeconomic;
- the Net Neutrality section (Section 5) further elaborates on such issues that are specific to the non-Best Effort nature of the ETICS solutions, depicting the debate and conflicting views on going beyond Best Effort.
- Finally, the market quantification section (Section 2) provides a complementary view, depicting the inevitable market and competition issues: For instance, whether ETICS becomes an attractive solution for delivering premium content from Content Providers to NSPs' users or not, is something that is dependent on a variety of economic issues such as the market dynamics, the inherent costs of the competitors, the price dynamics of storage versus bandwidth, and so on.

Therefore, the aforementioned three sections of this deliverable should be read in a complementary fashion, since they provide pieces of the same big ETICS "puzzle".

Overall the presentation of this section has demonstrated that the novelty of ETICS also results in new threats and opportunities in the socioeconomic domain. Some of these issues can (and will be) resolved by means of careful design of the ETICS framework, while others depend on the competitiveness of the resulting market and the strategies of the involved stakeholders.

Thus, ETICS objective is to remain an open, fair and stable (though not necessarily static) solution which is attractive for all the ecosystem stakeholders: this is the only way to ensure its adoption and impact in the market, as well as its (long-term) sustainability. To this end, the issues identified in this section should be carefully reviewed and considered by the ETICS designers and prior to the commercial roll out of ETICS (and ETICS-like) platforms, thus serving as a guide that points out strengths and weaknesses in the socioeconomic domain that can promote or hinder respectively the adoption of such solutions in the (Future) Internet services ecosystem.

Within the ETICS project, the identification of these issues will be communicated to the on-going ETICS requirements refinement task of the project, where WP3 partners are also active contributors. This will both strengthen the consistency among the project work packages and contribute towards requirements that follow Clark's design-for-tussle principles [Clark05]. These issues will also be used to further guide the on-going work on the ETICS community thread of work and the finalization of the WP3 work to be reported in [Del3.5], contributing in a complete, concrete and concise economics and business framework that complements that of the ETICS technical solutions. To this end, the proposal and evaluation of ETICS community rules, as well as the revisiting of the WP2-provided ETICS ecosystem and business requirements and the WP3 work in [Del3.5] will greatly benefit from the material presented in this section.

4. ASSESSMENT OF LEGAL IMPACT FOR THE ETICS FRAMEWORK

4.1. METHODOLOGY FOR LEGAL IMPACT ASSESSMENT

In this section, a set of significant set of impacts pertaining to the legal domain and resulting from the introduction of ETICS ASQ solutions is first identified and subsequently described.

The rationale/methodology employed to select such impacts was to consider a set of aspects of a legal/regulatory nature, raised by the consortium's partners, which could affect or be affected by the ETICS project in a significant way.

Legal aspects are described from the perspective of the ETICS project, assuming that providing a rigorous, in depth definition for each of them is beyond the scope and aim of the present work.

4.2. EXPECTED LEGAL IMPACTS

4.2.1. MONOPOLY AND OLIGOPOLY

In order to better understand the possible criticalities arising because of the adoption of the ETICS solution, it is useful to address the definitions of two extreme though insightful situations: market monopoly and oligopoly.

Monopoly indicates the condition in which a market is dominated by a single supplier whose product cannot be substituted by others. In this condition the quantity and the price of the good or service offered are fixed by the producer according to the maximization of his profit, in contrast with the welfare of the society and of other involved stakeholders (limited quantity and high prices). The factors that allow a company to become a monopolist are:

1. The exclusive control over fundamental inputs; though the continuous innovation in the technology field limits this advantage in the long term, its effect may be felt in the short-medium run.
2. Economies of scale arousing from the cost structure of the market: in case of decreasing long-term average cost, it is convenient for the market to be served by a single firm, which by reaching a higher quantity of output could benefit from lower internal costs (resulting in lower prices for customers). It constitutes an exceptional case called *natural monopoly* and the most renowned sector where it appeared was the supply of telephone services.
3. Patents to exploit new inventions during a fixed time span. In this context, on one side the price for consumers will be higher than in regular competition, but the profit compensates the R&D costs, fostering research.
4. Network economies that can be associated to economies of scale and natural monopoly. Such economies arise whenever the product's value is directly linked to the number of its users because

of the advantages in availability, assistance and exchange. The spread of the Windows operative system, for instance, derived from these network externalities, as well as many other ICT services.

5. Governmental licenses.

However, in the long term the most important factor leading to monopoly is the presence of economies of scale, including those derived from network economies and governmental licences.

Authorities may adopt different policies with respect to the natural monopoly:

1. Public property: government-owned companies are managed so as to keep the price under the average cost of production, while covering the economic loss thanks to taxes.
2. Regulation of prices in case of private property. This policy often includes subsidies for the company, but these kinds of interventions tend to distort the market, leading to uncertain economic effects.
3. Competitive tenders: usually this is the less expensive option, thanks to the guaranteed strong competition among firms to win the auction.
4. Strict antitrust policies enforcement to avoid any monopolistic position or significant market power establishment. The antitrust regulation is fundamental in market for public utilities, defending the social welfare against the lobbies.
5. *Laissez-faire*. This policy has been adopted without damaging the consumers when the company exploiting the monopoly was able to segment the market, differentiating prices.

The market configuration in between monopoly and perfect competition is the oligopoly. It is very common in many existing market and it can take different characteristics. Generally, it indicates a market in which the power is concentrated in the hands of very few players. This condition provides lower prices than a monopoly, since there is a minimum competition among the players; still, the consumers' welfare is lower than in perfect competition.

Several theoretical models have been proposed to frame monopoly and oligopoly cases (e.g. Cournot, Bertrand, Stakelberg, Chamberlain): however, the often strong assumptions these models are shaped on limit their applicability and explanatory power in real-world situations.

Since the Treaty of Rome in 1958, the European Union has been enforcing a legislation to protect competition within its market. Article 101 prohibits agreements distorting competition, while 102 refers to the abuse of dominant position. The antitrust commission is linked to the national laws of the Union's members in case of mergers and acquisition; in particular, if the agglomerations have a European dimension, according to specific criteria of turnover, the case is managed by the European commission; otherwise the operation is regulated locally according to the national legislations. Effective competition among players, who must be independent, pushes down prices and usually offers better products to consumers, fostering innovation. These are the reasons why the antitrust Commission has a very important role with reference to the society.

There are many examples of antitrust interventions in the European Community in the technological sector regarding both products and services. As for the first category, on May 19th 2010 the European Commission enforced the article 101 against a cartel of ten companies (Samsung, Toshiba, Micron, Hynix, Mitsubishi, Elpida, Nanya and NEC) involved in the production of DRAM and RDRAM. The fine imposed was the 16% of

the revenues multiplied by the years of the violation. As for services, on June 22th 2011 *Telekomunikacja Polska SA* has been penalized for its predatory behaviour, which denied the access to the Internet network to the other market players in Poland, against the article 102. The fine imposed was 127.554.194 € calculated on the average value of sales during the time of the infraction.

Within the ETICS environment, monopoly and oligopoly only represent polar or extreme conditions: however, mostly oligopoly may emerge in some activities in the value network.

In fact, the introduction of an ASQ connectivity offer from a strong but potentially close alliance of actors may lead to the adoption of opportunistic strategies from involved members so as to exclude other stakeholders and maintain high margins (see Section 4.2.2). Incentives to continuously expand the network of alliances should be introduced so as to avoid this outcome.

Also, while concentration and centralized models do offer advantages over distributed architectures (for a detailed discussion, see ([Del3.3], Section 5.3), they may let monopolistic or oligopolistic roles emerge in the process: an example would be that of the actor/s taking on the interconnection platform's operations and management. An external "trusted third party" or a coordinated team of alliance members should handle the control of key physical, informational or relational assets, though such introduction of intermediary or hybrid roles increases the overall offer's coordination costs.

Such extremes conditions should be obviously put under control and eventually blocked, first to avoid any antitrust intervention or heavy penalty (as the aforementioned cases clearly show), but also to restrain from distorting one of the key project's objective, that is, achievement of ecosystem's welfare for all stakeholders involved.

4.2.2. CARTEL, PRICE SETTINGS AND OFFER CONTROL

The theory of cooperative oligopoly [Stigler64] provides the basis for analysing the formation and the economic effects of cartels. Generally speaking, cartels or cartel behavior attempts to emulate that of monopoly by restricting industry output, raising or fixing prices in order to earn higher profits.

More precisely a cartel is a formal agreement among firms in an oligopolistic industry. Cartel members may agree on such matters as prices, total industry output, market shares, allocation of customers, allocation of territories, bid-rigging, establishment of common sales agencies, and the division of profits or combination of these [Khemani93].

However a distinction needs to be drawn between public and private cartels. In the case of public cartels, the government may establish and enforce the rules relating to prices, output and other such matters. Export cartels and shipping conferences are examples of public cartels. In many countries depression cartels have been permitted in industries deemed to be requiring price and production stability and/or to permit rationalization of industry structure and excess capacity. In contrast, private cartels entail an agreement on terms and conditions from which the members derive mutual advantage but which are not known or unlikely to be detected by outside parties. Private cartels in most jurisdictions are viewed as illegal and in violation of antitrust laws.

With regard to price setting and offer control, which are the two main issues related to the formation of possible illegal coalitions, as cartels, within oligopoly theory a distinction is made between models in which firms choose quantities and those in which they choose prices. Quantity-setting models are often referred to as Cournot models and price-setting models as Bertrand models. In Cournot competition firms compete

on the quantity they produce, based on their cost production. The quantity is represented by the marginal cost. In Bertrand competition companies compete on price and supply the quantities demanded at those prices.

In cartel coalitions, to work effectively, firms member must control the offer to maintain an artificially high price. Collusion is easier to achieve when there is a relatively small number of firms in the market and a large number of customers, market demand is not too variable and the individual firm's output can be easily monitored by the cartel organization. The creation of barriers to entry by cartels is thus a complex process that exploits interdependencies between offer control and pricing strategies.

From an antitrust perspective, an important issue is identifying price-fixing decision and characterizing the properties of collusive pricing. Therefore pricing strategies and price setting practices are carefully analysed to discern the presence of a cartel.

With regard to cartel Pricing Dynamics [Harrington06] recognize a cartel price path, which is comprised of a transition phase – in which price moves largely irrespective of cost – and a stationary phase – in which price is responsive to cost. In the transition phase, price initially rises though, for some parameter specifications, the price path overshoots so that it converges from above. While price is sensitive to cost in the stationary phase, it is much less volatile than either the non-collusive price or the simple monopoly price path. In industries with less cost variability, the transition phase tends to be longer, price doesn't rise as fast, and there is more overshooting.

The legal framework containing the basic rules on competition, and particularly all the actions against cartels, refers to the "Treaty on the Functioning of the European Union - Part Three: Union Policies and Internal Actions - Title VII: Common Rules on Competition, Taxation and Approximation of Laws - Chapter 1: Rules on Competition - Section 1: Rules Applying to Undertakings - Article 101 (ex Article 81 TEC)" [TEC_article101], which says:

> *1. The following shall be prohibited as incompatible with the internal market: all agreements between undertakings, decisions by associations of undertakings and concerted practices which may affect trade between Member States and which have as their object or effect the prevention, restriction or distortion of competition within the internal market, and in particular those which:*
>
> *(a) directly or indirectly fix purchase or selling prices or any other trading conditions;*
>
> *(b) limit or control production, markets, technical development, or investment;*
>
> *(c) share markets or sources of supply;*
>
> *(d) apply dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage;*
>
> *(e) make the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts.*
>
> *2. Any agreements or decisions prohibited pursuant to this Article shall be automatically void.*
>
> *3. The provisions of paragraph 1 may, however, be declared inapplicable in the case of:*
>
> *- any agreement or category of agreements between undertakings,*
>
> *- any decision or category of decisions by associations of undertakings,*
>
> *- any concerted practice or category of concerted practices,*

which contributes to improving the production or distribution of goods or to promoting technical or economic progress, while allowing consumers a fair share of the resulting benefit, and which does not:

(a) impose on the undertakings concerned restrictions which are not indispensable to the attainment of these objectives;

(b) afford such undertakings the possibility of eliminating competition in respect of a substantial part of the products in question.

Some cases in which the European Commission imposed heavy fines on companies involved in a cartel are presented in Section 9.3. Conditions related to these examples seem to have a chance to occur as a consequence of the implementation of the ETICS solutions. Particularly resulting from the provision of ASQ goods by strategic alliances or strong federations of carriers.

Solutions to these issues were addressed in [Del3.3] with regard to the impact of the newly defined ASQ services mainly for the scenario of an ETICS alliance. For such issues, the stated research work suggest to incorporate a careful handling of competitive information to facilitate fair competition and define pricing and revenue sharing models that encourage collaboration among providers and hence can produce higher profits for all providers.

Moreover a framework addressing the previously mentioned network service provisioning problems is proposed according to a federation scenario. The framework is composed of two main blocks, a Bandwidth Allocation building block (BA block) and a Revenue Sharing building block (RS block). The first one is in charge of the selling mechanisms for quality assured services. Such services can be sold, for instance, to the end user, or to a broker or over-the-top provider, who will in turn resell them to the final user. The RS building block, in the first place, has the objective to solve the distribution of the revenues among all the ASes belonging to the federation, fulfilling some fairness notions. The entire solution is conceived as a means of selling premium services, in addition to the traditional best-effort businesses the domains may have.

However, despite the above considerations, even in a federation or strategic alliance scenario defined as by ETICS, two main features reinforce the belief that such coalitions as cartels will not occur: first the public nature of the alliances, and then the explicit objective of contributing “to improve the production or distribution of goods or to promote technical or economic progress, while allowing consumers a fair share of the resulting benefit” as stated in [TEC_article101], which is a fundamental condition to identify such an agreement as non-projected to illegal or collusive purposes.

4.2.3. Control of Content Availability

A proposed use case for ETICS technology is in the delivery of content through interconnected CDNs [Betrand12]. This would enable a Content Service Provider to have a business relationship with only one CDN (CDN-a) and yet get their content delivered to end users who aren’t directly connected to CDN-a.

Today a CSP may want to define content delivery policies that specify when, how, and/or to whom the (non-interconnected) CDN delivers content. With interconnected CDNs, the CSP will want to define similar content delivery policies that are enforced through the chain of interconnected CDNs.

A practical example may better clarify these concepts:

- content should only be delivered to End Users in the UK (geo-blocking; needed if the CSP only has the UK distribution rights)
- content should only be delivered to End Users this week (April 10-16), and should then be purged from the CDN's Surrogates (temporal restriction; needed if the CSP has sold to different CSPs "this weekend's football highlights" and "the archive of football matches")
- content should be pre-populated in the CDNs Surrogates, but only delivered to End Users after 01:00 GMT 13th March (temporal restriction; needed if the CSP only allows the new film to be accessed after a specific "release" time)
- content should only be delivered to high definition end devices (resolution restriction; needed if the CSP only allows the cricket to be shown on high definition)
- content should only be delivered to End Users over https (security constraint; needed if the CSP wants to make sure their content is not liable to eavesdropping)
- content should only be delivered after the End User is authenticated and authorised (security constraint; needed if it is important to track exactly who has received what content)
- content should appear, to the End User, to come from URI (Uniform Resource Identifiers) <name-of-csp.com> (branding constraint; needed if the CSP insists on the End Users seeing the CSP's own URI appearing when viewing content)

ETICS technology needs to achieve the above semi-legal, semi-business capability of content delivery policy enforcement.

4.2.4. SLA ENFORCEMENT

SLA enforcement is another semi-legal, semi-business issue that impacts ETICS.

An SLA is an agreement between two business entities, for example a global corporate and a network provider. There is a negotiation and set-up phase, followed by a monitoring and enforcement phase. SLAs are very relevant for ETICS, as presumably a higher price is charged for the improved quality that ETICS brings ("ASQ").

The network provider may 'contract out' aspects to another network provider – for example in the 'business branch office' use case, in another country access connectivity may be provided by a local NSP. This typically involves a contract between the two network providers which is hidden from the global corporate. More generally, there may be a chain (or mesh) of network providers, with a chain of bilateral SLAs. There may also be an alliance of network providers, for example each provides service in one country and they cooperate to give global coverage; this can be seen as a series of bilateral contracts between a network provider and the alliance, which is a kind of virtualised operator (from a legal perspective, the alliance might exist as a separate legal entity with which each network provider has a contract, or every provider might have a contract with all the others). It might also be possible for the two business entities to agree to delegate some role to an independent third party, for example monitoring of network performance.

Since the SLAs are bilateral, every agreement can be different in terms of technology, protocol, policies, contracts, QoS targets, payments, penalties and so on. Commonality can be a good thing, as standards (at any layer) generally allow freer competition, encourage efficiencies and reduce prices. Commonality can be

particularly good within an alliance, as openness and uniformity help create trust and cooperation which in general is required for a long term successful alliance.

Multilateral agreements are therefore possible but in some sense an unnatural state – it must be motivated by self-interest, be that standards, regulation, market forces, a common enemy, creating scale and scope, or whatever – if that driver disappears then the system may revert to bilateralism.

Many detailed aspects of SLAs are covered in earlier deliverables [Del3.2] [Del3.3], so here we only cover a couple of recent developments.

4.2.4.1. Congestion-Volume as a Metric in SLAs

Most proposed QOS metrics fail as they are difficult for either the operator (e.g. delay; but queuing delay varies with the amount of traffic on the network), or the end user (e.g. link utilisation; but what does this means for applications and how does it combine along the path).

'Congestion-volume' is the volume of traffic in bytes that is dropped or ECN-marked in a given period of time. Counting congestion-volume allows each user to be held responsible for his or her contribution to causing congestion. An SLA would include a congestion-volume 'allowance' as one metric.

For the operator, congestion-volume links naturally to their traffic management. As their network gets busier they drop (or mark) more packets, so a customer's allowance is consumed faster; and the operator will apply harsher traffic management to customers who have consumed more of their congestion-volume allowance and so are contributing more to congestion. For the customer, they would have software that automatically reduced the rate of less important traffic when congestion was higher, but went at much higher rates when congestion was low. For a chain of networks, congestion naturally adds along the path and it is easy to measure at each border (just a counter), so it is easy for a provider to determine the overall congestion through the downstream provider(s).

These ideas are being explored and standardised in the ConEx working group at the IETF [Briscoe12], where ETICS members are lead participants.

4.2.4.2. End-to-End SLA Compliance

Information from monitoring has been typically used as feedback for upgrading or fixing different aspects of the network. Dimensioning capacities, changing disruptive equipment, solving configuration problems, applying fees to non-fulfilled agreements between domains, exporting network usage statistics for multiple usages, are, among others, within the traditional use cases of network monitoring output.

In the ETICS ecosystem, users are envisaged to pay differentiated prices for ASQ goods. This implies that users would need to be sure that they are obtaining what they are paying for. In addition, network performance is dynamic and it depends on multiple aspects, so the offered ASQ goods not only need for especial traffic engineering techniques in order to be planned, but also a performance verification must be carried out, in order to know its actual performance with respect to the expected ones. The ASQ goods related performance parameters are agreed between domains and users through the so called SLAs. Following [Del4.1] terminology, we shall refer as end-to-end SLA monitoring to the monitoring of the QoS parameters associated to a given network connectivity service, from end to end of the service.

In section 2.5 of previous [Del3.3] we have proposed a framework where the provisioning decisions taken by the interdomain network -which could be an AS alliance- take into account QoS parameters and economic ones (demanded ASQ goods and money paid for them). We propose to integrate to such

framework a money compensation scheme, where results from SLA monitoring are used in order to decide if compensation applies or not. This constitutes a feedback, which contributes to close the control loop between the service and control planes, through the monitoring plane.

In particular, we propose to use the information received through SLA monitoring for deciding if a user must be reimbursed or not, according to the achievement or not of the quality he paid for. This yields us to first study how to determine the percentage of reimbursement that would be agreed -beforehand- for each service. The latter implies studying the influence of the reimbursement on the demand and willingness to pay of the users. Intuitively, several aspects have an effect on the users' willingness to pay. For instance, the percentage of received-back money in case of failure, how critical obtaining the right quality is for their application and how likely a failure to occur is, are factors whose influence on the demand needs to be studied. We intend to present a formal model of the problem and deduce the optimal values of the parameters revealed by such model (e.g. percentage of guaranteed reimbursement). These parameters must be determined so as to optimize certain indicators, from the user and seller (e.g. AS alliance) points of view. Altogether, this would lead us to perform the aforementioned link, between the service and control planes through the monitoring plane.

In addition, the influence of the reimbursement on the revenue received by each domain needs to be studied. For such study the revenue sharing scheme and the existence or not of local measurements (i.e. per NSP SLA monitoring) need to be taken into account as well.

4.2.5. DENIAL OF SERVICE

A legal theme of significance for the ETICS project, which also relates to the broader Net Neutrality issue (see Section 5), is that of denial of service. The Network Neutrality debate has also been associated with denial of service in two ways:

a) The Denial of Service attacks and the respective security and traffic prioritizations concerns.

b) The Denial of Service among network service providers, due to the pricing structure employed in the associated interconnection business agreements. In this case the Denial of Service refers to de-peering and the subsequent inability of one of the peer's customers to communicate with the customers of the other.

Regarding a), there has been much debate regarding the impact of Network Neutrality on the potential for preventing Denial of Service (DoS) attacks on top of the Internet infrastructure. In particular, combating Denial of Service attacks, as well as filtering spam and preventing the spread of computer viruses is typically associated with packet inspection and filtering. Closely related to these concerns, is the potential to prioritize certain services, especially in times of crisis. For instance, the Electronics Communications Act prescribes that it should be made possible to give priority to functions critical to society in crisis or emergency situations. Examples of application types whose quality of service may require special handling are telephony and video, especially after natural disasters and/or widespread network failures.

Regarding b), there have been several cases in the industry where Internet service has been interrupted among networks. This was due to de-peering, after significant change of peering ratios and subsequent estimates of one of the peers that the other one was abusing the peering agreement. For instance, in October 5th, 2005, Level 3 dropped its peering arrangement with tier 1 ISP Cogent Communications. Level 3 felt it was carrying more traffic under the deal than Cogent, and wanted compensation. While multi-homed

Level 3 customers could get round the problem, Cogent users could not exchange traffic with Cogent customers for many weeks. There have been similar cases of de-peering disputes between Cogent and Telia, Sprint, Teleglobe (then Tata). A similar case occurred between Level 3 and Comcast. Prior to the disrupt Level 3 was one of Comcast's Internet transit providers. As Level 3 became content delivery network for Netflix (see [Lasar11]), the outbound traffic from Level 3 to Comcast radically increased, making it look more like a CDN and less than an upstream network provider. The limited control over the traffic exchanged and respective pricing created an uneasy relation between the two networks, especially since Akamai and Limelight were already paying Comcast to deliver their traffic to their end users. Level 3 resorted to the press and the regulators, raising claims for unfair treatment and starting a legal battle. This indicates that the service-agnostic nature of interconnection agreements and limitations of control over the traffic mix and pricing that are clearly associated with the Net Neutrality debate, the nature of interconnection agreements, the terms of service and the respective legal implications.

4.3. CONCLUSIONS, GUIDELINES AND RECOMMENDATIONS ON THE ETICS LEGAL IMPACTS

Section 4 has provided an overall view on the legal issues that already impact or could affect the ETICS framework. Starting from the notions of monopoly and oligopoly and their relative enabling factors, we have addressed the possible policies adopted by authorities to preserve the welfare of the society and of the involved stakeholders. In particular the European Union has always been paying attention to any possible distortion of the market and it enforces fair competition according the articles 101 and 102. The regulatory objective is to keep players independent, so that prices are pushed down and products are constantly innovated.

While monopoly appears as an unrealistic condition, the implementation of ETICS solution may result in oligopolistic behaviours or cartels (e.g. strong federation of carriers), in which actors set agreements on prices or production quantities to gain mutual advantage. Being cartels a form of distorted competition, they are forbidden by the EU legislation. In this perspective an ETICS federation scenario (Bandwidth Allocation block and Revenue Sharing block) for network service provisioning seems to offer a higher degree of fairness.

The control of content availability, the SLA enforcement and the denial of service are important subjects in term of legal implications. **ETICS must pursue efficiency in these fields encouraging free competition through standardization (e.g. QoS classes in SLA), common clear policies and openness.** In this way each actor of the framework will find itself in a cooperative trusted environment, which is the appropriate base to build a sustainable ecosystem.

The discussion on legal impacts deliberately refrained from considering in detail another set of factors of considerable significance for the ETICS project: the impacts pertaining to the Net Neutrality issue. The discussion covering these impacts is initiated in Section 5.

5. AN OVERVIEW ON NET NEUTRALITY IMPACTS

As the Internet has come to play an increasingly important role in the European and global economy, concerns have been expressed about the potential risk that firms (especially vertically integrated broadband network operators with market power) might exploit their control over the network to inappropriately discriminate among different kinds of traffic. This discrimination, it is argued, could enable the firms to thwart consumer choice and to unfairly expropriate the benefits that should otherwise flow to consumers. These concerns have led to a debate, in Europe and elsewhere, over Network Neutrality.

The main objective of this chapter is to provide a preliminary view on Net Neutrality in order to support the argumentation in [Del3.5]. This main objective has been split in four specific objectives, in order to provide the work baseline on the topic:

- synthesize a summary of Net Neutrality definitions in literature;
- provide an updated picture of the regulatory landscape on Net Neutrality in some significant countries;
- outline a general overview of Macro economic impacts determined by Net Neutrality vs. Non-Net Neutrality;
- highlight some impacts for the NSPs determined by Net Neutrality.

Different methodologies were employed so as to reach these objectives:

- collection of contributions by partners;
- wide literature analysis;
- short analysis, by each partner, about the regulatory landscape in its own country;
- few direct interviews with key experts;
- conferences/workshops participation.

The following sections are devoted to presenting the finding of the analysis performed per each objective.

5.1. AN ETICS-RELATED DEFINITION FOR NET NEUTRALITY

There are many different definitions of Network Neutrality, so the present section provides an overview of the different definitions in literature. Price and quality differentiation can have both positive and negative consequences; thus, any concerns should focus on unreasonable, anticompetitive or socially damaging discrimination. The European Commission conducted a public consultation on Network Neutrality between June and September 2010. The Commission found a consensus among "…network operators, Internet service providers (ISPs) and infrastructure manufacturers that there are currently no problems with the openness of the Internet and Net Neutrality in the EU … They maintain that there is no evidence that operators are engaging in unfair discrimination in a way that harms consumers or competition. This general view is supported by a number of Member States." [Policy_Department11]

What constitutes Network Neutrality? Several definitions are in current use [Policy_Department11]:

- the ability of all Internet users to access the content or applications of their choice.
- the Assurance that all traffic on the Internet is treated equally, whatever its source, content or destination.
- the absence of unreasonable discrimination on the part of network operators in transmitting Internet traffic.

These definitional differences are not a mere matter of semantics. They differ in (1) the degree of focus on access, versus the quality of access, versus the price of access to content and applications; and (2) whether one should be concerned with all forms of differentiation, or only with those that are anticompetitive, discriminatory, or otherwise unreasonable. It is worth noting at this point that the concern here is not only with traditional text and audio-visual content, but also with services such as search engines (such as Yahoo, Google, and Bing) and voice over IP (such as Skype and Viber). The use of various forms of quality differentiation for Internet traffic has been routine for decades. This differentiation serves in most cases (but not necessarily in all) to benefit consumers. A key question, then, is whether European policymakers should concern themselves with all forms of quality discrimination, or whether they should instead focus on possible unfair or unreasonable quality differentiation [Policy Department11].

Contrarily to a simplistic understanding of Net Neutrality or Internet Neutrality – all data packets should be treated equally, independent of their content, source and destination – a closer investigation finds a multitude of proposed concepts, none of which has been endorsed with universal acceptance or has been codified as legal definition.

[Deutsche_Telekom10] identifies three main concepts:

- **Absolute non-discrimination**: attributed to Tim Wu of Columbia Law School this definition claims that "Network Neutrality is best defined as a network design principle. The idea is that a maximally useful public information network aspires to treat all content, sites and platforms equally. This allows the network to carry every form of information and support every kind of application. The principle suggests that information networks are often more valuable when they are less specialized – […]".
- **Limited discrimination without QoS tiering**: This definition, found in the 'Internet Freedom Preservation Act' which was proposed to the US House of Representatives in July 2009, "would allow quality of service discrimination as long as no special fee is charged for higher-quality service".
- **Limited discrimination and tiering**: This approach is credited to Tim Berners-Lee and allows higher fees for QoS as long as there is no exclusivity in service contracts. "If I pay to connect to the Net with a certain quality of service, and you pay to connect with that or a greater quality of service, then we can communicate at that level. That's all. It's up to the ISPs to make sure they interoperate so that that happens. Net Neutrality is NOT asking for the Internet for free. Net Neutrality is NOT saying that one shouldn't pay more money for high quality of service. We always have, and we always will".

While the first and most absolute definition implies that non-discrimination is to be interpreted in the widest possible form as absence of discrimination it is evident that this includes an immediate normative valuation: future innovation should occur on the edge of the network only, not on the network itself. This in itself cannot be considered technologically neutral and would – if actually implemented – severely discriminate network operators versus anyone else in the Internet economy.

The US proposal for limited discrimination does in principle allow for future innovation on the network but at the same time fails to provide the needed economic incentive for this innovation. A ban of priority pricing is unduly dismissing the most fair and practicable mechanism to decide who gets to actually use those higher qualities. Why would anyone be satisfied with less than the highest possible quality if there is no price for obtaining it? This approach neglects two basic economic principles. Market pricing is the most efficient mechanism to allocate a scarce resource, such as top tier quality, to the individuals valuing it the most. Second, the classic "tragedy of the commons" would unfold: the Internet users, acting independently and individually completely rational, would deplete the shared resource bandwidth even though this is in no one's interest.

The third definition which is based on limited discrimination and non-exclusive tiering suffers neither from a normative innovation-bias nor from evident economic shortcomings. By axiomatically classifying the Internet economy as an extension of (and therefore integral part of) the real world economy and consequently proposing to apply the same guiding principles this definition respects both the basic economic principles and established regulatory best practice. Furthermore it balances the interests of consumers and economic actors by essentially promoting to apply non-discrimination rules to the Internet in accordance with established competition law [Deutsche_Telekom10].

"Network Neutrality" has become a shorthand description of a policy that would regulate how network providers design, manage, and price the use of their networks. Depending upon the industry in which it is applied, however, the Net Neutrality concept has taken different forms. In the wireline context, Net Neutrality regulation primarily seeks to prevent a high-speed Internet service provider, such as a cable modem provider or a DSL provider, from charging a fee for enhanced quality of service to content providers. By contrast, requests for "wireless Net Neutrality" regulation primarily seek to prevent a wireless operator from imposing certain limitations on equipment manufacturers and application providers. They also seek to prevent wireless operators from imposing usage limits on end-users. Net Neutrality regulation is important from a policy perspective because it is likely to have a significant effect on the development and use of future wireline and wireless broadband networks. In particular, broadband operators face capacity problems as the demand for bandwidth-intensive applications, such as streaming videos and online games, accelerates. Network operators have limited options for addressing this demand, including rationing existing capacity in the short term, and building more capacity and more intelligent networks over the long term. If Network Neutrality regulations are implemented, it could have a dramatic effect on the future of the Internet, which may help to explain why the issue has received a great deal of attention from scholars and the broader policy community [Hahn07].

The Internet is the primary global network for digital communications. A number of different services are provided on the Internet, including e-mail, browsing (using Internet Explorer, Firefox, Opera or other browsers), peer-to-peer services, Internet telephony (Voice over Internet Protocol "VOIP"), and many others. A number of different functions/applications run on top of the Internet browser, including information services (Google, Yahoo, MSN), display of images, and transmission of video and other features [Economide09].

Net Neutrality is a slogan that stands for the proposition that the Internet and physical means of access to it should be available to all on uniform, non-discriminatory terms. Net Neutrality policies could only be implemented through detailed price regulation, an approach that has often failed, in the past, to improve consumer welfare relative to what might have been expected under an unregulated monopoly [Owen07].

Proponents of Net Neutrality argue that the openness of the Internet, i.e., the ability to access any content, run any application, or attach any device to the Internet, leads to the very success of the Internet. This openness and freedom drives innovation, promotes free speech, and encourages democratic participation. If ISPs were able to discriminate packets based on content or ownership, innovative ideas would not necessarily be rewarded. Instead, well-funded ideas or ISPs' own services would be more likely to succeed.

Opponents of Net Neutrality (e.g. NSPs) argue that tiered service, or data prioritization, is a legitimate business model. The increasingly popular video and audio applications on the Internet put a high bandwidth demand on their networks. Tiered service can provide desired quality of service to different applications and recoup the capital investment used to upgrade their networks. Some opponents dislike the idea of regulation in principle, arguing that market forces are sufficient to regulate what broadband ISPs would do. If one ISP blocks contents or applications that consumers desire, consumers would switch to a different ISP [Yang06].

Numerous situations arise where sellers of goods and services pay for the opportunity to provide their products to consumers and even pay premium prices for superior delivery or access. Web content providers such as Yahoo can purchase web-caching services from companies such as Akamai to speed the delivery of their web content to customers. Providing superior access to customers also occurs on the World Wide Web where web site providers can pay Google for premium placement on its search engine web pages to improve customers' access to their web sites.

Recently there has been concern over the desires of some Internet Service Providers (ISPs) or NSPs to offer Internet content providers faster, premium delivery of content and services to end user customers and to charge the content providers for the superior transmission. This is part of the so-called Net Neutrality issue [Jamison08]. Net Neutrality is a broad topic covering a number of issues [WU04], the exact specification of which varies across authors and over time. But the provision of and charging for premium transmission speed of Internet packets consistently appears in the public debate [Hahn06]. Proponents of Net Neutrality, such as Wu [WU03] argue innovation should only occur at the edges of the network and that the network itself is simply infrastructure that should not add value. Net Neutrality proponents also hold that the network should be a commons that broadband users are allowed to use in ways that are not illegal and that do not harm the network and that networks should not discriminate between uses, users, and content [WU04]. In contrast, network providers such as AT&T argue that offering premium transmission services will improve customer choice and that ISPs would not degrade anyone's service [Whitacre06].

Net Neutrality represents the idea that Internet users are entitled to service that does not discriminate on the basis of source, destination, or ownership of Internet traffic. The idea is rooted in the manner in which the Internet has historically operated, in which all traffic is forwarded as quickly as possible, with limited differentiation based on the application and without any performance guarantees. There is great disagreement, however, about the future implications of this relatively simple idea as the Internet progresses and as the economic communications landscape changes. Proponents of Net Neutrality (generally, application providers and consumer groups) argue that without a prohibition on discrimination, Internet Service Providers2 (ISPs) may charge application providers discriminatory prices for access to dedicated bandwidth or for quality of service (QoS), or may outright block access to certain applications or websites, and that such activity will inhibit development of new Internet applications. Most proponents believe that ISPs should not be allowed to charge for priority access to the Internet portion of their service offerings. Opponents of Net Neutrality (generally, ISPs) argue that there is no current problem, that

competition is sufficient to ensure that commercially negotiated arrangements for bandwidth or QoS will not negatively impact consumers, and that any regulation will discourage investment in network infrastructure [Jordan07].

5.1.1. CONCLUSIONS

We tried to summarize a list of the main service feature involved in Net Neutrality (Access Content, Source, Devices, QoS, Price, etc.), crossed with the type of actor impacted by Net Neutrality: in some cases, it is emphasized how the End User is affected, while in others the Application/Service Provider is involved.

TABLE 53 below categorizes some of the features and provides some examples.

		Types of users impacted by Net Neutrality	
		End User	**Application/Service Provider**
Service feature involved in Net Neutrality	**ACCESS**	• Block application access • Block content access • Discriminate access area or on the basis of destination • Provider's experiments with techniques "unreasonable" traffic management to block access	• Block application access to end user
	CONTENT	• Block access to specific applications types (e.g. IM, VoIP, etc.)	
	SOURCE	• Different access to the same content from web site or application	
	DEVICES	• Block Internet access from some device	
	QoS (Quality of Service)	• Provide access with different speed against the same fee • Provide different QoS for some application or content	• When ISPs charge application providers discriminatory prices for access to dedicated bandwidth or for quality of service (QoS), or outright block access to certain applications or websites
	PRICE	• When a Network Provider offers premium transmission services to the customer • Requires extra fees to use alternative communication applications, like Skype or WhatsApp, from NSPs to end user	• Requires extra payment to provide Internet services for accessing the network used to reach the end user
	TIME		• Content not delivered to End Users this week (April 10-16) because of political situations
	…		

TABLE 53 – SERVICE FEATURE INVOLVED IN NET NEUTRALITY

5.1.2. AN EXAMPLE OF NET NEUTRALITY - VOIP SERVICES (E.G. SKYPE)

The Internet is the primary global network for digital communications. A number of different services are provided on the Internet, including e-mail, browsing (using Internet Explorer, Firefox, Opera or other browsers), peer-to-peer services, Internet telephony (Voice over Internet Protocol "VOIP"), and many others. A number of different functions/applications run on top of the Internet browser, including information services (Google, Yahoo, MSN), display of images, and transmission of video and other features [Economide09].

The following section provides an overview about international cases involved in Net Neutrality.

Skype has been installed by over 250,000,000 users worldwide, mainly on their PCs to allow them to engage in free VoIP telephone calls, file transfers, conference calling, voice-mail and video calling functionality.

Many mobile telephones now run Windows derivatives and Skype can be installed on those devices. The user can then utilize the mobile operators network to use Skype functionality.

This is a major threat to the calling revenue of mobile operators.

Mobile telecom companies regularly block VoIP and prevent services such as Skype from functioning on their networks (sometimes mobile operators decide to offer a premium-rate value-added service where authorized users pay an additional amount each month to allow them to use Skype).

BEREC analysed this situation, and the preliminary findings on traffic management practices in Europe show that blocking of VoIP traffic is common [BEREC]. EU regulators found that VoIP services such as Skype are mainly blocked by mobile operators.[3]

Moreover, operators argue, in opposition to many other points of view reported, that filtering, blocking and slowing down (known in jargon as throttling) is necessary to allow a functioning traffic management which ultimately benefits all Internet users and prevents congestion of the net.

As more services migrate to the Web, operators seem to be increasingly tempted to discriminate against other services which compete with their own services or do not yield much profit, effectively creating fast lanes and slow lanes for different services. Net Neutrality would therefore be seriously challenged (see background).

The European commissioner in charge of telecoms, Neelie Kroes, so far has not taken a clear position on the thorny subject. However, in a written response via email, she underlined that the Commission "welcomes the development of new business models that create more dynamism in the market" and that "consumers must be able to switch operators easily and quickly."

5.2. A REGULATION OVERVIEW ON NET NEUTRALITY IN DIFFERENT COUNTRIES

The last years has experienced many events related to Network Neutrality question. Exceptional legislation initiatives have been taken, that may pave the way to shape a different future Internet. 2010 saw the first country, Chile, adopting a legislation that establishes Network Neutrality. At the same year, a USA Court

[3] This statement highlights and confirms that there is not a clear view on Net Neutrality definitions if compared to the sentence: "[…] there is no evidence that operators are engaging in unfair discrimination in a way that harms consumers or competition.[…] " [Policy_Department11], reported also in section 5.1

shook the foundation of the Net Neutrality in USA by denying the USA telecom regulation body, the FCC, the authority to take decisions and actions on that topic. In preparation to legislation on the topic, public consultations were launched in USA, France and the European Union (EU) [Altman11].

It is important to remember antitrust policy works by seeking to prevent, directly or through deterrence, welfare reducing expansions in the scope of firms, without indirectly deterring expansions that benefit consumers. As it is difficult to calibrate antitrust policy, regulation is even more difficult. Aimed at improving serious long term structural incompatibility between private incentives and social welfare, regulatory tools intervene continuously and directly in firm decisions [Owen07].

In this light the following section provides an overview about the state on Net Neutrality regulatory landscape in several European countries and Americans countries (Austria, Germany, Greece, Israel, Italy, Scandinavia, Spain, UK, EU Level, US, Brazil and Chile), being these countries important for the ETICS project and partners, or because important Net Neutrality-related facts occurred in the past years. Each section tries to highlight the most important aspects per each country/area.

5.2.1. NET NEUTRALITY REGULATION SITUATION IN EUROPE [COMMISSION11] [BEREC]

When concluding the 2009 EU telecoms reform package [4], the European Commission set out in a declaration its commitment to "preserving the open and neutral character of the Internet, taking full account of the will of the co-legislators now to enshrine Net Neutrality as a policy objective and regulatory principle to be promoted by national regulatory authorities". According to this declaration, in addition to monitoring implementation of the relevant provisions relating to net freedoms, the Commission would "monitor the impact of market and technological developments on net freedoms reporting to the European Parliament and the Council before the end of 2010 on whether additional guidance is required".

Although there is no set definition of 'Net Neutrality', Article 8 (§4) (g) of the Framework Directive requires national regulatory authorities to promote the interests of the European Union citizens by promoting the ability of end-users to access and distribute information or run applications and services of their choice. This is naturally subject to applicable law and thus without prejudice to EU or national measures taken to counter illegal activities, notably the fight against crime.

The essence of Net Neutrality and the issues underpinning the debate concern first and foremost how best to preserve the openness of this platform and to ensure that it can continue to provide high-quality services to all and to allow innovation to flourish, while contributing to enjoyment of and respect for fundamental rights, such as freedom of expression and freedom to conduct business.

Much of the Net Neutrality debate centres around traffic management and what constitutes reasonable traffic management. It is widely accepted that network operators need to adopt some traffic management practices to ensure an efficient use of their networks and that certain IP services, such as for instance real-time IPTV and video conferencing, may require special traffic management to ensure a predefined high quality of service. However, the fact that some operators, for reasons unrelated to traffic management, may block or degrade legal services (in particular Voice over IP services) which compete with their own services can be considered to run against the open character of the Internet. Transparency is also an essential part of the Net Neutrality debate. Obtaining adequate information on possible limitations or traffic management

[4] This section is synthetized and taken from one specific document [Commission11], found particularly complete.

enables consumers to make informed choices. These issues of traffic management, blocking and degradation, quality of service and transparency need to be addressed.

Blocking or throttling of lawful traffic was one of the main issues raised during the public consultation and Net Neutrality summit. Blocking can take the form of either making it difficult to access or outright restricting certain services or websites on the Internet. A classic example of this would be mobile Internet operators, blocking voice over Internet protocol (VoIP). Throttling, which is a technique employed to manage traffic and minimize congestion, may be used to degrade (e.g. slow down) certain type of traffic and so affect the quality of content, such as video streaming provided to consumers by a competitor.

At European level, the Body of European Regulators for Electronic Communications (BEREC) conducted a survey among its members in early 2010 to assess the state of play in the different Member States. In addition, at national level, prior to the launch of the Commission's public consultation, both ARCEP and OFCOM, respectively the French and United Kingdom national regulatory authorities launched their own consultations.

In its response to the public consultation, BEREC noted that there have been instances of unequal treatment of data by certain operators. Indeed, BEREC reported some concerns voiced by both users and content providers:

- Limits on the speed ('throttling') of peer-to-peer (P2P) file-sharing or video streaming by certain providers in France, Greece, Hungary, Lithuania, Poland and the United Kingdom;
- Blocking or charging extra for the provision of voice over Internet protocol (VoIP) services in mobile networks by certain mobile operators in Austria, Germany, Italy, the Netherlands, Portugal and Romania

The growing demands placed on broadband networks as well as different services and applications which require continuous data exchange mean that traffic management is required to ensure that the end user's experience is not disrupted by network congestion.

There are different types of traffic management techniques:

- Packet differentiation allows different classes of traffic to be treated differently, for example for services which require real-time communication such as live streaming of audio or video events and VoIP. This differentiation guarantees a certain minimum quality of service to end-users.
- IP routing allows ISPs to route packets via different communication paths to avoid congestion or provide better services. For example, an Internet Service Provider may route packets towards a server that contains a copy of the requested information which is located either in its network or somewhere close.
- Filtering allows an Internet Service Provider to distinguish between "safe" and "harmful" traffic and block the latter before it reaches its intended destination.

Several respondents to the public consultation agreed that traffic management was not new in the field of electronic communications. For example operators prioritised voice traffic, particularly in the case of mobile. Properly used, some respondents argue that such traffic management techniques should enhance consumer experience. Even those respondents in the public consultation that alluded to blocking of peer-to-peer or VoIP services argued that traffic management was a necessary and essential part of the

operation of an efficient Internet. They agreed that its use for the purposes of addressing congestion and security issues was entirely legitimate and not contrary to the principles of Net Neutrality.

On 3 October 2011 BEREC launched a consultation on "draft Guidelines on Net Neutrality and Transparency: Best practices and recommended approaches". The draft guidelines describe transparency as the first of several regulatory remedies to promote Net Neutrality, as it enhances the end users' ability to make informed choices among service offers. The guidelines underline the responsibility of NRAs (National Regulatory Authorities) to ensure that consumers are benefitting from effective transparency and analyse some possible approaches and tools that could be put in place to help reach this goal.

A total of 77 responses were received, coming from a range of organisations, including consumer associations, operators, content providers and device manufacturers, as well as from individuals.

A lot of respondents saw the need for transparency obligations to apply to the whole value chain. Indeed, some were of the opinion that ISPs represent only a small part of the value chain, which should be taken into account by NRAs when putting into place a transparency policy in the scope of Net Neutrality. Some general observations made were around the fact that there is a risk of imposing disproportionate obligations and costs on a single link of the value chain, at a time when important network investments are required (with the need of an adequate return of investments and a reasonable balance between all the actors in the Internet value chain). Accordingly, some felt that BEREC should address this issue even if the other players in the market are not bound by the EU electronic communications regulatory framework.

Another specific comment received around this topic was the need to extend transparency to interoperability, in both services and equipment. In this regard, one stakeholder asked BEREC for a wider public consultation on more general and wider regulatory obligations. Several respondents pointed explicitly to the fact that transparency should not only be restricted to ISPs but expanded to applications and content providers, as well as terminal suppliers (the so called "device neutrality"), because they also have a decisive influence in the end user's service experience.

Regarding the relationship between competition, transparency and other factors considered to achieve Net Neutrality, there were four main groups of opinions:

1. In the view of some respondents, the existence of competition in a market, the reduction of barriers to switching and transparency are sufficient to handle Net Neutrality concerns. Some stakeholders emphasised the role of transparency as a key factor that, if implemented effectively, can address most of the problems mentioned in the public debate. Other stakeholders pointed out that traffic management is necessary for ensuring quality and differentiation of services, and those additional regulations in that regard could be counterproductive in a dynamic market, such as the provision of Internet services.
2. Competition is the real key to achieve Net Neutrality. Some opinions received stated that it is very important to prevent discrimination and that the debate on Net Neutrality should not lead to an increase of the remedies already imposed at the national level. The regulations must be proportionate and balanced, fostering competition and avoiding the imposition of burdensome obligations.
3. Transparency and the other factors taken into account by BEREC are not sufficient to achieve Net Neutrality. Therefore, the proposal of respondents who share this opinion was to establish more prescriptive regulation and propose measures that protect Net Neutrality. In general, their view was that transparency is a mere regulation to help the comparison of products in a framework where

Net Neutrality is no longer ensured (transparency itself highlights the breaches to Net Neutrality). Furthermore, it acts as a kind of "loophole" which enables operators to introduce restrictions as long as they inform their customers about it. In addition, it was remarked that the lack of competition, remaining barriers to switching and the Net Neutrality interferences already occurring in Europe show the insufficiency of this approach. BEREC should take a harder position on Net Neutrality and on traffic management in particular.

4. Lastly, a few opinions recognized that transparency and competition are part of the answer, but remarked that they do not provide the full solution.

5.2.2. NET NEUTRALITY REGULATION SITUATION IN AUSTRIA [TA]

Settled in the context of the frameworks and guidelines of the European Commission's regulatory body BEREC [BER], the Austrian parliament has passed an adaption of the telecommunication regulation laws – Telekommunikationsgesetz Novelle 2011 [Tele11]. This may appear as rather late integration of Net Neutrality issues in Austrian laws, but this may on the other hand be explained by the Austrian competition situation, as detailed later on. Among other regulatory improvements, this new law has concentrated on the following modifications relevant for Net Neutrality argumentations in Austria:

- The regulatory authorities have received the additional competences to protect customer interests in the market. This marks a notable paradigm shift, as in the past the authorities' focus has been intentionally centred around market competition only. The strong market competition in recent years has clearly endorsed the focus on market rather than customer issues. With this new law however, regulations protecting customer interest may be enforced in the future.
- A minimum quality for network services is defined. The Federal Ministry for Transport, Innovation and Technology [bmvit] is able to extend the relevant minimum quality beyond basic standards defined in the present law. In addition, for each contract with an end customer a (minimum) service quality is required to be contractually stated, which automatically entitles customers for compensation payments in case of dissatisfaction of minimum qualities. These modifications ensure a more central role for the satisfaction of customer interests regarding QoS requirements. Hence, this modification may strongly correlate with the European Commission's endeavours for increasing QoS transparency, especially regarding Net Neutrality concerns.
- The transparency of services for customers shall be explicitly, moreover, enforced by regulatory measures. The regulatory authorities are allowed to independently test the quality of networks and their services.

Although these steps may seem promising in terms of customer interests, clear statements regarding Net Neutrality interpretations and regulation – especially regarding interconnection QoS – are left unnoticed. Hence, the Austrian market requires a further investigation for understanding the moderate judicial changes in this context.

The Austrian market, especially regarding mobile services, is highly competitive – low prices and high quality, especially in the mobile sector [CON]. This is also reflected in the provider's Net Neutrality statements, which will be subsequently discussed by the example of Telekom Austria Group [TA] – Austria's incumbent telecommunication provider:

- According the Telekom Austria Group, the retail prices in Internet access are rapidly falling, although growth is still perceived to be strong.
- Mobile broadband / Internet via 3G infrastructure are often cheaper than fixed line offers, which may be interpreted as indicator for high competition in the mobile sector.
- Resulting from the stated high competition, the Telekom Austria Group claims that providers would have a strong incentive for providing high network quality. In this argumentation line, quality also explicitly includes the unrestricted access to the Internet.
- Capacity shortages may occur and, hence, may require solutions through traffic management, increase of retail prices compensating infrastructure investments, QoS differentiation, or wholesale charging models targeting InfSPs.

Consequently, the Austrian telecommunication laws do not provide explicit recommendations for interconnection QoS as discussed within ETICS. The reasoning for the absence of clear regulations, however, may underline the importance of competition on the protection of Net Neutrality values. On the other hand, the need for transparency and minimum QoS requirements strongly relates to ETICS's quality assurances, which are integrated in ETICS on the basis of SLAs that allow the explicit modelling of compensation payments in case of dissatisfaction.

In the future, we expect that the Austrian telecommunication regulator RTR [RTR] will utilize its now regulatory competencies in order to further protect customer interests – as relating to Net Neutrality – on the Austrian market.

5.2.3. Net Neutrality Regulation Situation in France [ARCEP10a]

Following discussions that started in the United States and in some European Countries, the French Regulator, the ARCEP, has launched the debate on the Net Neutrality in France in October 2009. From November 2009 to March 2010, the ARCEP had consulted different actors of the Internet in France, Europe and other continents. In April 2010, the French authority has organized an international conference on the topic, gathering key speakers from universities, including the "fathers of the Net Neutrality" Timothy Wu and Eli Noam from the university of Columbia, network operators (Orange, Vodafone, Bouygues Telecom, ILIAD, and SFR), Content Providers (Dailymotion, Google, Video Futur Entertainment) and users representatives (UFC que choisir, la Quadrature du Net), French regulators (CNIL on user privacy, CSA on video services, ARCEP on communication services, autorité de la concurrence) and politics [ARCEP workshop].

Resulting from these consultations, the ARCEP has issued in September 2010 a global document providing an analysis of the context and main stakes [ARCEP10b]. Despite some peculiar issues highly documented in press articles (MegaUpload-Cogent/orange dispute, YouTube/Free dispute, or a frequent blocking of Skype traffic in mobile Data communication user contracts), the ARCEP globally considers the French market as enough neutral thanks to a high level of competition both for fixed and mobile Internet access, allowing consumers to choose and change quite easily their Internet Service Providers. The document concludes providing 10 recommendations interestingly organized in two categories: A. "Neutrality of Internet access networks" addressing recommendations for ISPs (recommendations 1. to 8.) and B. "Other dimensions of neutrality" addressing recommendations for other actors such as Information society service vendor –ISV- (rec. 9) or device manufacturers (rec. 10).

The 10 recommendations are:

1. **Freedom and quality of Internet access**

ARCEP recommends that, in accordance with the legislative provisions that are in effect, ISPs marketing Internet access be required to provide end users with:

- the ability to send and receive the content of their choice;
- the ability to use the services and run the applications of their choice;
- the ability to connect the hardware and use the programmes of their choice, provided they do not harm the network;
- a sufficiently high and transparent quality of service.

There may be exceptions to this principle, provided they comply with the guidelines set out in proposal no. 3.

2. **Non-discrimination between Internet data streams**

On the matter of Internet access, ARCEP recommends that, as a general rule, no differentiation should be made between the way in which each individual data stream is treated, whether according to the type of content, the service, application, device or the address of the stream's origin or destination. This applies to all points along the network, including interconnection points.

There may be exceptions to this principle, provided they comply with the guidelines set out in proposal no. 3.

3. **A framework to govern traffic management practices**

Marking exceptions to the principles stated in proposals nos. 1 and 2, and to limit any possible deviations from these principles, ARCEP recommends that when ISPs do employ traffic management techniques for ensuring access to the Internet, they shall comply with the general criteria of relevance, proportionality, efficiency, non-discrimination between parties and transparency.

4. **Managed services**

To maintain all of the players' capacity to innovate, all electronic communications operators must be able to market "managed services" alongside Internet access, to both end users and information society service vendors (ISV), provided that the managed service does not degrade the quality of Internet access below a certain satisfactory level, and that vendors act in accordance with existing competition laws and sector-specific regulation.

5. **Increased transparency with respect to end users**

ISPs must provide end users – in both their sales material and the contractual terms and conditions of their electronic communications services, and in the information that is available to the customers of these offers for the duration of their service contract – with clear, precise and relevant information on:

- the services and applications that can be accessed through these data services;

- their quality of service;
- their possible limitations;
- and any traffic management practices that might affect them.

To this end, ARCEP recommends in particular that:

- any restriction on a data transmission service that deviates from the principles of freedom of use and non-discrimination between data streams, stated in proposals nos. 1 and 2, should be stipulated explicitly in the ISP's sales material and contractual clauses, in a clear and understandable fashion;
- the term "Internet" cannot be used to qualify these services if certain of these restrictions do not meet the requirements of proposal no. 3;
- the term "unlimited" cannot be used to describe service offerings that include "fair use" type limitations that result in access being cut off temporarily or in extra billing for the services, or in an excessive degradation of access speeds or the quality of the service.

The Authority will initially request that ISPs and consumer association representatives work together to define common systems for providing end users with information on the limitations of the offers and their traffic management practices, and to submit their proposals on the matter to ARCEP by the end of Q1 2011.

Subsequently, should it prove necessary, the Authority could work in tandem with the General directorate for fair trade, consumer affairs and fraud control, DGCCRF, to complete these proposals.

6. Monitoring traffic management practices

ARCEP will ask ISPs and their representative associations, ISVs and their representative associations, as well as consumer associations to work together to identify and qualify the different types of traffic management practices, including "fair use" limitations associated with so-called "unlimited" offers, and to submit their proposals on the matter to ARCEP by the end of Q1 2011.

In the meantime, the Authority will monitor the evolution of the traffic management techniques that operators are employing, in particular to evaluate whether they comply with the criteria of relevance, proportionality, efficiency, non-discrimination between parties and transparency.

Subsequently, should it prove necessary, the Authority could work in tandem with the DGCCRF to complete these proposals.

7. Monitoring the quality of the Internet access service

To ensure that the quality of the Internet access service is both sufficiently high and transparent, ARCEP will work to:

- identify the main quality of service parameters for Internet access and establish suitable indicators;
- require ISPs to publish these QoS indicators periodically for their retail data transmission services, particularly for Internet access on both fixed and mobile networks.

This work will be performed in tandem with the DGCCRF, operators and their representative associations, ISVs and their representative associations, as well as consumer associations.

8. Monitoring the data interconnection market

ARCEP recommends:

- that parties providing end users with access to the Internet grant, in an objective and non-discriminatory fashion, all reasonable requests for interconnection whose purpose is to provide these users with access to Internet services or applications;
- those parties providing ISVs with access to the Internet grant, in an objective and non-discriminatory fashion, all reasonable requests for interconnection whose purpose is to make these vendors' services or applications accessible to Internet users.

To eradicate the lack of clarity that currently exists in data interconnection markets, and to obtain information that will be useful to exercising its powers, the Authority will be adopting a decision on the periodical collection of information on these markets, before the end of S1 2011.

Based in part on this information, the Authority will later assess whether it is necessary to implement more prescriptive regulatory measures in these markets.

9. Taking account of the ISV's role in Internet Net Neutrality

ARCEP underscores the fact that users' actual ability to exercise their freedom to choose between offers (services/applications/content) made available by ISVs over the Internet implies that these vendors comply with:

- a principle of non-discrimination in the different operators' ability to access these offers;
- Principles of objectivity and transparency with respect to users, in terms of the rules employed, in cases where the ISV selects and/or ranks content coming from third parties, which is notably the case with search engines.

The Authority invites the private- and public-sector parties concerned to take these issues into full consideration.

10. Increasing the neutrality of devices

As part of the upcoming review of the RTTE Directive, ARCEP recommends that the opportunity to complete this directive be examined, to take better account of developments in the devices market, particularly the growing importance of the software layers and interactions with ISVs.

The Authority invites the private- and public-sector parties concerned to take these issues into full consideration.

Recommendations 1 to 3 provides the general guidelines of the French regulator on the Net Neutrality and are quite classical positions since the beginning of the overall debate has started. The recommendation 4 is interesting, in particular for proposals along the one suggested in ETICS, as it also clarifies the right for ISPs to develop managed services to end customers or ISVs, as a mean to also create more value in the Internet value chain for ISPs, as soon as it does not imply a degradation of the current Internet quality. This is why recommendations 5 to 8 also take advantage of the increasing role allocated to National Regulation Authorities (NRAs) to monitor and possibly enforce the quality of access to the content on the Internet. As a first outcome, ISPs are more and more forced to clarify their contracts towards end-users and show in a transparent manner possible usage restrictions in the provided Internet access service. The amended Universal Service Directive at the European level also gives the possibility to NRA to ask for a minimum

quality of service to be provided to the end users. However, and as mentioned before, aware of the so far reasonably neutral behaviours on the French market, the ARCEP mainly provides preventive recommendations and initiates monitoring actions on the quality of service. These actions concern the current situation as well as the evolution in time, following rec. 6 & 7. They target the quality of service of Internet Access in France, as well as the interconnection rules.

The ARCEP has therefore recently launched two public consultations from the 23rd December 2011 to the 17th February 2012), respectively on:

- The setup of means for a follow-up of the Internet access quality of Service [ARCEP10d]: the consultation aims at measuring the quality of service provided by French fixed ISPs to their DSL or FTTx users [ARCEP10d]. The consultation provides details on parameters to be measured (not only the bandwidth, but also the delay, the jitter, etc.), possible methods to do the measurements (active probes deployed in a panel of users or on dedicated lines), segments to be monitored (access line, backhaul and interconnection points). The first goal is to provide comprehensive measurements to allow end users for comparing the quality of the French ISPs, and not for imposing a minimum quality for the moment.
- A quarterly gathering of information on technical and economical interconnection and data transport among ISPs [ARCEP10c]: the goal is, for the ARCEP, to increase its knowledge on current interconnection rules and contracts in order to better understand this unregulated market and have, in case of disputes, more information to be able to fulfil its extended role with the amended Universal Service Directive. The consultation targets any ISP interconnected to a French operator and any ISV that has actively started to make available its service or content to French users.

5.2.4. Net Neutrality Regulation Situation in Germany

The recently adopted Telecommunications-Act is aligned with the provisions of the European Directives and Recommendations. On top of the EU framework the German parliament has adopted a new article (§ 41a TKG) that addresses all telecommunications-network providers and installs the competence with the German Government to impose an ordinance specifying general requirements of non-discriminatory data traffic and non-discriminatory access to content and applications. The intention is to safeguard against arbitrary degradation of services and unjustified interference or slowing-down of data traffic. Whether such an ordinance will actually be issued is left at the discretion of the German Government and will be dependent on the course of the on-going public discussion on Net Neutrality as well as the actual developments in the market place.

As of today no specific regulations regarding Net Neutrality have been issued by the German regulatory authority Bundesnetzagentur (BNetzA). The BNetzA approach towards Net Neutrality is actively and publicly promoted by the agency itself and consistent with the EU-Commission's view on this matter. It is mainly characterized by:

- Wait-and-see-Approach; closely monitoring of market developments and reacting to emerging competitive threats rather than acting pre-emptively;
- Securing competition on the access market;
- Securing transparency;

- Safeguarding of minimum standard for all users;
- Enabling competition and fostering innovation;
- Recognition of two-sided market;
- Recognition of traffic management as integral factor of data networks;
- Need of best-effort Internet to be maintained and developed;
- Accepting quality-classes on top of best-effort promoting increase of choice for users.

The regulatory background currently allows traffic management differentiation to foster innovation and new services and meet demand for different levels of quality. Business models can reflect the two-sided market and be based on commercial agreements, respecting the principles of openness and non-discrimination.

Over the past few years the only regulatory investigation in the context of Net Neutrality concerned the treatment of mobile VoIP. After inquiring with all stakeholders the BNetzA concluded that optional tariffs pose no threat to competition, as long as unrestricted Internet access offers are available in the mobile market.

5.2.5. Net Neutrality Regulation Situation in Greece

The legislation and regulatory framework in Greece is in line with the European directives and no specific regulatory framework has been introduced in Greece regarding Net Neutrality by the regulator (namely EETT – www.eett.gr). However, the regulator has undertaken certain initiatives regarding Net Neutrality both within its national activities to promote competitiveness and efficiency of the market and as part of its participation in BEREC (Body of European Regulators for Electronic Commerce) where EETT holds the vice presidency since 2011.

The major initiatives of EETT in Greece regarding Net Neutrality are the following:

1. Net Neutrality and Transparency: This initiative has been kicked off to investigate a set of methods and tools that achieve transparency and also to identify the required information that the consumers must have in order to choose broadband provider, as this is affected by the provider's policy regarding the Net Neutrality issues. To this end, EETT has committed to investigating methods that when adopted can ensure that the consumers indeed receive accurate information and can compare alternatives in the market, as well as developing new tools for overseeing the providers' respective policies.

This initiative has also been coordinated with efforts in BEREC where the discussion on similar issues has also been kicked off. To this end, a new draft has been circulated, namely BEREC DRAFT, "BEREC Guidelines on Net Neutrality and Transparency: Best Practices and Recommended Approaches" where these issues are further elaborated.

2. Net Neutrality and Quality of Service: This initiative will investigate whether it is possible and beneficial to enforce a minimum quality for the broadband services provided to consumers. Furthermore, it will identify the respective delegation of authority and tools that should be provided to the regulator in order to be able to check the conformance of the providers to that minimum quality of service level and also enforce this to the providers' networks. To this end, a separate code of practice adopted by the Greek regulator ensures

that end users are provided with information about the speed of their connection, and any restrictions to the access of specific services.

Regarding the provision of information to end users, **two regulations** apply:

EETT Decision 488/82/5-7-2008 (Official Gazette 1505/B/30-7-2008) "*Code of practice for the provision of electronic communication services to the end users*". According to this Decision the service provider should ensure that the end user is informed of the following:

- whether the activation of the service is required before determining if the connection speed on the contract can be achieved for the specific end user connection; and
- whether the connection speed on the contract is ensured continuously and without interruption throughout the provision of the service, since the actual speed may depend on the use or the quality of the network or the quality of the equipment of the provider.

Furthermore, the service provider should also ensure that the end user is informed of possible restrictions to the access of a certain service.

EETT Decision 480/017/2008 (Official Gazette 1153/B/24-6-2008) "Designation of quality indicators for the electronic communication services provided to the public and definition of the content and the form of the information to be published and the time and means of its publication by the electronic communications service providers". According to this Decision, EETT has designated specific quality indicators of the electronic communication services provided to the public so that:

- end users are able to compare the quality of services provided by different operators and have information on the quality of the services already provided to them; and
- a clear framework of obligations of the service and network providers to the end users is imposed.

Among the services concerned are **broadband and VoIP services**, for which quality indicators and measurement methods are defined by the above regulation.

5.2.6. Net Neutrality Regulation Situation in Israel [ISR]

5.2.6.1. Status of Net Neutrality Legislations

Israel is probably the first country worldwide that passed laws enforcing Net Neutrality. As early as the end of 2009, and including a wide scope of other legislations relating to the country's 2010-2011 budgets, the Israeli parliament (the Knesset) approved the Net Neutrality law.

The new law prevents communication companies that own communication infrastructure, including cellular operators, NSPs and ISPs, from blocking or limiting the use of services and applications that are delivered over the Internet. Wi-Fi, Bluetooth and VoIP (Skype) are mentioned as examples of such services; operators cannot block them on, e.g., hand-held devices.

There are two exceptions to the law:

1. The minister of communications can respond to an explicit "fair traffic management" request by an operator, and approve it. This is mainly for avoiding the exploitation of this Net Neutrality law in bad or malicious manners, but may also be based on the grounds of security needs, network performance, traffic optimization or "premium service" arguments.

2. Subscribers or group of subscribers may ask the operator to block certain traffic. This is primarily meant for filtering out certain applications for devices owned by employers and are given to employees for specific use.

5.2.6.2. Market Status and Global Trends

Bezeq International's CEO, The ISP arm of the Israeli incumbent telephone company (Bezeq), recently estimated that the current household data consumption rate is at 20 GB per month, and it is expected to grow 33% annually. The Smartphone revolution makes this trend significantly stronger. A recent report by Allot Communications (www.allot.com) reveals that the median consumption of data services over cellular networks increased by astonishing 77% within one year, with video being the most significant contributor to this growth (93%, primarily from YouTube).

This astonishing data consumption growth forces the communication companies to significantly upgrade their communication infrastructure by installing additional routers and servers, and increasing the capacity of their international lines. The problem is even more acute for the cellular operators, which need to accommodate the limited spectrum that is available for Four-Generation cellular services, acquire more frequencies, add or enhance base stations, and upgrade the backhauling capacity. The costs associated with these massive capital expenditures force operators to identify innovative means to maintain profitability, as this cost cannot be directly rolled into more expensive services. This is clearly an international phenomenon; all countries face the same trend and challenge, while Israel really demonstrates it somewhat earlier and in a more extreme manner.

The same report from Allot Communications identifies that 32% of the worldwide cellular operators are adapting a so-called "aware-charging application" strategy, in which applications are charged at different rates. Vodaphone, for example, reported that it was able to save 31% of cost associated with the increase in data consumption by adopting this strategy.

This might sound reasonable, but it threatens the free nature of the Internet. Skype, for example, exist and emerged, among other things, thanks to the fact that it was not blocked. If during the early stage of the Internet, operators would have been charging extra for special services, it is feasible that Skype, ICQ, Facebook and YouTube would not be alive, and consumers would not be trying them and using them. Net Neutrality enables innovation.

Allot Communications is a leading international technology provider of Deep Packet Inspection solutions (DPI), which are the means to associate each IP packet to a specific application in real-time (i.e., at wire speed), and control its flow, by means of blocking, delaying, or prioritizing. The company is in the best position to identify such global trend. It is no wonder that Allot Communications enjoys significant increase in its international sales, which is primarily due to the installation of its products in this application.

Clearly, this aware-charging application strategy violates the neutrality of the network. Without full transparency to consumers, operators can discriminate among applications, while providing preferences to those that provide higher profit and taking into the service charging scheme the amount of information consumed by the service, and the cost associated with it.

5.2.6.3. Israeli Net Neutrality Status

The Net Neutrality legislations actually position Israel as a pioneer in this global front. The bad news, however, are that the Israeli authorities fail to enforce this law, and thus, the actual situation in Israel is similar to the global trends described in the previous section.

As quoted by Amdocs' CEO, "the cellular operators are looking for means to sell 1 bit of data to different consumers at different prices. This is similar to the differential charging schemes in a toll highway and parallel free highways".

Celcom's CEO (the second largest cellular operator in Israel), noted that "while 70% of the network traffic originated from data consumption, the voice services are the ones that generate 70% of the revenue for cellular operators". Clearly, it is the interest of the cellular operators to fix this anomaly, and violating the Net Neutrality law is a feasible mean to do it.

The situation with the Internet over the fixed infrastructure is also somewhat problematic. The ISPs experience ever-growing traffic, and are implementing some forms of "traffic management", but they do not specify what exactly they do, and how they do it, and thus, the only sources of information are complaints from customers.

Creating a differential charging schemes, ensuring that revenue is sufficiently generated from the cellular-based data services, and traffic management are clearly legal and legitimate practices, as long as they are implemented in a transparent manner. These means cope with the needed infrastructure upgrades and maintain profitability from the operators' point of view, while allowing consumers to make the right choices. However, without transparency, operators are free to exploit the aware-charging application strategies, implementing practices that might demonstrate conflict of interests (i.e. by providing preferences to applications that the operators have direct or indirect incentives, or those that consume less bandwidth). By doing so, the Net Neutrality law is violated, and consumer rights are severely affected.

The "Israeli Internet Association" (IIA), represents the interests of Net Neutrality in Israel. Its chairman spells out three universal principles: the right to access information, the right to choose between services, and transparency. When information is blocked, or when the selection between a Skype and a cellular call is prohibited, these rights are violated. The DPI solutions that implement the aware-charging application strategy are really some form of information privacy violation, similar to wiretapping, and thus, are illegal. It is, however, very difficult to prove that the DPI is used to discriminate between data access or services for non-technical reasons. When operators are not forced by law to be transparent, i.e. to specify how exactly they implement traffic management, consumer rights are violated. In Israel, this transparency is not enacted by means of legislations, and therefore, the consumers do not know that the promised service is indeed provided. Without such legislations, the chairman if IIA claims that "they will consider the deployment of neutral third-party entity, to monitor and provide such transparency".

5.2.7. Net Neutrality Regulation Situation in Italy

Net Neutrality, strongly debated in the EU, is now rapidly catching the attention of regulatory authorities and of the electronic communications operators in Italy [Apa11].

5.2.7.1. Regulatory Proposals

In Feb-2011 the Parliament has discussed a proposal to promote the development of broadband services under an investment programme and to ensure transparency for consumers in respect of Internet access.

The proposal assigns a key role to the communications authority, AGCOM (Agency to guarantee the communication) and overall focuses on:

- ensuring that suppliers and providers of Internet connection services comply with new transparency rules.
- promoting cooperation between operators.
- monitoring user satisfaction in relation to services from specific suppliers.

On February 28, 2011 AGCOM published a consultation on key questions concerning Net Neutrality [AGC] having as focus:

- the evolution of Net Neutrality – specifically, the problems that may arise in future in relation to the different ways in which Internet services are used and the intervention by national regulatory authorities;
- the transparency of service conditions for consumers;
- the necessary conditions to ensure effective competition and the structural characteristics of the Internet;
- the values inherent in Net Neutrality and the political, cultural and social dimension of the debate.

This consultation contributes to the international debate although the questionnaire focuses mostly on certain traffic management practices and their potentially unfair effects on users. It represents an opportunity for stakeholders to indicate the anti-competitive effects of traffic management systems and to propose regulatory measures to protect consumers from misleading or unfair conduct by operators.

With reference to these issues, AGCOM's consultation paper notes the proposals by the Body of European Regulators for Electronic Communications (BEREC) on addressing such issues.

BEREC has highlighted the importance of seeking to:

- adopt regulations or individual provisions to protect consumers.
- monitor the conduct of operators with significant market power in a relevant market (including in cases where de facto market power may exist, but remains unproven).

In order to protect the consumer the use of traffic management techniques must be made transparent in order to detect discriminatory traffic management techniques and its effect on service quality or influence of other factors.

In addition to the above, Art. 22(2) of the EU Universal Service Directive (2002/22/EC) empowers national regulatory authorities to set minimum quality of service requirements [EU Directive02] and from a competition perspective, AGCOM emphasises that CDNs regulations is aimed at preventing discrimination, such as blocking access to specific content or price discrimination on the basis of service quality or other elements (so-called 'access tiering').

AGCOM, aware that Net Neutrality will be regulated by EU at least, has invited stakeholders to contribute to an international debate in the coming months.

5.2.7.2. Net Neutrality and Traffic Management

Net Neutrality is based on the principle that all electronic communications passing through a network are treated equally. Many technical and resource availability reasons, in recent years, have undermined this principle. Traffic management can be legitimate and may be useful in ensuring service quality for the

benefit of users. Thus, traffic management is not in itself a deviation from the Net Neutrality principle. In a recent European consultation [EU_information_society10] the close relationship between Net Neutrality and traffic management has been explained, drawing a distinction between best-effort and managed services. In relation to different traffic management techniques:

"best-effort" *service means that there is no guaranteed level of performance (nor is priority a guarantee for the data to be delivered) without necessarily implying proof of low quality. Having said this, the general principle is that all traffic demands are accepted – this is fundamentally based on an 'openness feature'. In cases where the maximum transport capacity is reached, this will, in turn, result in an overall decrease in quality.*

Managed services *are therefore designed to provide guaranteed characteristics (e.g., end-to-end quality or security)* [BEREC10].

According to the statements above, operators should provide both best-effort and managed services. Therefore, it is important that end users be guaranteed: information, transparency and awareness of service characteristics, competition in the relevant market, easy switching and acceptable quality for best-effort Internet access.

In short, such an approach may provide a paradigm for solving Net Neutrality concerns in practice.

5.2.7.3. Operators' Initiatives

On March 1 2011 Telecom Italia, the incumbent telecommunications operator, announced that it *would adopt a bandwidth management and traffic-shaping system. Telecom Italia will limit the connection speed for more bandwidth-intensive applications (e.g. peer-to-peer and file-sharing applications), but not for Voice over Internet Protocol (VoIP) applications.*

The Italian Association of Internet Providers has filed a complaint with AGCOM, alleging that Telecom Italia's initiative breaches the Net Neutrality principle. It is not the first time that an Italian telecommunications operator has adopted network management measures. In February 2011 Vodafone Italia decided to increase the fees for VoIP services on mobile phones. Although it may be claimed by consumer association that these measures are detrimental to competition, Italian Competition Authority had a strong position against the "Net Neutrality taboo" at a conference in Capri on October 7 2010. The opinion was that Net Neutrality stifles the creation of next-generation networks – operators should be allowed to discriminate between content depending on the bandwidth capacity that such services require, thereby encouraging efficient investment in infrastructure and promoting innovation.

However, despite varying opinions, the Electronic Communications Regulatory Framework makes it necessary to ensure certain values:

- **Transparency** – this ensures that consumers and other end users have the ability to make informed choices between competing service providers. Information must be detailed and technical, but also simple enough for the average user to understand.
- **Competition** – the transparency of technical and economic conditions of different operators encourages a competitive market.
- **Net freedom** – the new business models could limit the free flow and exchange of information and thus restrict freedom of expression.

The challenge in Italy as well as in Europe is to balance the interests of customers in accessing online content and services against those of content providers and Internet service providers (ISPs) as well as the related associations. Three issues are particularly significant in this context.

First, from a **privacy standpoint**, traffic management may breach the fundamental right to confidentiality of communications in relation to the so-called 'right to be forgotten' – an increasingly significant concern. Second, the **relationship between search engines and advertisers** gives cause for concern. Search engines could use technical measures to favour certain operators without ensuring transparency for consumers: this issue is called 'search neutrality' where Google has been involved.

Finally, **vertical integration applications for traffic management** could create incentives for network operators and ISPs to integrate on content, applications and services markets. There may be an incentive for operators or ISPs to discriminate against a competitor's equivalent services.

5.2.8. Net Neutrality Regulation Situation in Scandinavia

The regulatory framework regarding Net Neutrality in the Scandinavian countries Sweden, Denmark and Norway adheres to the EU Commission legislation, with BEREC advising and coordinating the national regulatory authorities (NRAs), i.e. PTS [PTS] (Post- och Telestyrelsen) in Sweden, Danish Business Authority (Erhvervsstyrelsen) [ITS] in Denmark and NPT [NPT] (Post- og teletilsynet) in Norway.

The Scandinavian NRAs have been contributing to BEREC reporting and fact finding exercises, e.g. for traffic management and minimum QoS considerations. On the BEREC work programme for 2012 [BEREC11b], key issues under "Network Neutrality" are Transparency (further developing the 2011 "draft Guidelines on Net Neutrality and transparency" [BEREC11a] e.g. through common terms and frames of reference between NRAs), QoS requirements (e.g. minimum requirements set by NRAs and end user tools for quality monitoring), Discrimination (identification and economic assessment of traffic management rules) and IP interconnection (development of commercial agreements regarding e.g. peering and transit).

In Norway, NPT released a document with principles for Network Neutrality in 2009 [NPT09]. This document was supported by major Internet and media companies (including Telenor and competitors), and is referred to as voluntary "codes of conduct", but interpretations differ among the actors. NPT has specifically announced that it interprets throttling and blocking of mobile VoIP to be a violation of these principles, but no specific actions have been taken.

NPT has furthermore announced a report in 2012 on regulatory challenges from Content Distribution Networks, including Network Neutrality. Preliminary indications are that CDNs will not be considered problematic from a Network Neutrality perspective by NPT.

In Sweden, PTS has officially stated that no additional measures in addition to monitoring transparency are necessary at this point in time. Technical measurements published by the national domain operator [IIS11] uncovered possible traffic shaping practices, e.g. affecting BitTorrent.

In Denmark, "codes of conduct" among actors have been established by the Telecommunications Industry Association in 2011 [Teleindustrien11], much in line with the Norwegian guidelines.

Danish and Norwegian consumer councils seem very aggressive in the public debate around Net Neutrality, but so far these positions have not resulted in any legislative actions.

5.2.9. NET NEUTRALITY REGULATION SITUATION IN SPAIN

The regulatory framework for Network Neutrality in Spain is not formally defined yet: the Spanish Parliament decided to include Network Neutrality regulation as part of the General Telecommunications Law planned to be approved during the former term. The urgent issues related to the economic situation and the earlier call for elections did not allow completing the task.

Nevertheless, there is a resolution of the Senate, unanimously voted by all members, requiring the Government to "*urgently modify the Spanish regulatory framework in all necessary aspects to guarantee the compliance of telecommunication providers operating in Spain to the principle of neutrality, in accordance with the European regulations on electronic communications. And ensure that all data packets flowing in those providers' networks are dealt in the same way, without priority nor hierarchy, independently of their contents, origin, destination, or protocol, and without any kind of traffic filtering oriented to privilege, hamper, or forbid access to specific pages or services*".

The only official statement made by the Spanish Government on this issue was through the reply to the consultation on open Internet and Network Neutrality launched by the Commission [EU_information_society]. The Spanish NRA (CMT, *Comisión del Mercado de las Telecomunicaciones*) has not expressed any official position yet, most likely awaiting the framework definition of the general law mentioned above.

Beyond this general declaration of principles made at the Senate, both main political parties (socialist and conservative) have expressed positions on Network Neutrality aligned with it, though certain points related to guaranteeing critical services and measurement mechanisms are being introduced.

5.2.10. NET NEUTRALITY REGULATION SITUATION IN UK

In a recent statement [Ofcom11], the UK regulator Ofcom has clarified its position on Net-Neutrality. Ofcom's position in the UK is to support the coexistence of best-effort and managed types of traffic:

(i) Best-effort traffic all treated equally (though some management may apply in case of congestion).

(ii) Managed Internet traffic which can be given greater priority over other traffic e.g. IPTV. Managed traffic requires some elements of discrimination, which according to Ofcom is acceptable as long as it is enhances efficiency and does not limit competition.

Ofcom recognises that best-effort traffic quality may deteriorate if not enough bandwidth is provisioned for it versus managed traffic. Currently Ofcom has no concern regarding the quality given to best-effort in the UK, but will monitor the market due to the important consequences on the whole country's economy that may arise if such traffic quality were to deteriorate. In case of deterioration, the new EU power to require minimum QoS could be used to enforce provision of adequate quality for Internet services.

In the UK, where network providers are increasingly posed with challenges due to finite capacity of their networks and faced with the decision to invest in extra capacity or to ration the existing one, some providers have introduced discriminatory traffic management solutions. As a response to such management solutions, Ofcom's approach is to leave it in the hands of market forces to rectify, but it supports greater transparency.

In March 2011 the Broadband Stakeholders Group (BSG) [BSG], supported by Ofcom, has published a code of practice on traffic management. This is a voluntary code of conduct, signed by BSkyB, BT, O2, TalkTalk,

Three, Virgin Media, and Vodafone, and aimed at increasing transparency on the practice that they adopt to control the traffic on their networks [BSG]. Such transparency should ensure that providers commit not to block or apply traffic management that disadvantages competing service providers. To increase transparency, Ofcom recommends that ISPs should provide customers with at least the following:

(iii) information on average speed indicating level of service that they can expect and information on services that are blocked;

(iv) detailed information about the impact of traffic management that they apply, so customers can make informed decision when deciding their broadband package;

(v) publish a common Key Facts Indicator (KFI) table which is currently being developed by the industry and Broadband Stakeholder Group (BSG) [BSG,] which indicates traffic management on each service. With respect to KFI Ofcom would encourage ISP to simplify and improve the quality of such information so as it can be understandable to all customers. Information provided by ISP should be verifiable, understandable, current, and comparable;

(vi) for marketing purposes, Ofcom supports adoption of a common standard on the definition of specific offered services. With regards to long-term contract, where it is not possible to provide customers with impact of traffic management at the point of sale, customers should be given a (free of charge) cooling off period. If changes to traffic management are made after a contract has been signed customers should be informed as soon as possible and been given the option to switch to different services.

Ofcom's position will be kept under review in cooperation with the Body of European Regulators of Electronic Communications (BEREC) taking into account UK and EU developments.

5.2.11. NET NEUTRALITY REGULATION SITUATION IN USA [FCC10]

Dangers to Internet openness are not speculative or merely theoretical, since broadband providers have the incentive and ability to limit Internet openness and they have actually been applying those practices. Several stated cases have occurred: a broadband provider, subsidiary of a telephone company, paid $15,000 to settle a Commission investigation into whether it had blocked Interned ports used for competitive VoIP applications (2005); Comcast disrupted certain peer-to-peer (P2P) uploads of its subscribers, without a reasonable network management justification and without disclosing its actions (2008); a mobile wireless providers entered into a contract to handle online payments and allegedly blocked customers' attempts to use competing service to make purchasing transactions using their mobile phones; a nationwide mobile provider restricted the types of lawful applications that could be accessed over its 3G mobile wireless network.

These practices have raised concern among edge providers and end users and have occurred notwithstanding the Commission's adoption of open Internet principles in the Internet Policy Statement (adopted in 2005) and longstanding norms of Internet openness. As a result, the US Federal Communications Commission (FCC) noted the need for better means for preserving and promoting free and open Internet.

Since 2010, discussions on Net Neutrality norms have been going on, and, on September 23, 2011, the FCC filed the Net Neutrality Final Rules thereby establishing the rule for an "Open Internet". In order to preserve

and reinforce Internet freedom and openness, the FCC adopted three core protections for broadband service:

Transparency: fixed and mobile broadband providers must disclose the network management practices, performance characteristics, and commercial terms of their broadband services.

No Blocking: fixed broadband providers may not block lawful content, applications, services, or non-harmful devices; mobile broadband providers may not block lawful Web sites, or block applications that compete with their voice or video telephony services.

No Unreasonable Discrimination: fixed broadband providers may not unreasonably discriminate in transmitting lawful network traffic.

The Commission believes that these rules, effective November 20, 2011, applied with the complementary principle of reasonable network management, ensure that the freedom and openness that have enabled the Internet to flourish as an engine for creativity and commerce will continue.

According to the FCC, transparency promotes not only competition, but also innovation, investment, end-user choice and broadband adoption. Effective disclosures expected by the FCC should include some or all types of information:

Network Practices: congestion management, application-specific behaviour, device attachment rules, security.

Performance Characteristics: service description (service technology, expected and actual access speed and latency, and suitability for real-time applications), impact of specialized services.

Commercial Terms: pricing, privacy policies, redress options (practices for resolving end-user and edge provider complaints and questions).

Although transparency is essential for preserving Internet openness, the FCC was not convinced that a transparency requirement by itself can adequately constrain problematic conduct, and therefore adopted two additional rules.

The no-blocking rule, in addition to prohibiting any blockage of lawful content, applications, services, or non-harmful devices, bars broadband providers from impairing or degrading the aforementioned so as to render them effectively unusable. It is claimed that degrading traffic can have the same effects as outright blocking. This rule also prohibits broadband providers of charging edge providers simply for delivering traffic to or carrying traffic from the broadband providers' end-user customers to the extent that only by paying a fee the content, application, or service provider could avoid being blocked.

The no unreasonable discrimination rule seeks an appropriate balance between restricting harmful conduct and permitting beneficial forms of differential treatment. This rule does not concern discrimination by broadband provider that constitutes "reasonable network management". Discriminations' reasonableness can be evaluated regarding the following aspects:

Transparency: differential treatment of traffic is more likely to be reasonable the more transparent to the end user that treatment is.

End user control: end user choice and control are touchstones in evaluating the reasonableness of discrimination. Thus, the rule does not hinder broadband providers from offering different services based on such factors as assured data rates and reliability, or providing quality-of-service enhancements on

connections for traffic of the end users choosing, given that those options are fully disclosed and are not harmful to competition or end users. Finally, it does not prohibit tiered or usage-based pricing by broadband providers.

Use-Agnostic Discrimination: differential treatment of traffic that does not discriminate among specific uses of the network of classes of uses is likely reasonable (e.g. during periods of congestion a broadband provider could provide more bandwidth to subscribers that have used the network less over some preceding period of time than to heavier users). Use-agnostic discrimination does not interfere with end users' choice about which content, application, services, or devices to use; nor does it distort competition among edge providers.

Standard Practices: the conformity or lack of conformity of a practice with best practices and technical standards adopted by open, broadly representative, and independent Internet engineering, governance initiatives, or standards-setting organizations is another factor to be considered.

In evaluating unreasonable discrimination, the types of practices that would be a concern include: discrimination that harms an actual or potential competitor to the broadband provider (such as by degrading VoIP applications or services when the broadband provider offers telephone service), that harms end users (such as by inhibiting end users from accessing the content, applications, services, or devices of their choice), or that impairs free expression (such as by slowing traffic from a particular blog because the broadband provider disagrees with the blogger's message). Furthermore, a commercial arrangement between a broadband provider and a third party to directly or indirectly favour some traffic over other traffic (pay for priority) would raise significant cause for concern.

In a summary, the no unreasonable discrimination rule provides broadband providers' sufficient flexibility to develop service offerings and pricing plans, and to effectively and reasonably manage their networks.

The three rules explained before should be complied together with a reasonable network management. It is reasonable if the network management's purposes are to ensure network security and integrity, including by addressing traffic that is harmful to the network, addressing traffic that is unwanted by end users and reducing or mitigating the effects of congestion on the network.

Mobile broadband presents special considerations that suggest differences in how and when open Internet protections should apply. Mobile broadband is an earlier-stage platform than fixed broadband, and it is rapidly evolving. Existing mobile networks present operational constraints that fixed broadband networks do not typically encounter. This puts greater pressure on the concept of "reasonable network management" for mobile providers, and creates additional challenges in applying a broader set of rules to mobile at this time.

Two of the open Internet rules defined by the FCC apply to mobile broadband: the transparency rule and a basic no-blocking rule. First, the transparency rule for mobile broadband is the same applicable to fixed broadband providers. Second, the no-blocking rule guarantees end users' access to the Web and protects against mobile broadband providers' blocking applications that compete with their other primary service offering (voice and video telephony). On the other hand, the no unreasonable discrimination rule does not apply to mobile broadband. The FCC decided to take measured steps to protect openness for mobile broadband and monitor this market's development in order to determine whether adjustments to this framework are necessary.

5.2.12. Net Neutrality Regulation Situation in Chile

In 2010, Chile approved the first Net Neutrality law in the world (Law No. 18168 of 2010). It regulates four different aspects of Net Neutrality for concessionaires of the telecommunications public utility[5] providing services to Internet Access Providers together with these providers:

1. They may not arbitrarily block, interfere with, discriminate against, hinder or restrict the right of any Internet user to use, send, receive or offer any legal content, application or service on the Internet. However, they may take any measure that may be necessary for purposes of traffic management and network administration, within the exclusive area of activity that has been authorized to them, provided that it does not affect fair competition. Additionally, they may block access to certain content, applications or services, only upon express request of the users and at their expense. Under no circumstance may this block arbitrarily affect providers of Internet services and applications.
2. Users have the right to add or use any kind of instruments, devices or equipment on the network, provided they are legal and do not harm or adversely affect the network or the quality of the service.
3. Concessionaires and Internet Access Providers shall offer, at the expense of the users requesting it, parental control services for content that is against the law, ethics or moral conventions, provided the user receives clear information, in advance, regarding the scope of such services.
4. Information about the Internet access offered, its speed and the quality of connection should be published on their websites.

5.2.13. Net Neutrality Regulation Situation in Brazil

Chile was one of the first country in the world to approve a Net Neutrality law in 2010. Following its example, other countries in Latin America initiated actions in assuring Net Neutrality. Colombia recently adopted a norm in its national development plan to prevent information discrimination practices. Currently, Argentina, Brazil and Mexico are also in the process of regulating Net Neutrality [Magrani11].

In 2009, the Internet Management Committee in Brazil [CGI] approved and published a resolution which defined the "Principles for the Internet Governance and Use in Brazil". Included in these principles, ten in total, there was one about Network Neutrality.

"*Neutrality of the network: filtering or traffic privileges must meet ethical and technical criteria only, excluding any political, commercial, religious and cultural factors or any other form of discrimination or preferential treatment*." [CGI]

Currently, other initiatives were taken regarding the Net Neutrality. On August 24, 2011, a draft of bill for a civil rights-based framework for the Internet (Projeto de Lei 2126/11) was sent to the National Congress. Among the framework's fundamental principles there is the "preservation and safeguarding of Net Neutrality, in compliance with further regulation".

The section of the draft bill proposition regarding data traffic states that:

"The party responsible for the transmission, switching or routing of data has the obligation of granting equal treatment to every data package, with no distinction by content, origin and destination, service,

[5] This highlights that telecom network services are considered a public services, managed according to terms fixed with country representatives.

terminal or application; any traffic discrimination or degradation that does not arise out of the technical requirements necessary to the adequate provision of services is prohibited, in accordance to further regulation. In the provision of Internet connection services, it is prohibited to monitor, filter, analyse or supervise the content of data packages, except in the circumstances allowed by the law." [Brazil11]

Meanwhile, in August, 2011, the Brazilian telecommunications regulator Agência Nacional de Telecomunicações (Anatel) proposed a new regulation for Multimedia Communication Service (SCM); the previous regulation was of 2001. The new regulation states that it is prohibited for an operator to block or treat with discrimination any type of traffic, such as voice, data or video, regardless of the technology used. However, Anatel creates an exception by declaring that the expected prohibition does not prevent the adoption of blocking or traffic management measures that prove to be indispensable to the guarantee of the service and network's security and stability [Anatel].

5.3. MACRO-ECONOMIC IMPACTS OF NET NEUTRALITY VS. NON-NET NEUTRALITY CHOICES

5.3.1. INTRODUCTION

This section provides a critical evaluation by the ETICS partners of a small collection of Net Neutrality-related papers. This shortlist, comprised of the papers presented below, has been generated from a wider list of papers collected; the full list is provided as Appendix.

The criteria used for the selection of these papers are the following:

1. Paper importance, visibility and technical depth
2. Main issues addressed
3. Lessons learned and generality/robustness of results
4. Potential to guide the ETICS Net-Neutrality work in [Del3.5]

The first criterion ensures that these papers are high-quality and well-reputed to the researchers of the field. This ensures that the papers chosen will not misguide the Net Neutrality-related work of the WP3 partners, both in this and the coming deliverable [Del3.5] where the ETICS Net Neutrality issues will be thoroughly investigated.

The second criterion pertains to the range of issues covered by these papers. In particular, these papers address the main issues that will also need to be addressed for the potential adoption of ETICS, as identified by the ETICS partners, which are affected by the Net Neutrality debate and its implications. In particular, these are the service discrimination and economic implications issues, impact on social welfare and providers revenue under both neutral and non-neutral regime, investments by network and content providers (as well as impact on their business as a whole), NSP profits and the impact of side-payments among NSPs and CPs.

The third criterion ensures that the lessons learned from these papers are useful for ETICS and the work to be carried out also in [Del3.5], as well as that they reflect multiple network and market conditions. These range from monopoly models (reflecting what would be perceived by CPs under a limited ETICS enrolment from a close federation of NSPs with strict business rules) to oligopoly and competition models. This way, the robustness of results is investigated but always under a critical investigation: this is also reflected in the

sections below where there is always a subsection where the papers findings are carefully reviewed in terms of assumptions and generality, usefulness for ETICS and how related these are to the expected ETICS market conditions.

Last but not least, the latter is closely related to the fourth criterion, which is the potential of these papers to provide guidance for the [Del3.5] work. This is crucial for linking the work performed in this section with the WP3 work to be carried out and reported in [Del3.5]. Our approach is to build incrementally on top of the findings reported in this section so as to take advantage of related research prior to performing an in-depth investigation of the ETICS-Net Neutrality issues, impact and interaction. Thus, these papers will provide the basis on top of which the [Del3.5] work will be structured.

The importance of these criteria is also reflected to the template used for the presentation of each paper: A structured template has been used so as to assist the reader in identifying the respective issues and thus improve the quality of the presentation and the readability of this section, which otherwise could be a loose collection of paper. It also ensures that a common methodology is in place and applied by all the partners involved in this task. Finally, the template ensures that all the issues of interest are addressed and properly covered by all individual contributions.

For each paper, first the point of view of the author/s is presented, including the main study's results; after that a study's critiques from the ETICS perspective is offered.

5.3.2. NET NEUTRALITY ECONOMIC IMPLICATIONS

5.3.2.1. Paper Reference

[Economide09] Economide, N. and Tåg, T.: "Revised Net Neutrality on the Internet: A Two-sided Market Analysis". May 2009.

5.3.2.2. Presentation

The Internet is the primary global network for digital communications. A number of different services are provided on the Internet, including e-mail, browsing, peer-to-peer services, Internet telephony (Voice over Internet Protocol "VoIP"), and many others. A number of different functions/applications run on top of the Internet browser, including information services, display of images, transmission of video and other features.

Since the inception of the Internet, information packets are transported on the Internet under "Net Neutrality." This is a regime that does not distinguish in terms of price between bits or packets depending on the services for which these bits and packets are used or based on the identities of the uploader and downloader.

From an economics point of view, the departure from Net Neutrality regulation will have six consequences.

First, it will introduce the possibility of two-sided pricing on the Internet where a transmission company controlling some part of the Internet (here last mile access) will charge a fee to content- or application firms "on the other side" of the network which typically did not have a contractual relationship with it. This is over and above the traditional one-sided payment to its ISP for "transit service" whereby a content or applications provider connects to the Internet.

Second, it will introduce the possibility for prioritization, which may enhance the arrival time of information packets originating from paying content- and application firms "on the other side," and may degrade the

arrival time of information packets that originate from non-paying firms. In fact, the present plans of access providers are to create a "special lane" for information packets of paying firms while restricting the lane for non-payers without expanding total capacity. By manipulating the size of the paying firms' lane, the access provider can guarantee a difference in the arrival rates of packets originating from paying and non-paying firms, even if the actual improvement in arrival time for paying firms' packets is not improved as compared to the case of Net Neutrality.

Third, if access providers choose to engage in identity-based discrimination, they can determine which of the firms in an industry sector on the other side of the network, say in search, will get priority and therefore win. This can easily be done by announcing that prioritization will be offered to only one of the search firms, for example the one with the highest bid. Thus, determining the winner in search markets and other markets "on the other side" will be in hands of access providers. This can create very significant distortions since it seems reasonable to assume that the surplus "on the other side" of the Internet is a large multiple of the combined telecom and cable TV revenue from residential Internet access.

Fourth, new firms with small capitalization (or those innovative firms that have not yet achieved a significant penetration and revenues) will very likely not be the winners of the prioritization auction. This might reduce innovation.

Fifth, access networks might favour their own content and applications rather than those of independent firms.

Finally, since the Internet consists of a series of interconnected networks, any of these networks, and not just the final consumer access network, can, in principle, ask content and application providers for a fee. This can result in multiple fees charged for a single transmission and lead to a significant reduction in trade on the Internet, similar to the reduction of trade in medieval times when the weakening of the state power of the Roman Empire allowed multiple fees to be collected by many independent city powers along a trading route.

5.3.2.3. Main findings and results

In this paper, the authors only concentrate on the issue of one-sided versus two-sided pricing and ignore other issues, such as exclusion of content providers, quality of service variations, dynamic investment incentives and price discrimination. They explicitly model the Internet broadband market as a two sided network consisting of broadband users on one side and content and applications providers on the other. Prices imposed on both sides have direct implications on the number of broadband consumers as well as on the number of active providers of content and applications. In their framework, Net Neutrality is defined as a restriction that Internet Service providers cannot directly charge content providers for access to consumers, i.e., the price on one side of the market is constrained to zero. This is a direct consequence of the fact that Net Neutrality would prohibit Internet service providers from inspecting packets to determine from where they originate. If they cannot tell packets apart, they cannot charge content providers for access to consumers, since they do not know whom to charge. Figure below shows the conceptual structure of the Internet connecting consumers and content providers.

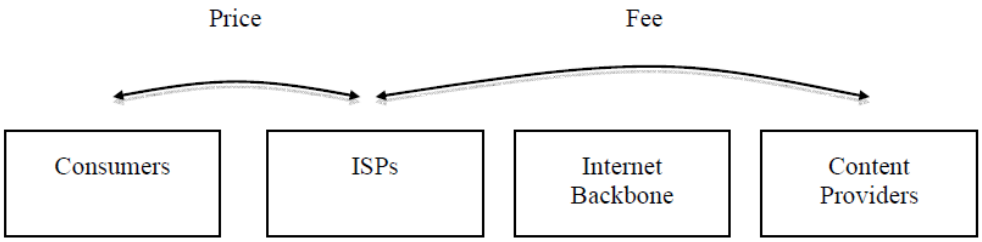


FIGURE 5 – STRUCTURE OF THE INTERNET CONNECTING CONSUMERS AND CONTENT PROVIDERS

They take the Internet Backbone competitive and consider the price for Internet access that consumers pay and possible direct fees imposed on content providers by ISPs. These fees are possible if Net Neutrality is abolished and an ISP can determine the origins of packets it delivers to consumers.

The authors discuss the incentives of a **monopoly** broadband Internet access network, starting from Net Neutrality, to initiate a positive fee to the content- and applications side of the market, besides the price it charges to users/subscribers. They show that while a monopoly broadband Internet access network has an incentive to charge a positive fee to content providers, for some parameter ranges when the monopolist would like to charge content providers, an increase in such a fee above zero decreases the total surplus. However, there also exist parameter values for which this result is overturned. Further, they show that in a duopoly setting with multi-homing content providers and single-homing consumers, Net Neutrality increases the total surplus as compared to duopoly competition between platforms that would impose positive fees on content providers. The reason is the surplus loss arising when some content providers choose to remain inactive when fees are positive.

A platform monopoly model of a two-sided market sells broadband Internet access to consumers at a subscription price *p* and possibly collects a fee *s* from each content or application provider to allow the content to reach the consumer. They assume that the platform monopolist (and duopolists) only offers linear fee contracts. Furthermore, they abstract from the full complexity of the Internet, which consists of many interconnected networks and assume that the networks that lie between the access provider and the content provider are passive (see *FIGURE 6*). Finally, they assume that the cost of providing the platform service is *c* per consumer.

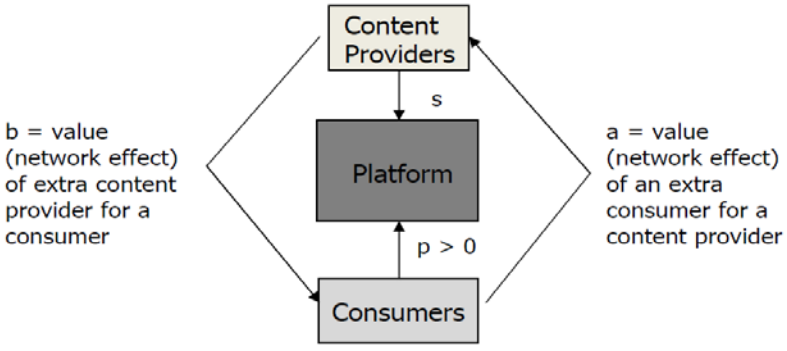


FIGURE 6 – INTERCONNECTED NETWORKS

Consumers are interested in accessing the Internet to reach search engines, online stores, online auctions and online video, audio, still pictures, and other content. Consumers are differentiated in their preferences for Internet access. Consumers pay a transportation cost equal to *t* per unit of distance "travelled".

Content providers rely on advertising revenue per consumer, *a*, to generate revenue. The authors make the simplifying assumption that content providers are independent monopolists, each in its own market, and

therefore do not compete with each other. Content providers are heterogeneous in terms of the fixed costs of coming up with a business idea and setting up their business. A content provider indexed by *j* faces a fixed cost of fy_j , where y_j is the index of the content provider's location on the unit interval.

Consider first the monopoly platform private optimum under which the platform is free to set both the subscription price p and the fee s to content providers.

Because the two markets provide complementary products, the monopolist finds an inverse relationship between *p* and *s*; that is, maximizing with respect to p results in a smaller *p* when *s* is larger, and maximizing with respect to *s* results in a smaller *s* when *p* is larger. Specifically, the optimal *p* for the monopolist given *s*, is given by $p(s) = \frac{f(v+c)-(a+b)s}{2f}$, and the optimal *s* for the monopolist given *p*, is $s(p) = \frac{av+bc-(a+b)p}{2r}$.

The monopoly platform service provider sets a positive fee to content providers for accessing users only if $\frac{a}{b} > 1$. This means that if content providers value additional consumers more highly than consumers value additional content providers, the platform will charge content providers a positive price for accessing consumers.

The authors extend their model to **duopoly** competition between two platforms with multi-homing content providers. They assume that consumers single-home i.e. each consumer buys Internet access from one platform only. Content and applications providers, however, are assumed to multi-home, i.e., they sell through both platforms, paying the fees charged by platforms. As in monopoly, they assume that platforms only offer linear subscription prices and content provider fees.

Extending the monopoly model to a duopoly setup, the authors came to the conclusion that most of their results are robust to the introduction of competition between platforms. In platform duopoly, they find that for $\frac{a}{b} > 1$, the private and social incentives to set a positive fee to content providers diverge. A social planner would prefer a negative fee, while competing duopolists would like to choose a positive fee. Hence, Net Neutrality regulation is beneficial for social welfare even when some competition is present in the platform market. Comparisons between outcomes under the private equilibrium with two-sided pricing and the private equilibrium under Net Neutrality regulation indicated that a removal of Net Neutrality regulation would lead to a lower subscription price for consumers, but less content available due to an increase in fees to content providers. Content providers are worse off in the aggregate, while consumers are better off. Social welfare is reduced, thereby supporting the result that Net Neutrality regulation is good for total welfare.

5.3.2.4. Critique – Link with ETICS

The authors developed a model of a two-sided market to assess the potential benefits of the Internet departing from "Net Neutrality" whereby broadband Internet access providers do not charge a positive fee to content and application providers. They explicitly allowed monopoly and duopoly access providers to charge a positive fee to content and applications providers. This was contrasted to a setup where a regulator chooses the fee to content providers to maximize the total surplus, taking into account the pricing of a monopolist or duopolists in the consumer subscription side of the market. They showed that under these conditions and for reasonable parameter ranges, the regulator will choose a negative fee to content providers while a monopolist or duopolists will choose positive fees. They also showed that for some parameter values, society is better off in terms of total surplus at Net Neutrality rather than either the

monopolist's or duopolists' choices of positive fees to content providers. However, there are also parameter ranges for which the opposite result is obtained.

The model appears very simple, but it could be the first step to analyse the impact of Net Neutrality on ETICS solution. The model is based on strong hypotheses (monopoly or duopoly, model of two-sided market, ignoring more issues such as exclusion of content provider, quality of service variations, dynamic investment incentives and price discrimination). With these hypotheses, regulation on Net Neutrality increase wealth without fee for provider.

So ETICS' solution should avoid the break Net Neutrality (defines as a restriction that Internet Service providers cannot directly charge content providers for access to consumers), but concentrate on Quality of Service and inter-carrier relations, considering that the model have different results in more complex situations, where more NSP are involved in back bone with QoS assurance among them.

5.3.3. NETWORK NEUTRALITY AND INVESTMENT INCENTIVES

5.3.3.1. Paper Reference

[Musacchio09] Musacchio, J., Schwartz, G., Walrand, J.: "A Two-Sided Market Analysis of Provider Investment Incentives With an Application to the Net-Neutrality Issue", Review of Network Economics, 2009.

5.3.3.2. Presentation

This paper assesses the investment incentives of NSPs and content providers (CPs) when CPs can (and cannot) be charged by the NSPs that are not directly connected to them (access networks) for carrying their traffic, due to the overhead they cause to their networks. This differentiates it significantly from a large body of related literature where only the respective impact on prices or network costs is solely investigated, while investments are typically neglected.

The authors provide a general formulation based on the ideas of two-sided markets and compare two different regimes: one with Network Neutrality and one where CPs has to compensate the access NSPs. The authors derive the equilibrium levels of investment of content and access providers in both regimes. The directions of payments in the authors' models are illustrated in the figure below, the dotted lines indicate payments made only with two-sided pricing ("non-neutral"), i.e. between content providers and ISPs denoted as c_i and t_i respectively:

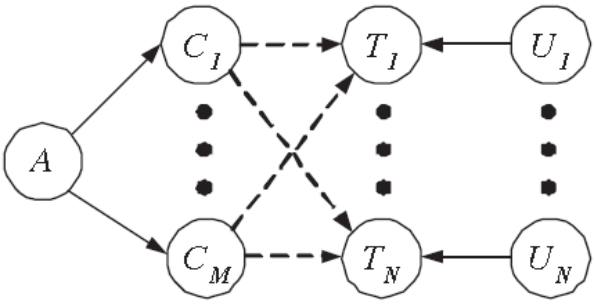


FIGURE 7 – THE DIRECTION OF PAYMENTS IN THE MODEL

Overall, this paper provides an interesting modelling of the value chain actors and identifies the potential payments among the actors by means of a graph. In their model the authors argue that it is the ISPs who first decide on their investment levels. Subsequently, the content providers respond to this choice of ISPs by

adjusting their own investments. This is justified since ISPs build their infrastructure in large time scales (e.g. by deploying fibre-optic cable) while content providers have more flexibility in shorter time scales: adding servers or more efficient algorithms takes much less time. Thus, the game is played in two stages. It is also assumed that the content providers charge a fixed amount α the advertisers. The best response functions in the game can then be computed. The authors subsequently compute the respective Nash equilibria of the two regimes and compare the revenue and social welfare attained as a function of certain model parameters.

5.3.3.3. Results

The results of this analysis is more or less inconclusive, since it is concluded that two-sided pricing (corresponding to a "non-neutral" network) is more favourable in terms of social welfare when the ratio between the parameters of the content advertising rate and the end user price sensitivity is either low or high. When this ratio is in the intermediate range, one-sided pricing (a "neutral" network) can be preferable. The intuition behind this result is that when this ratio is high, the content providers' revenue from advertising are high and the ISPs revenue from end-users are relatively low. Because of this, the incentives to invest for ISPs are suboptimal unless they can extract some of the content providers' revenue by charging the content providers. An additional interesting result is that the degree by which one-sided pricing is preferable increases with the number of ISPs.

5.3.3.4. Critique – Link with ETICS

This model is useful for the potential impact of offering differentiated QoS-aware contracts in the interconnection market and the respective payment flows among the value chain actors. The formulation provided by the authors is quite general and the model is elegant, thus capturing most aspects of the problem.

Most of the model parameters have a natural interpretation. The fact that the authors do not clearly favour one of the two regimes is also in accordance with other economists' findings (e.g. Robin Mason) who clearly argue that there is not in economic terms a regime that clearly dominates the other.

However there are some modelling simplifications that may have an impact in the authors findings: The fact that the roles of transit and edge ISP are "merged" may have an impact on the model outcome, since competition games between these two actors may impact the range of prices that are feasible in the overall market. Also, users are assumes to be single-homed and ISPs are monopolies over their users: relaxing this assumption could also differentiate the results significantly.

An interesting contribution of this paper though is that it indicates that there is a parameter, which is "exogenous" to the ISP-content providers competition game that has a big impact on the impact of Net Neutrality decisions on social welfare and investments: This is the advertising rate α. This clearly suggests that the impact of Net Neutrality on ETICS-like ecosystems can be evaluated only by considering the whole ecosystem and actors that are not limited to the ISP and content providers role. This is a valuable finding that can be used in the WP3 subsequent work to be reported in [Del3.5] where the linkage of Net Neutrality decisions on both the ETICS and the IC market as a whole must be further investigated.

5.3.4. Network Neutrality Impact on Provider Innovation and Infrastructure Investments

5.3.4.1. Paper Reference

[Krämer09] Krämer, J., Wiewiorra, L.: "Network Neutrality and Congestion-Sensitive Content Providers: Implications for Service Innovation, Broadband Investment and Regulation", September 2009. Last Accessed on April 24, 2012. Web site: http://mpra.ub.uni-muenchen.de/22095/1/MPRA_paper_22095.pdf

5.3.4.2. Presentation

This paper makes a formal analysis of the incentives for content providers and ISPs, comparing them in Network Neutrality and managed network services scenarios. The analysis is based on a model of a two-side market, with content providers on one side and Internet consumers on the other side. Each of the sides values an increasing presence of the other side and seeks for the lowest network congestion. The full complexity of networks forming the Internet is abstracted by considering a single monopolistic Internet service provider providing access to consumers and content providers, respectively.

Network Neutrality is modelled by considering the ISP only obtains revenues from consumers, charging them a fixed, flat access rate. Managed services (termed "discriminatory" in the paper) are modelled by charging those content providers willing to pay for it a fixed rate for enhanced quality of service. Those not willing to pay get a best-effort network service. Content providers have different sensitivity to network congestion, and therefore can or cannot be motivated to pay the additional fee.

Content providers are assumed to obtain their revenue exclusively from advertisement, and consumers are assumed to be accessing providers according to a regular distribution

5.3.4.3. Results

Several formulae are established to calculate consumer, provider, and ISP utility functions, discussing the assumptions and simplifications made, and how they keep the scenario aligned with real scenarios. Using these formulae, the incentives for new innovative content providers willing to join the network, for the ISP to invest in enhancing the network (by reducing congestion), as well as the cost reduction for consumers, are analysed in both a Network Neutrality and managed network services scenarios. The comparison of both scenarios according to this analysis are summarized in three propositions:

1. In the short run, "network discrimination" has no effect on innovation. The number of active content providers do not change compared to Network Neutrality, independent of the price for priority access.
2. The ISP has a short-run incentive to introduce a "network discriminatory" regime, because this allows him to collect extra profits from selling priority access to content providers. However, consumers pay the same price for network access than under the network neutral regime.
3. Under a "discriminatory regime" the ISP will invest more in network infrastructure and provide higher transmission capacity in the long run. Thereby, ISP profit, consumer access charge and content variety are higher than under a network neutral regime.

In order to gain some insights in regulatory aspects, formulae on general welfare are established as well, and applied to the analysis of how this welfare changes between the two considered scenarios. Two additional propositions are made according to these results:

1. In the short run, "network discrimination" unambiguously increases welfare with respect to the network neutral regime, because congestion is alleviated for the most congestion sensitive content providers in lieu of the less congestion sensitive content providers. However, all content providers are worse off under a discriminatory regime because the ISP expropriates the increased surplus.
2. Under the "network discriminatory" regime, the overall congestion level is reduced compared to Network Neutrality. The already positive short-run welfare effects of network discrimination are therefore even increased in the long run.

Considering a regulatory body willing to maximize welfare, the paper concludes that it would have the same investment incentives as the ISP and, therefore, that price regulation under the desired level of the platform will inevitably lead to welfare reductions.

5.3.4.4. Critique – Link with ETICS

While the model presented in the paper is necessarily a strong simplification, the rationale given for these simplifications seem valid, and the conclusions of the original equations do agree with real-world experience. A deeper analysis on how competition and non-uniform access to content providers influence the utility functions would yield results closer to real-world scenarios, as well as a model for varying consumer requirements, and the situations in which some content providers are in a dominant position.

To some extent, the "monopolistic ISP" could be associated to an ETICS-based alliance, though the possibility of competing alternative services should be considered as well.

The authors suggest in their conclusions that refining the model (at least in what relates to content provider competition and different consumer requirements) would translate in an amplified advantage of "network discrimination".

Finally, a reflection on the semantics field used in this paper and elsewhere: even in the case of studies that derive favourable conclusions to managed network services, the common terms to refer to the contending proposals are biased towards Network Neutrality. "Neutrality" itself has positive implications, especially when compared with terms like "discriminatory". Furthermore, footnote 2 in pages 3 and 4 makes a clear distinction between two kind of Network Neutrality fields, that should be stressed elsewhere: while the first (avoiding intentional traffic hampering but applying prioritization) can more exactly be termed as "neutrality", the other (avoiding any kind of traffic management) should be better qualified as "egalitarianism". Regrettably, as stated in the paper, the positive connotations of "neutrality" are often (if not always) associated to both.

5.3.5. NET NEUTRALITY AND INVESTMENT INCENTIVES

5.3.5.1. Paper Reference

[Choi10] Choi, J.P., Kim, B.: "Net Neutrality and Investment Incentives", March 2010. Last Accessed on April 24, 2012. Web site: https://www.msu.edu/~choijay/NN-Rand_Final%20Version.pdf

5.3.5.2. Presentation

The paper analyses the effects of Net Neutrality regulation on investment incentives for Internet service providers (ISPs) and content providers (CPs), and their implications for social welfare. This work complements the analysis of [Hermalin07], who analysed the market positioning of CPs in case multi-tier networks and service quality chosen, by providing a model for investment incentives where the authors

have found that capacity expansion decreases the sale price of the priority right under the discriminatory regime. Thus, contrarily to ISPs claims that Net Neutrality regulations would have a chilling effect on their incentive to invest, the possibility for the opposite is concrete. The discrimination can also weaken CPs investment incentives because of CPs' concern that the ISP would expropriate some of the investment benefits.

The paper introduces the debate around Net Neutrality and legislation initiative when started to regulate multi-tier (quality of service differentiation made by ISP for CP). There is no universally accepted definition of Net Neutrality which in principle would mean that all packets that travel through the Internet are treated equally on the basis of the first-come, first served logic. Any routing practice deviating from this principle is a violation of Net Neutrality[6]. Concerning the debate and regulatory achievements, the situation is still stalled after an initial rush around p2p services when on October 19,2007 the Associated Press (AP) reported that Comcast (cable TV Operator and ISP) had interfered (port blocking) with users access to whole-sharing sites such as BitTorrent.

The paper thus assessed the validity of conflicting claims made by opposing parties, by setting up a model based on the queuing theory, because scarce bandwidth and the potential need for rationing (due to substantial increases in multimedia usage of the Internet) are the root causes of the debate. With a monopolistic network operator and two application providers, the authors provide a formal economic analysis on the effects of Net Neutrality regulations on investment incentives for Internet service providers (ISPs) and Content Providers (CPs), and their implications for social welfare. In addition the document studies the long-run effects of Net Neutrality regulation on the ISPs investment incentives.

The proposed model finds that there are two channels through which Net Neutrality regulation can have impacts on the ISPs investment incentives:

- the network access fee effect;
- the rent extraction effect.

In the network with Net Neutrality, capacity expansion speeds up the delivery of content uniformly, thereby enabling the ISP to charge more for access. This is the current flat rate access governing most of the Internet deployment via DSL accesses.

Similarly, in the non Neutral Network, capacity expansion also increases the delivery speed of content and thus allows the ISP to charge a higher network fee. This is the PAY per USE or assured Quality of leased lines normally used for trunk or WAN interconnections.

Since such effects are asymmetric it is not possible to tell unambiguously under which regime the effect of capacity extension is larger. Hence, it is difficult to establish a model governing profitable plan for extending the capacity of the infrastructures according to the demand profiles.

Capacity expansion also affects the sales price of the priority right under the discriminatory regime. As the relative value for the first priority becomes relatively small for higher capacity levels, the ISPs incentive to invest on capacity under a discriminatory network is smaller than that under a neutral regime where such rent extraction effects do not exist. As a result, the ISPs investment incentive hinges upon the relative magnitudes of these two potentially opposing effects.

[6] It is interesting to compare this definition with the ETICS solution and its overall approach towards the regulation of assured quality of services.

It means that the neutrality of the network may be an incentive for the ISP to make investment to expand the infrastructures[7].

Contrarily to ISPs claims that Net Neutrality regulations would have a chilling effect on their incentive to invest, it cannot be said that the possibility of the opposite is dismissed.

The paper also shows that the ISPs incentives to invest in a multi-tiered network vis-a-vis within a non-discriminatory network under Net Neutrality regulation depends on a potential trade-off between the two-sides of the market:

- the network access fee from the end users;
- the revenue from content providers through the potential trade of the first-priority in delivery.

Concerning CPs, incentives to invest in cost reduction/quality enhancement as well as social welfare across different regulatory regimes exist. The authors of the paper found that the relationship between the Net Neutrality regulation and investment incentives is subtle. In any case, both are key effects that are expected to play important roles in the assessment of Net Neutrality regulations.

5.3.5.3. Description of the Model

Interestingly, the description of the reference scenario introduced to carry out the analysis is very similar to ETICS's expected scenario, with the only difference that all description are referred to the Internet.

In this model we have the following items/actors: the network operator who provides hosting services to a content provider, the ISP who provides Internet connection to end users, transit NSPs when a consumer requests specific content from a content provider. When the content is delivered, even packets comprising the same web page can travel different routes before they are assembled at the client's computer. The transit between networks is governed by a variety of peering agreements between networks. Tier 1 networks constitute the Internet backbone and have direct connections to the Internet. Tier 1 network operators interconnect with each other without purchasing transit or paying settlements. Tier 2 and 3 networks are relatively small players and purchase at least some transit from other networks to reach the Internet. These existing peering agreements between networks are given as an assumption.

The paper focuses on the market in which a local monopolistic ISP provides the "last mile" connection service to consumers and the effects occurring when the local ISP discriminates (on two tiers) content once the packets from content providers have arrived at the local ISP domain. In this case the ISP extracts additional payment from content providers as a price for "priority" delivery in the absence of Net Neutrality regulation.

Under Net Neutrality: CPs pay access fees to the hosting network operator only once at the origin and are not required to pay additional payment for "transit," which should already be covered in the existing track routing arrangement governed by peering agreements between networks. Thus, the local ISPs that provide the last mile transit to end consumers are not allowed to demand additional compensation from CPs.

Without Net Neutrality regulation: preferential treatment for a particular content provider is no longer prohibited. Then, the ISP can sell the first-priority, the right to be served ahead of the other, to either of the two content providers.

[7] Also in this case it is interesting to compare this behaviour in case of best effort network and assured quality networks.

Long Run Analysis with Investment Incentives

The Net Neutrality debate centres on future investment and innovations. In particular, one of the main issues in the debate is how the broadband operators incentive to expand capacity in infrastructure would be affected by allowing preferential transmission of content. ISPs oppose Network Neutrality regulation and claim that such regulation would discourage their investment incentives in broadband networks.

The intuition behind their claims is simple: they face an obvious free-rider problem, unless content providers who support bandwidth-intensive Internet traffic pay a premium.

5.3.5.4. ETICS Impacts

The most probable scenarios for final Network Service Provider (NSP) offers in ETICS architecture are essentially based on two different approaches. The first one is the "pull model", in which the ETICS community starts computing the composition of NSP products only upon the reception of a customer request. In the alternative "push model" Network Service Providers (NSPs) push their offers in a repository and products are pre-computed in the form of well-defined final offers. These offers need to be shared by other members in the community in order to be able to compose a final product.

From the market and economics point of view, the pull feature is intrinsically more suitable to discover customers' expectations, instead in a mature Assured Service Quality (ASQ) market, a segmentation of highly demanded offers may provide cost benefits to the push model.

From a regulatory point of view, the push model may be perceived as more open with published offers stimulating competition, but over time the multiplication of demands should bring a similar visibility on the different offers in the pull model. About composition offers, in the push model, the fully centralized model could intrinsically provide more neutral market behaviour. This model must act for the global sustainability of the ecosystem, maximizing the social welfare of customers having access to Assured Service Quality (ASQ) goods but also providing incentives for Network Service Providers (NSPs) to participate.

In most cases network operators who provide hosting services to a content provider (CP) would be different from the Internet Service Provider (ISP) who provides Internet connection to an end consumer. Thus, when a consumer request specific content from a content provider need to traverse several different networks. The diversity is governed by a variety of peering agreements between networks (i.e. ETICS community).

Content providers (CPs) investments under Net Neutrality are characterized by the marginal cost-benefit comparison, instead in a discriminatory network marginal benefit from investments depends on whether or not such investment receives the priority: for that reason, CPs are forced to reach agreements with NSPs. In the vertical integration scenario between NSP and CP the possibility that NPSs may confer advantages to use services from hosted CPs with respect to competitors appears implicitly: in fact the allocation of the first-priority, the right to be served ahead of the other, without Net Neutrality, is reserved to hosted CPs, causing impacts on NSP's capacity investment and profitability of price increase in the ETICS pull model. This is suitable also under Net Neutrality regulation, without allocation of fist-priority, by using services from hosted CP.

The horizontal integration scenario among multiply NSPs, when governed by common objectives and rules agreed by participating Network Service Providers (i.e. ETICS community with ASQs among multiply NSPs), and on which CPs provide services using ASQs, encourages investment incentives in broadband networks.

5.3.6. NETWORK NEUTRALITY AND NSP PROFITABILITY

[Dhamdhere08] Dhamdhere, A., Dovrolis, C.: "Can ISPs be profitable without violating Network Neutrality?" NetEcon'08, August 22, 2008, Seattle, Washington, USA.

5.3.6.1. Presentation

The paper studies access network providers' (AP) strategic options for retaining profitability under the pressures arising from future Internet traffic growth. Such traffic growth, mainly driven by on-line video, may require carriers to make large capital investments, which will not be accompanied by revenues increase. Some APs are against NN and argue that they want to be able to charge Content Providers for shipping content to their customers and that if NN is preserved they would not be able to invest in expanding their networks, at the detriment of the whole Internet ecosystem The paper analyses some of the most commonly envisaged strategies that APs could adopt to retain their profitability with the objective of understanding whether violation of "net-neutrality" is necessary to sustain their business or whether APs' can prosper without violating "net-neutrality" principles. More specifically the following strategies are considered:

1. *AP charges heavy-hitter subscribers based on usage* in proportion to the volume downloaded. In the paper it is assumed that the AP charges customers based on volume that exceeds a given threshold "T".
2. *AP charges CP/CDN ("non net-neutral strategy"):* in this case the AP charges CP/CDNs a fee based on usage. They consider a discriminatory regime where APs only charge a fraction of top CP/CDNs.
3. *Selective peering with popular content providers ("net-neutral strategy").*
4. *Cashing content from content providers ("net-neutral strategy")*

The analysis is based on a simplified network model of the interactions between an AP, a transit provider (TP) and multiple CPs (see *FIGURE 8*). It uses analytical expressions for AP's peering, transit and operational cost functions and focusses on AP's profit arising from the above four strategies against a baseline strategy where AP does not apply usage-based charging and does not selectively peer or cache CP. The AP's baseline revenues derive from residential broadband customers. Its costs are assumed to have fixed and volume-dependent elements and arise from transit, peering, as well as internal operational costs. Volumes are derived by taking a bottom-up approach: customers generate traffic in line with a truncated Pareto distribution and such traffic is then associated to the various CPs with CPs' popularity described by a Zipf distribution.

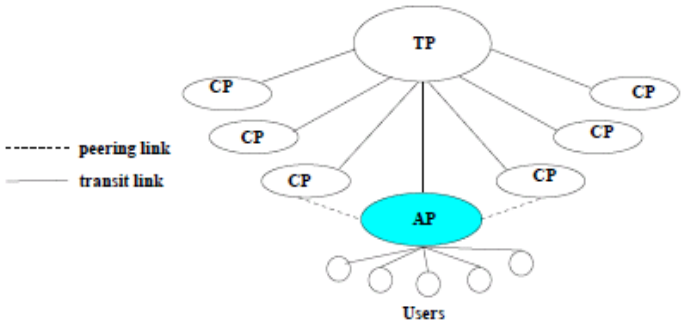


FIGURE 8 – NETWORK MODEL

5.3.6.2. Main findings

- With the baseline strategy, the AP's profitability would be increasingly unpredictable, as greater broadband speed could lead to erratic usage mean and variance. In addition the growth in proportion of video traffic would result in comparatively greater increase of the AP's transit costs since transit costs are incurred on traffic 95th percentile and video traffic gives rise to a ratio between 95th percentile to average traffic ~4:1 different from 2:1 typical of web traffic.
- The analysis of strategy 1) found no robustness around the choice of threshold T beyond which the ISP would charge heavy hitters subscribers. Hence a possible sub-optimal choice of threshold T could lead to less profit for the AP than with the baseline strategy. Hence this strategy could have an unpredictable impact to the AP and its profits would depend upon the probability of customers (not only the heavy hitters) switching to a different provider if such usage-based charged were introduced.
- The analysis of the "non-net-neutral" strategy 2) where AP charges top CP/CDNs also shows potential for unexpected outcome for the AP. This strategy in fact could be disfavoured by the AP's customers who could switch to another AP. Again depending on customer departure probability this could leave the APs worse off; additionally there would be the risk of transit costs' increase for the AP (if CP/CDN refused to pay and shipped AP's traffic through its transit provider).
- Both strategies 3) and 4) would incur no risk of disputes/bad publicity from violation of "Net Neutrality". Strategy 3) is shown to consistently provide equal/greater profits versus the baseline and seen particularly beneficial if cost of peering with top CP/CDNs is minimal. Strategy 4) would be particularly advantageous if the cost of caching were negligible compared to transport cost. Hence, unlike with 1) and 2), the AP has greater control on its profitability with both strategies 3) and 4) as it could decide when to selectively peer and whether to cache depending on associated costs and caching efficiency.

5.3.6.3. Critique – Link with ETICS

The model provides an analytical framework that allows evaluating an AP's strategic options for sustained profitability. The AP's cost functions, relative to peering, transit, and operational costs reflect fixed and volume dependent elements, attempt to capture different economy of scales, and use parameters fitted with market figures. The network model's simplifying assumptions seem justifiable and adequate for a first cut analysis considering the nature of its conclusions. Considering a more detailed model accounting for example of topology and distance-dependent cost functions would have minor impact on the confidence of its findings.

The paper studies content delivery strategies for APs without a distinction between *best-effort* and *managed* services which, in line with EU NN regulatory positioning, are designed to exist alongside "best-effort" traffic and provide quality assurances. Since the paper has the underlying assumption that traffic is *best-effort* only it has limited applicability for ETICS. It provides fairly intuitive conclusions on desirability and drawbacks associated with the considered strategies, without accounting for competitive market forces which may have greater effects than costs. Caching and distributed peering are indeed approaches that have been adopted by some APs both in Europe and in US in order to reduce their transport costs. However, reducing costs are not necessarily the driving force behind caching and distributed peering. In fact, these approaches are not favoured by all APs since strategically caching and deep-peering closer to eyeballs could

undermine their current/future services. Hence despite charging CPs being a more risky strategy for APs, it is increasingly being favoured and some carriers such as Comcast, Verizon, AT&T, DT, Orange, and Telefonica have implemented paid-peering for unbalanced traffic with the majority of the "Hyper Giants". Nevertheless not all APs have been able to demand such "entry fees" on grounds of unbalanced traffic; one of the reasons behind this is believed to be market power as not all last-mile providers operate in the same competitive environment.

5.3.7. Application Neutrality and a Paradox of Side Payments

5.3.7.1. Paper Reference

[Caron10] Caron, S., Kesidis, G., Altman, E.: "Application Neutrality and a Paradox of Side Payments," In Proceedings of the Re-Architecting the Internet (ReARCH '10).

5.3.7.2. Presentation

The work of Caron et al. [Caron10] investigates the effects of side payments on Net Neutrality by extending the work of [Altman10] for the non-monopolistic case. Out of many relevant aspects, this work focuses on the analysis of content neutral in terms of "side payments among providers and application neutrality". Methodologically, this works has concentrated on „usage-priced game-theoretic "approaches aiming for the quantitative analysis of Nash Equilibrium Points (NEPs). Throughout this work the cooperation such as coalition formation is ruled out. Other relevant assumptions and fundamental definitions are summarized as follows:

- There is a willingness of end users to pay for monthly and usage-based service fees –service of NSP and Content Provider (CP). Provider may also opt for flat prices curves.
- Competition on monthly fees, service quality, and service type are not considered
- The demand of NSPs and CPs is expressed by a single aggregated demand metric
- The service provided by NSPs and CPs are paid by end users, who do not differentiate to whom the price is paid
- Players: End users with given demand-response behaviour, Edge NSPs providing Internet access, and Content Providers (CP)

Neutral Non-Discriminatory Setting – No Side Payments. The service demand is represented by a linear demand-response model reducing the maximum demand (only monthly fees) due to usage-based fees from the NSP and the CP. Price differences may be partially compensated by users' loyalty towards providers ("end user stickiness"), which is calculated as function of the price charged by the provider. A game-theoretic analysis is then formed around the revenue functions of NSPs and CPs.

Non-Neutral Discriminatory Setting – Side Payments. The non-discriminatory setting is thereafter extended by usage-based side payments between NSPs and CPs. The provider with higher demand, in particular, always compensates the other entity of its efforts. The level of this side payment is fixed in this model in order to avoid the drop out of players when prices are modified unilaterally. On this basis, again a game-theoretic analysis is placed, where every provider is assumed to independently pick the best responses.

Application Neutrality. The effects of application-differentiation in networks are investigated on the basis of two exemplary CP types: web surfing and P2P. In the neutral case (without application-differentiation), two

different demand curves (web, P2P) with equal usage-based prices are formed. The users readiness to pay more for one service, e.g. P2P, than for another, as well as service-specific variations in price sensitivities are captured in dedicated factors.

5.3.7.3. Results

Side Payments. Without side payments, NSPs' competition is beneficial for customers, as the demand increases with the number of NSPs and CPs. In turn, also CPs profit form increasing numbers of NSPs and vice-versa–rendering the appearance of a two-sided market as discussed in [Del3.2]. With the introduction of side payments the two NEPs can only be reached when side payments are small (4.64% of the maximum price based on an analysis of demand sensitivity). Although both NEPs strongly differ in their demand and revenue levels, they share the paradox that receivers of side payments receive less revenue than others.

Application Neutrality. In the application neutral case, any solution of the model represents a NEP. Whereas in the non-neutral case only one NEP solution results. Comparing both cases, Caron et al. argue that P2P CPs seem to profit from neutral regulations, whereas NSPs and Web CPs prefer the non-neutral model. This result is agnostic to the variation of competition levels.

5.3.7.4. Critique – Link with ETICS

The discussed work highlights a series of interesting and very specific pricing aspects relating to Net Neutrality issues, which may need to be complemented by further specific analysis work. The most interesting outcome for ETICS may be the critical inspection of side payments, which seem to yield unbeneficial consequences for the system, but especially for those receiving those payments. Hence, ETICS may focus on economic models avoiding such constellation. Another interesting implication may be derived from the results of application-neutrality analysis: P2P customers (or other users with high demands) seem to benefit from the system on the expense of other users, which may be regarded as unfair preference of such customers. Nevertheless, ETICS's connectivity services may be considered as mostly independent from application-neutrality issues.

These results are subject to some notable drawbacks, which are critically inspected as follows:

- It may be questioned, if the market can overcome the prevailing flat rate pricing model or if NSPs would automatically tend to offer flat price curves again. The assumption of an existing demand under this model may, hence, be subject to competitive forces.
- The loyalty of customers is mainly subject to price of all competing providers, which leaves branding or long-term customer relationship effects untouched.

The assumption of comparable demands of NSPs and CPs yielding side payments may be too simplistic, as services may not be directly comparable. However, the usage of comparable demands and services may make the transferring from games between NSPs and CPs to games among NSPs (Edge, Transit) more realistic.

5.4. IMPACTS OF NET NEUTRALITY ON CARRIERS

Carriers are the main opponents of Net Neutrality, and argue that tiered service, or data prioritization, is a legitimate business model. The increasingly popular video and audio applications on the Internet put a high bandwidth demand on their networks. Tiered service can provide desired quality of service to different applications and recoup the capital investment used to upgrade their networks. Some opponents dislike the idea of regulation in principle, arguing that market forces are sufficient to regulate what broadband ISPs would do. If one ISP blocks contents or applications that consumers desire, consumers would switch to a different ISP [Yang06].

There is great disagreement, however, about the future implications of Net Neutrality as the Internet progresses and as the economic communications landscape changes. Proponents of Net Neutrality (generally, application providers and consumer groups) argue that without a prohibition on discrimination, Internet Service Providers (ISPs) may charge application providers discriminatory prices for access to dedicated bandwidth or for quality of service (QoS), or may outright block access to certain applications or websites, and that such activity will inhibit development of new Internet applications. Most proponents believe that ISPs should not be allowed to charge for priority access to the Internet portion of their service offerings. Opponents of Net Neutrality (generally, ISPs) argue that there is no current problem, that competition is sufficient to ensure that commercially negotiated arrangements for bandwidth or QoS will not negatively impact consumers, and that any regulation will discourage investment in network infrastructure [Jordan07].

The following analysis starts from a study about the evolving Internet interconnections market and its dynamics, with the focus on the interaction between different Net Neutrality regulations and possible alternative business models [Friederiszick11].

The aim of this research is to study whether and how the Internet economic model needs to evolve and what role regulation should play in this process, taking into account the implications of Net Neutrality regulation on some possible Internet business models.

Studying the developments of the Internet it has been found that the current business model might not be sustainable in the future for NSPs. The main features of the industry and resulting challenges that lead to this conclusion are described by the following stylized facts [Friederiszick11]:

- traffic is expected to increase significantly, in particular due to video-based applications;
- over the course of the day, traffic volumes fluctuate greatly and high levels of congestion might be reached;
- new applications such as 3DHD video, cloud gaming, and video conferencing require high-quality transmission standards;
- end consumers are currently priced such that they experience little or no incentive to control the traffic they generate;
- peer-to-peer applications might jeopardize the payment balance under traditional transit agreements;
- network management practices allow a more cost-effective way to satisfy demand than over-provisioning;
- content providers earn the largest share of the overall revenue in the Internet value chain;

- the segment of content providers is becoming increasingly concentrated.

On this basis alternative Internet business models could emerge or become more prominent in the future from the point of view of ISPs' profit maximization. Having identified the dimensions that business models can potentially cover and examined which characteristics of the identified dimensions constitute potentially important elements of future business models, four different business models are proposed. Each one of those focuses on a different aspect.

- **"Congestion-Based Model"** stresses the possibility to tackle congestion problems through congestion-based pricing, however, no quality differentiation is introduced. Specifically, in this business model ISPs are assumed to charge content providers higher prices for traffic in peak periods than in off-peak periods. For example, the cost for a provider of movie downloads of an end user downloading an HD movie during the peak evening period could be significantly higher than if the same movie was downloaded in the early morning hours or within a 24-hour period. End users in this business model can choose between flat rates with differentiated data caps.
- **"Best Effort Plus"** considers a two-tiered Internet structure. It preserves the traditional best effort network for traditional (existing) services and assumes that content providers and end users are priced as in the status quo if they operate on the best effort level. However, these restrictions do not apply to innovative future services, for which pricing and guaranteed service requirements follow individual negotiations between the eyeball ISP and the content provider The Internet as we know it would keep operating under similar principles as it does today, but there would be more flexibility in the provision of novel services and the pricing thereof. For example, an ISP could charge a premium price from an innovative e-health service provider in return for guaranteeing a specified level of transmission quality (premium service). This model implies that there is a greater level of vertical cooperation between ISPs and content providers necessary to implement quality guarantees. Future innovative services would remain unregulated; however, policy makers and regulators would have to define what defines an innovative service and which type of service is thus exempted from Net Neutrality regulation.
- **"Quality Classes – Content Pays"** stresses the perceived need of different applications for various degrees of quality of service and offers different quality classes open for different applications. Unlike in the previous business model, the quality classes encompass all services, including currently available traditional services. Depending on their requirements, content providers could purchase the transit quality most appropriate for its type of content. For example, a content provider offering HD movie streaming or gaming services requiring low latency would purchase a more expensive premium quality class to ensure the quality of experience for end users. In contrast, for delivering an e-mail a cheaper, lower priority class could be chosen. It would become the ISPs responsibility to deliver the quality of service paid for by the content provider. In other words, content providers could choose to pay a premium price for a higher quality of transmission of their data. End users would still pay a uniform flat rate in this model and experience the quality as chosen by the content provider.
- **"Quality Classes – User Pays"** puts the focus on consumer choice for higher quality levels and offers multiple quality classes for end users that are designed to match their different usage patterns. For example, end users who frequently use interactive applications might choose the quality class which is more suitable for dealing with such applications, that is, that offers a low level

of delay and jitter. Other users, who focus on multimedia applications, might choose another quality offering characterized by low packet loss and high bandwidth, and so on.

Given the complexity of the Internet and the broadness and variations in business models, which may partially coexist with each other, a rigorous assessment within a unique theoretical framework is not feasible. For this reason a number of fairly general and robust results from the economic literature are defined and considered for the assessment of the expected effects of new business models from the social welfare point of view. Each of the business models may lead to a different overall welfare implication as well as to different financial transfers across market participants.

In the analysis carried out are identified the major impacts linked to each business model:

- The **"Congestion-Based Model"** reduces congestion and allows more efficient utilization of the existing infrastructure. However, it is unlikely to provide sufficient incentives to entirely eliminate congestion. Still, it offers an increased participation of (light) users and increased incentives to invest in infrastructure due to better utilization. Content providers will be negatively affected in so far as they produce heavy traffic and cannot shape the traffic according to peak times. To the contrary, off-peak services (and investments in such services) could rise. From a broader policy perspective a minor drawback is that uncoordinated implementation can lead to increased complexity for content providers as well as subsequently end users.

- In the **"Best Effort Plus"** scenario ISPs gain the option to offer premium services to content providers who need their content delivered at a premium rate (value added service). Guaranteed reserved bandwidth for priority novel services would ensure their quality or even viability, and thereby induce the creation of new services. Prices for best effort services are not expected to change. However, end users have additional access to separately marketed innovative services. However, the risk of foreclosure due to exclusive agreements and bundling strategies might be increased. This concern is alleviated within the European environment with its existing access regulation.

- For the **"Quality Classes – Content Pays"** model higher qualities facilitate new content. Charging content providers rather than users for the higher quality levels is likely to maximize the value of the platform, and thereby increases incentives to invest both in infrastructure and content. The model, however, introduces a risk of under-investment into the infrastructure due to a strategic incentive: degrading quality in best effort might hike up the price for higher quality levels. The effect is substantially reduced or even eliminated, though, in an environment with limited market power of individual ISPs in the best effort segment. In so far as the model proves to be problematic, a minimum quality of standard regulation might be required.

- The **"Quality Classes – User Pays"** model also facilitates new content through higher qualities. However, charging users rather than the content provider for the higher quality levels is likely to lead to lower value and lower incentives to invest for the platform than in the previous business model. The regulatory risk related to foreclosure strategies seems smaller though: the ability of a dominant ISP to favour a vertically-integrated content provider is lower. Both business models, "Quality Classes – Content Pays" and "Quality Classes – User Pays," bear the risk of fragmentation in so far as no common Internet standard emerges.

The implications of various forms of Net Neutrality regulation on those NSP's business models are taken into account.

Net Neutrality regulation, if and when formally implemented in some shape or form, has the potential to reallocate resources among industry participants, affect optimal pricing strategies and affect their investment and innovation incentives. Through these effects, the shape of Net Neutrality regulation is going to affect which business models are going to be at all feasible, which are going to thrive, and which are going to become obsolete. Therefore, when assessing the potential impact of Net Neutrality regulation, one needs to consider how the regulation may affect future business models and the costs and benefits associated with them.

The impact of different regulatory choices for Net Neutrality on the business models proposed is analysed as follow:

- The implementation of a **strong form of Net Neutrality** prevents "Best Effort Plus" and "Quality Classes - Content Pays," but still allows the other two business models. This implies that some benefits of these new business models can be reaped with Net Neutrality regulation whereas other efficiencies cannot materialize: congestion-based pricing could decrease congestion to some extent and the ability to have differentiation quality classes for end users would open the possibility for higher quality content offerings. However, charging users rather than content providers for the higher quality levels is likely to lead to lower value and lower incentives to invest for the platform than a scenario where the content provider (also) pays. Furthermore, it might still be the case that delay-sensitive content is crowded-out of the network.
- In contrast, the implementation of a **weaker form of Net Neutrality** would enable the adoption of a business model which prices content providers for higher qualities. The comparison between content pays and user pays scenarios involves the following trade-off: the increased risk of foreclosure in the content pays model must be weighed against inefficiency related to pricing the consumer side.
- Finally, under the "Best Effort Plus" model any **Net Neutrality regulation could only apply to traditional services** while novel innovative services would not be subjected to these rules. Ultimately, the crucial comparison is between this type of regulation versus a modest, but comprehensive Net Neutrality regulation. This comparison is, however, very complex and involves the quantification of effects as both models tend to increase the participation of end users and both open the way for content demanding higher quality of service.

As a consequence, in implementing the new EU regulatory framework for electronic communications, policy makers and regulators should carefully consider its impact on business models and the foregone benefits associated with those models in the short and long run. Since it is difficult to predict with any certainty which business models will dominate in the future, economic analysis suggests that authorities apply a patient "wait and see" approach: closely monitoring market developments and forcefully reacting to any emerging competitive threats rather than acting pre-emptively and therewith preventing some beneficial business models from developing.

6. THE INTERPLAY BETWEEN BUSINESS, LEGAL AND SOCIOECONOMIC DOMAINS

6.1. AIM, SCOPE AND METHOD

In the previous sections, we have presented and discussed the core impacts in the domains of Business (Section 2), Socioeconomic (Section 3), Legal (Section 4) and Net Neutrality (Section 5), which have relevance for the ETICS project. Still, while those sections offer a detailed discussion for each impact of the given domain under scrutiny, they largely consider such impacts as stand-alone items: as a result, the proposed discussion may not be sufficient to draw the necessary insights on the existence of both intra-domain and especially inter-domain synergies, dysergies (i.e. negative synergies) and potential mutual interactions among impacts.

Section 6 aims at closing this potential gap, addressing how the listed impacts pertaining to the four domains[8] mutually affect one another, in order to synthesize the previous stand-alone analyses in a unified vision.

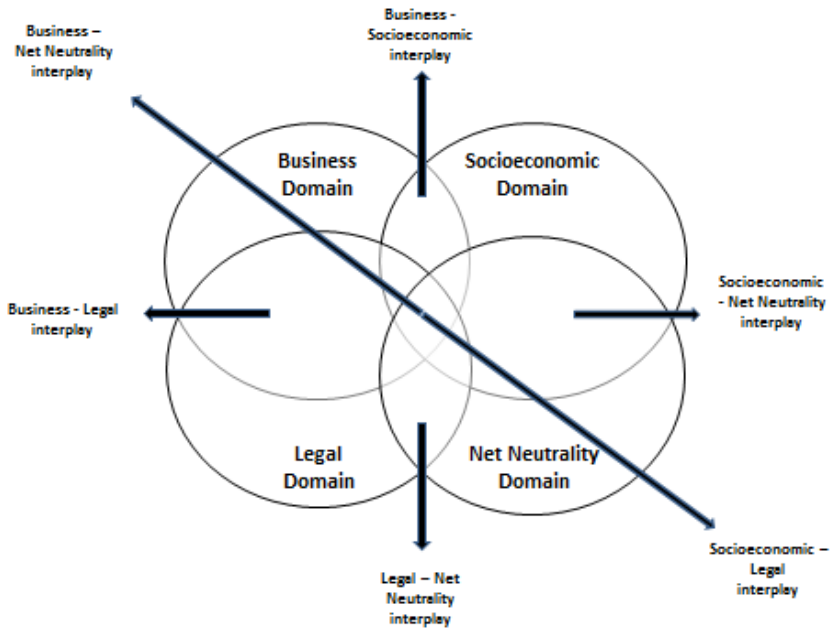


FIGURE 9 – THE JUXTAPOSITION OF THE BUSINESS-LEGAL-SOCIOECONOMIC-NET NEUTRALITY DOMAINS, AND THE RESULTING INTERPLAYS

Specifically, as *FIGURE 9* shows, **six combinations of interplays** emerge and are consequently investigated:

1. **Business – Legal interplay (B – L);**
2. **Business – Socioeconomic interplay (B – S);**
3. **Business – Net Neutrality interplay (B – N);**

[8] Note that the concept of "domain" and its derivatives (intra-domain; inter-domain) refer and pertains to the four "areas" or "categories of impacts specified at the beginning of the section (i.e. Business, Socioeconomic, Legal, Net Neutrality). Thus, it shall not be confused with the notion of domain or inter-domain services for ETICS in a technological sense.

4. **Socioeconomic – Legal interplay (S – L);**
5. **Socioeconomic – Net Neutrality interplay (S – N);**
6. **Legal – Net Neutrality (L – N).**

In order to perform the interplay assessment process, a system of tables and matrixes is proposed, which is organized in the following steps:

1. Provisioning of a list of impacts for each of the four domains (extracted and synthesized from Sections 2, 3, 4, and 5);
2. Assessment of intra-domain cross-effects of impacts for each of the four domains, so as to highlight how impacts within the same domain mutually affect one another;
3. Assessment of impacts mutual interdependencies, so as to investigate the potential cross-domain nature for each and every impact; assessment of inter-domain cross-effects of impacts, so as to highlight and discuss how each and every impact of a given domain may mutually affect other impacts belonging to different domains.

The next subsections disclose the outcome of each of these steps.

6.2. STEP 1: LIST OF IMPACTS FOR THE FOUR DOMAINS

The first step consists in listing the core impacts for the Business (B), Legal (L), Socioeconomic (S) and Net Neutrality (N) domains. Impacts are extracted from the detailed discussions presented in from Sections 2, 3, 4, and 5.

The following tables synthesize the core ETICS impacts for each domain.

ID	BUSINESS IMPACT NAME
B1	REVENUES
B2	CUSTOMER GROUPS
B3	COSTS
B4	QUALITY & INVESTMENT
B5	MARKET & COOPERATION

TABLE 54 – BUSINESS CORE IMPACTS

ID	LEGAL IMPACT NAME
L1	MONOPOLY & OLIGOPOLY
L2	CARTEL, PRICE SETTING & OFFER CONTROL
L3	CONTROL OF CONTENT AVAILABILITY
L4	SLA ENFORCEMENT & END-TO-END COMPLIANCE
L5	DENIAL OF SERVICE

TABLE 55 – LEGAL CORE IMPACTS

ID	SOCIOECONOMIC IMPACT NAME
S1	INTERCONNECTION AGREEMENTS STRATEGIES
S2	INVESTMENT & CAPACITY PLANNING FOR BEST EFFORT VS. ASQ SERVICES TRAFFIC
S3	USAGE OF ASQs AS PEERING SUBSTITUTES
S4	PRICING & REVENUE SHARING
S5	ROUTING
S6	HIGH-VALUE APPLICATION DEPLOYMENT AND NETWORK PERFORMANCES
S7	MONITORING & MARKET TRANSPARENCY
S8	ENTRY BARRIERS & THRESHOLDS

TABLE 56 – SOCIOECONOMIC CORE IMPACTS

ID	NET NEUTRALITY IMPACT NAME
N1	INNOVATION IN INTERNET SERVICES
N2	DISCRIMINATION, DEMOCRATIC PARTICIPATION AND ACCESS TO INFORMATION
N3	NETWORK INVESTMENTS SUSTAINABILITY
N4	SERVICE VARIETY
N5	REGULATORY ACTIVITY

TABLE 57 – NET NEUTRALITY CORE IMPACTS

Net Neutrality main impacts are here summarized on the basis of Section 5 discussion ([Yang06] [Economide09] [Jordan07] and others, see the Chapter 5):

- **N1 – innovation in Internet services.** Non Net Neutrality exceptions may influence innovation, mainly because of new firms with small capitalization (or those innovative firms that have not yet achieved a significant penetration and revenues), e.g. freemium models like Dropbox, who will very likely not be able to access network services, as well as already established Internet companies who can rely on an existing paying customer base allowing them to pay much more than others to access high quality network connections to provide their services (e.g. Netflix). Also, futuristic models might be envisioned, where, for instance, newcomers Application Providers of premium services are initially given a free access to premium transport, while starting to pay the NSP a share of their revenues (rather than a fixed fee) as soon as they become sufficiently consolidated and established: such option, allowed by Non Net Neutrality exceptions, might be configured as an innovation sponsorship by NSPs, which promotes and bets on innovative services, and could be beneficial for the whole ecosystem in the long run.
- **N2 – discrimination, democratic participation and access to information.** Net Neutrality on fix and wireless networks can provide an easy possibility to access and share information among the Internet users (for instance, the use of social network during the recent riots in Egypt or Iran). This defines the democratic impact of easy-to-access Internet services provided with strict Net Neutrality compliance. A symmetric impact of this variable is the possibility to control illegal

activities using techniques able to monitor and, if necessary, block services that are not legal in some countries. Examples of such services are: peer to peer file sharing and social network that enable subversive activities (e.g. discussion on independence in some country, also in Western Europe) or illegal content (in some case, this blocking action is considered).

- **N3 – network investments sustainability.** Opponents of strict Net Neutrality (e.g. NSPs) argue that tiered service can provide desired quality of service to different applications and recoup the capital investment used to upgrade their networks (the increasingly popular video and audio applications on the Internet put a high bandwidth demand on their infrastructure).
- **N4 – service variety.** Net Neutrality has implications regarding quality of access ensured to customers, price of access to content and applications, and concerned with all forms of differentiation (also those that are anticompetitive, discriminatory, or unreasonable). For example, an ISP could charge a premium price from an innovative service provider in return for guaranteeing a specified level of transmission quality (premium service).
- **N5 – regulatory activity.** The issue on Net Neutrality implies that the authorities of individual countries shall decree a Net Neutrality law, regulating the different aspects of Net Neutrality for all the stakeholders involved (e.g. NSPs and Service providers that provide Internet Access and Services) in order to assure the desired social welfare. The impact of this variable strongly depends on how (which actions) and how much (with which intensity) it is used by the body in charge of it (this is clear comparing developing countries and developed countries, but also benchmarking different EU countries).

As a whole, twenty-three impacts are identified and considered, divided as follows:

- five impacts for the Business domain;
- five impacts for the Legal domain;
- eight impacts for the Socioeconomic domain;
- five impacts for the Net Neutrality domain.

These sets of impacts constitute the input for the interplay assessment. **It is to note that, while this subsection proposes a rigid classification for impacts as classified in previous sections, sometimes the boundaries of the classification are subtle: impacts may be border-line, belonging to both categories.** This is especially the case for the Business and the Socioeconomic domains (e.g. S1, S4 and S8 may be labelled as business impacts as well), and for the Legal and Net Neutrality domains (e.g. N2 and N5 are basically legal impacts). It is the objective of Subsection 1.4 to further explore any multiple dependence of impacts to different categories.

6.3. STEP 2: ASSESSMENT OF INTRA-DOMAIN CROSS-EFFECTS OF IMPACTS

As mentioned above, the simple discussion of impacts as single entities shall not drive to overlooking the complex interplay which may occur among them. The second assessment steps, hence, consider any intra-domain cross effect or correlation among impacts, that is, impacts of a given domain mutually affecting other impacts within the same domain.

Impacts may have synergic effects, i.e., mutually reinforce each other, or a so called dysergic effect, where a negative correlation arises and the rise of one determines the fall of the other; controversial or

non-generalizable effects may also occur, as one or both impacts are characterized by complex, multi-layered cross-effects which vary according to the specific context or case.

This steps focuses on providing a discussion of intra-domain positive or negative reciprocal influences through a set of tables, which follow the key below:

- ↑↑ Strong positive correlation (strong synergy);
- ↑ Positive correlation (synergy);
- N.G. Non generalizable or controversial correlation;
- ↓ Negative correlation (dysergy);
- ↓↓ Strong negative correlation (strong dysergy).

For a more complete discussion, it is argued that the side, direction and cause-effect relations of the correlation also matters in identifying the mutual influence: this allows accounting for cases where a given impact occurs prior than another, or determines it. Accordingly, both-ways correlations are considered: i.e., Impact X on lines may affect Impact Y (e.g. positive correlation) on column, while Impact Y may have a potentially different effect (e.g. non generalizable) on Impact X.

Considering the **Business intra-domain cross-effects**, the following interplays are highlighted.

B1 – B2: Price discrimination based on customer groups, service offers, or network characteristics may improve the revenue levels of NSPs. As ASQ services are only introduced, if beneficial for the providers, we can assume that there has to be a revenue effect based on satisfying further service demands.

B1 – B4: Increasing revenues may help to maintain a sustainable environment for investments in network quality. A transitive relationship to customer groups may also be considered here, as motivator for the potential revenue growth (see B1 – B2).

B1 – B5: The possibility of combining several ASQ offers to a single offer (or reselling an already bundled offer), may further trigger the revenues and may be positive for the revenue of NSPs, as NSPs can better bundle ASQ segments to the needs of their customers. Especially, smaller NSPs may have the opportunity for better integration in ETICS's cooperation model also potentially leading to revenue effects.

B2 – B3: ASQ services may have the potential to replace other more inefficient technologies, e.g. leased lines, by enabling IC QoS differentiation on a common infrastructure. Hence, cost reductions may arise by analysing today's QoS offerings for specific demands, e.g. telepresence offers. In addition, better traffic forecasting may be enabled by price discrimination of customer groups (provide incentives for early reservation of resources etc.).

B3 – B5: Broader variety of required QoS assured network segments through NSP cooperation (satisfying present demands) may reduce costs for offering end-to-end ASQ services to end customers. Especially smaller providers with limited access to peering agreements may profit from such a shift.

Positive correlations are substantially symmetric (for more argumentation details, see Section 2.3).

	B1	B2	B3	B4	B5
B1		↑↑	N.G.	↑	↑
B2	↑↑		↑	N.G.	N.G
B3	N.G.	↑		N.G.	↑
B4	↑	N.G.	N.G.[9]		N.G.
B5	↑	N.G.	↑	N.G.	

TABLE 58 – BUSINESS INTRA-DOMAIN IMPACT CORRELATIONS

For the **Legal intra-domain cross-effects**, the following correlations are identified:

L1 – L2: The presence of monopolies or oligopolies strongly facilities the rise of cartels and price setting/offer control vicious mechanisms. The same applies for the symmetric effect (L2 – L1), where price and offer control situations may lead to the formation of monopolies. Such strong positive correlation has anyway a negative effect on the value systems' welfare and sustainability.

L1 – L3: The rise of a monopolistic/oligopolistic role in the chain of interconnected parties may increase the complexity related to risk of having a single entity (or a small cartel) controlling what content is made availability available to users. This market power towards content owners and service providers may result in setting unfair policies to enforce such monitoring activities for content dissemination. Such disergy holds true also for the symmetric case (L3 – L1).

L1 – L4: It is possible to argue that monopolistic possessors of key assets may easily force other parties acting as partners in the market to accept and comply to SLAs set by the monopolist itself, thanks to its significant bargaining power. Such SLAs, however, are likely to reflect the interest of the monopolist alone, rather than the whole ecosystem's benefit and fairness. On the contrary, a monopolist may be hardly constrained by SLAs set by parties with lesser market power (L4 – L1).

L1 – L5: It is arguable that the presence of bargaining power unbalances in the network could increase the risk of falling into denial of service cases (with specific reference to Internet service interruption among networks).

L2 – L3: As for (L1 – L3), scenarios where the offer is controlled by a cartel and price is set should increase complexity in content availability management in a monopolistic way, deterring some dissemination of content and setting market entry barriers for small players. This also happens for (L3 – L2).

L2 – L4: Cartels may find it easier to control SLAs, as they are basically part of the offer they control, and often deal with prices and incentives/penalties system; on the contrary, enforcing SLAs is negatively correlated to the presence of offer and price constraints somewhere in the supply chain (L4 – L2).

L2 – L5: Price setting and offer control attempts may lead to denial of service issues, so the two effects are positively correlated (even though such positive correlation leads to criticalities in the ecosystem).

[9] Although it may be seen as negative correlation when costs are reduced that absolute network investments may also go down, we argue that this may not negatively affect the quality perceptions of users.

L3 – L4: Control of content availability is strongly in synergy with SLA enforcement and compliance, as the former policies can be well included in the latter agreements. The strong positive correlation applies either way it is looked at (L4 – L3).

L5 – L3: Denial of service cases may create severe breaches in content availability policies.

L5 – L4: Breaking service supply is detrimental to SLA enforcement and compliance.

	L1	L2	L3	L4	L5
L1		↑↑	↓	↑	↑
L2	↑↑		N.G.	↑↑	↑
L3	↓	N.G.		↑↑	N.G.
L4	↓	↓	↑↑		N.G.
L5	N.G.	N.G.	↓↓	↓↓	

TABLE 59 – LEGAL INTRA-DOMAIN IMPACT CORRELATIONS

Within the **socioeconomic domain**, several intra-domain cross-effects are identified:

S1 – S2: A controversial correlation exists, as the long-term strategic decision to use ASQ (either as a strict complement to the Best Effort services, or as a gradually substitution of the free Best Effort services) has fluctuating effects on interconnection agreement strategies and the respective dimensioning decisions for the Best Effort and premium part of the network. In [Del3.3] we have already provided sample examples where the impact of ASQ services in both Best Effort and premium services (and capacity investments) can be positive, but examples to the contrary can also be found (similar inefficiencies have been identified for pure Best Effort services in [Del 3.2]).

S1 – S3: A synergic cross-effect emerges as interconnection strategies would leverage on the availability of ASQ IC to rearrange specific agreements, if the occasion calls. ASQ-traditional peering substitutability represents an additional strategic alternative at hand for stakeholders (S3 – S1).

S1 – S4: Interconnection agreements ultimately provide the ability to set new pricing scheme and revenues sharing agreements. The same applies for the opposite relationship (S4 – S1).

S1 – S5: A negative correlation is present, as interconnection agreements may be constrained by user routing preferences; at the same time, user routing independence might result in constraints to interconnection agreements (S5 – S1).

S1 – S6: ASQ interconnection option makes way for high-value application deployment and enhanced network performances. At the same time, innovative bandwidth-hungry applications require new interconnection agreements (S6 – S1).

S1 – S7: ASQ interconnection providers would prefer not to disclose too much information to other involved parties concerning their network features, but such information is necessary to guarantee monitoring. At the same time, market transparency calls for information sharing, which is positive for the whole Internet ecosystem, though potentially undesirable for ETICS suppliers. However, should ASQs result in an open market for premium services with IC agreements announced publicly (as part of some coordination models), thus helping to disclose some of the "hidden mystery" of peering and transit agreements, then

providers would have an incentive also to reveal some QoS guarantees, as opposed to the black box of confidential bilateral agreements of today.

S1 – S8: ASQ introduction may increase entry barriers for newcomer NSP, while it may create segmentation opportunities for OTTs.

S2 – S6: Investing to enable ASQ traffic would facilitate the introduction of high-value application deployment. At the same time, the need to enhance network performances calls for investments (S6 – S2).

S3 – S4: ASQ usage in place of peering can affect prices and revenue sharing agreements. Accordingly, the promise of new pricing agreements may trigger ASQ-peering substitution (S4 – S3).

S3 – S6: ASQ may replace peering in order to ensure the delivery of innovative applications. Consistently with this argument, the need to introduce applications which are differentiated in terms of QoS may drive ASQ diffusion in place of peering.

S3 – S8: As for some previous intra-domain cross-effects, ASQ may influence entry barriers and threat of newcomers; such influence would vary according to the nature of such newcomers (NSP vs. OTT).

S4 – S2: New pricing schemes and revenue sharing agreements may impact investment incentives, pushing for ASQ introduction and ASQ-BE parallelization or replacement.

S4 – S6: The quest for more incentivizing revenue sharing and higher prices goes through the enablement of QoS differentiated offer of content, services and applications. Reversely, the deployment of such high value applications and the required network capabilities extension is only justified if higher prices can be set (S6 – S4).

S4 – S8: Price level may constitutes a clear entry barrier for new entrants: in fact, should dominant players opportunistically set pricing and revenue sharing and control the service composition process, then newcomers would experience some difficulties, risking to be excluded from the market even if they are competitive and cost efficient. On the other hand, should fair rules be put in place, then this would promote competition and newcomers would stand a chance by investing in small very efficient networks that provide fast and cheap routes to some areas.

S5 – S4: A dysergy here arises, as the need of competitive offers for popular routes may set prices thresholds.

S5 – S7: End user control over routing facilitates monitoring and increases transparency.

S6 – S8: The deployment of differentiated ASQ offers may heighten entry barriers for newcomers, unless the ASQ market is kept open and transparent.

S7 – S4: A negative correlation occurs as information spill over due to monitoring and market transparency needs may reduce the current information asymmetry which allows to keep higher prices, in favour of increased competition.

S7 – S8: Market transparency is somewhat negatively correlated to entry barriers, as the former aims at ensuring competition while the latter put a ceiling to the competitive level of an industry by limiting the threat of new entries.

	S1	S2	S3	S4	S5	S6	S7	S8
S1		N.G.	↑	↑↑	↓	↑↑	N.G.	↓/↑
S2	N.G.		N.G.	N.G.	N.G.	↑	N.G.	N.G.
S3	↑	N.G.		↑	N.G.	↑	N.G	↓/↑
S4	↑↑	↑	↑		N.G.	↑	N.G.	N.G.
S5	↓	N.G.	N.G.	↓		N.G.	N.G.	N.G.
S6	↑↑	↑	↑	↑↑	N.G.		N.G.	↑
S7	N.G.	N.G.	N.G.	↓	N.G.	N.G.		↓
S8	N.G.	N.G.	N.G	N.G.	N.G.	N.G.	N.G.	

TABLE 60 – SOCIOECONOMIC INTRA-DOMAIN IMPACT CORRELATIONS

With reference to the **Net Neutrality intra-domain cross-effects**, the following relationships emerge:

N1 – N2: Service innovation, if coupled with an easy-to-access logic, would drive the diffusion of innovation among large user groups. The reciprocal effect (N2 – N1) is not generalizable, as a strict Net Neutrality compliance may limit the suppliers' innovation options.

N1 – N3: Service innovation on the OTT side drives network investments up, thus challenging the business sustainability for Carriers, unless innovations' benefits are shared among all involved players. At the same time in the symmetric effect (N3 – N1), Carriers' need to justify expenditures at a network infrastructure level should get OTTs to share revenues, though this cannot be taken for granted.

N1 – N4: Innovation, differentiation and product range or variety are positively correlated, as mutually reinforcing one another. The same applies for the symmetric effect (N4 – N1).

N2 – N3: A strict Net Neutrality compliance would not ensure the gathering of sufficient resources to be allocated to network enhancement. The symmetric effect (N3 – N2), where investments sustainability is the driver for the spread of services, may be positive, as services diffusion should first take into consideration the need for Carriers to justify any expenditure.

N2 – N5: The correlation is here positive as democratic and easy access to content and services are to be preserved by any authority's regulatory activity.

N3 – N4: A way to sustain investments for a supplier is to vertically and horizontally enrich its offer by widening the service range. Therefore, the two impacts are synergic. On the other side of the coin, the mere service variety (if, for instance, managed by an OTT rather than the Carrier itself), may have a dysergic effect with reference to investments' viability.

	N1	N2	N3	N4	N5
N1		↑↑	N.G.	↑	N.G
N2	N.G.		↓↓	N.G.	↑
N3	N.G.	↑		↑	N.G.
N4	↑	N.G.	↓		N.G.
N5	N.G.	N.G.	N.G.	N.G.	

TABLE 61 – NET NEUTRALITY INTRA-DOMAIN IMPACT CORRELATIONS

6.4. STEP 3: ASSESSMENT OF INTER-DOMAIN CROSS-EFFECTS OF IMPACTS

After identifying the intra-domains relationship, the next steps aims at arguing whether a given impact has a cross-domain nature, i.e. if it may loosely belong to other categories.

	BUSINESS	LEGAL	SOCIOECONOMIC	NET NEUTRALITY
B1	X		X	
B2	X		X	X
B3	X		X	
B4	X	X	X	X
B5	X	X	X	X
L1	X	X	X	
L2	X	X	X	
L3	X	X		X
L4	X	X	X	
L5	X	X		X
S1	X	X	X	X
S2	X		X	X
S3	X		X	X
S4	X		X	X
S5	X	X	X	
S6	X		X	X
S7	X	X	X	
S8	X		X	
N1	X			X
N2		X	X	X
N3	X			X
N4	X	X	X	X
N5		X	X	X

TABLE 62 – IMPACTS MUTUAL INTERDEPENDENCIES

This third step allows to infer that several impacts under scrutiny are characterized by an inter-domain nature: specifically, almost each impact has a business flavour. This means that, first, they may affect or be

affected by other impacts belonging to different domains, and second, that they shall be treated through a multi-perspective approach.

While intra-domain cross-effects for the twenty-three impacts identified are taken from the system of tables reported in Section 6.1.3, the discussion below aims at generating an essential insight on the assessment of inter-domain impacts cross-effects. **Since the analysis carried out in *TABLE 62* allows to infer that most of the impacts investigated, to a greater or lesser degree, belong or affect the Business domain, the assessment attempts to link this domain to all other available domains.**

Such attempt may start from considering that it is frequently claimed in literature [Tellabs] that the enormous transformation of the Internet environment has rendered an economically challenging ground for future investments. On the other hand Net Neutrality discussions grant social values in the Internet a high importance, leading to a reduced sphere of influence for NSPs' economic counteractions. Entailed from these discussions it is, hence, our aim in this section to subsequently conciliate the analysis dimensions of business, legal, socioeconomic, and Net Neutrality analysis in order provide a better argumentation basis on ETICS's impacts.

The market quantification of relevant services has highlighted a potential overall market at € 50 billion, (where ETICS overall revenues range from €4.9 to €5.0 billion in 2013), while the global market quantification based on Best-Effort traffic volumes indicated even an ETICS potential up to € 15 Billion in 2015. **This may not only seem promising, we further argue in Section 2.3 that we expect positive revenue effects (in comparison to developments without ASQ services) through the introduction of ETICS, as inferred from similar observations in theoretical QoS pricing literature. Such a revenue growth potential is obviously a fundamental prerequisite for the introduction of ETICS**. As stated in Section 3.3, **there may arise control tussles among BE users, ASQ users, and NSPs.** For example from a business perspective the disutilities of one customer group have to be compensated by a raised overall utility (in order to make a transition desirable), which may be achieved by taking the user's willingness to pay (as anticipated by [3.3]) into account – **ETICS may facilitate the price and quality discrimination on aggregate and end user level.** Generally in [Del3.3] and Section 3.3 the positive effects of ASQ services on BE Internet being retained in parallel, seem to support our hypothesis that **ASQ may have strong potential for overcompensating punctual disutilities of individuals.** We may, moreover, infer from these series of considerations that **the incorporation of user groups may be useful for selecting interesting service scenarios for the bootstrapping case, e.g. services with high willingness to pay for quality enhancements potentially facilitating positive spillover effects for other users.**

Beyond that, the analysis of Section 3.3 has revealed **a series of positive effects on immanent socioeconomic tussles being inferred from the introduction of ASQ services**, e.g. more transparency of QoS, more customer influence on routing decisions, paid interconnection and revenue sharing mechanisms etc. In this section we attempt for revisiting this category of issues in order to emphasize on their interplay with general business impacts: similar to above we argue that **whenever the power of control is handed over to another entity** (e.g. routing decisions being partially transferred to end customers or QoS is information is disclosed by NSPs) **the inferred disutilities have to be overcompensated by contractual agreements or other gains.** Hence, we argue that **with such modifications the business may better adapt to the needs of individuals, while maintaining a relevant business case for the NSP** – in analogy to the price and quality discrimination discussions. **The flexibility of ASQ services therefore provides the required capabilities for providing such focused services to customers, e.g. enabling traffic isolation (as interesting**

for in-house caching), targeting unsatisfied demands, or substitution of costlier technologies, which seem to constitute an enabler for ETICS business cases.

ETICS may in addition be conducive for reducing operational costs in QoS differentiation by providing technical and economical means for replacing inefficient deployed mechanisms, e.g. leased lines. This may be regarded to be neutral or positive to the users' utility for the provisioned services. Other cost or revenue factors could result from **better forecasting opportunities, which may help to better control customer satisfaction.**

Placing these effects in the context of Net Neutrality discussions, we may also positively note that **ASQ services do not seem to be an obstacle to reasonable or growing user utilities.** Though we have to take into consideration that the legal situation may conclude differently in particular countries on the same matter (cf. Section 5.3). In fact, the overview on Net Neutrality presented in Section 5 surely shed light on **positive externalities driven by the introduction of differentiated services (sometimes characterized by a border-line Net Neutrality compliance); moreover, depending on the different Net Neutrality regulation in place, alternative business models may arise** [Friederiszick11], **some of which featuring innovative design options focused on incentives alignment and fairer pricing schemes** (e.g. congestion charging). On the other side of the coin, **a "dark side" of Net Neutrality also emerged, as the concept is sometimes obscure in its application and business-socioeconomic-legal implications**: elaborating a pure, univocal definition for Net Neutrality is almost fancy; different countries worldwide appeared to be adopting fairly diverging approaches to the issue, whose inter-domain results are yet to be fully disclosed, being constantly evolving over time; in each context considered, NSP-OTT debate over the risks to introduce further perturbation and delays in the regulatory consolidation process; and, as a last point, given the potential trade-off existing between ASQ offer differentiation and overall social welfare and democratic access to services, wrong decisions on this topic might either decrease the ecosystem's wealth, or metaphorically kill Future Internet's ASQ-enabled killer applications.

Additionally to the field research performed, in the literature study of Section 5.3 as bridge to business considerations, a series of interesting recommendations for configuring ASQ service could be inferred, e.g. side payments [Caron10] are often introduced in the Net Neutrality discussion, while works in literature claim that it would be beneficial to avoid such side payments at all. In a similar way, the analysed literature (e.g. see [Economide09]) highlights the social drawback of deviating from Net Neutrality states under some conditions.

Legal issues, if not properly governed, may in many ways have negative implications on the business dimension of ETICS. In particular, monopoly constellations may be in terms of revenue unbeneficial for the overall market, but potentially even unattractive for monopoly holders in the long run. It may provide negative implications on the cooperation and competition of NSPs, as on the considered market only one provider is available (cooperation is hence limited to the willingness of one provider). Similar negative effects may occur in the case of cartels for NSP and customers not forming the cartel. The cooperation of NSPs may in addition be negatively influenced by denial of service strategies among NSPs, which may exclude smaller or less powerful NSP in participation – this may be mitigated by the suitable coordination model choice as discussed in [Del3.3]. The end-to-end SLA compliance requirement may be seen as risk for supplier NSPs, but as cost-reduction effect (or as utility resulting from the assured service) for customer NSPs.

As a whole, the analyses performed in previous Sections 2, 3, 4 and 5, as well as the aforementioned assessment steps in the present section, clearly confirm that the ETICS project's rollout and deployment will have a significant impact on the four domains investigated, whose expected outcomes are to a large share positive to ensure a sustainable and socially fair Future Internet evolution; still, some criticalities emerged, both at the intra and at the inter-domain level.

This deliverable has the ultimate purpose to serve as a unified point of reference to set the policies, rules, models and agreements to efficiently and effectively govern the interplaying impacts and recurring themes disclosed so far.

7. CONCLUSION

The assessment of the project's impacts is a crucial task for ETICS, whose aim is to virtuously reshape the Internet ecosystem's landscape. This applies for all impacts, whether they are commercial or technological, positive or negative, caused by or influencing the offer's deployment, and so forth.

In fact, identifying and disclosing impacts in the various domains of interests enables the establishment of a common system of rules, policies and agreements to guarantee a proper project governance, and in turn, a fair and sustainable evolution of the Future Internet.

As the devoted sections showed, several impacts may affect or be affected by ETICS, at different complementary domains.

Business domain: The impacts assessment first addressed the financial viability and potential of an ETICS-related ASQ offer, through a detailed quantification of eight significant markets where such offer could be launched; then, it identified and discussed other businesswise effects at a strategic and tactic level.

This analysis shed light on those markets to be targeted for current and future ETICS growth (on a business portfolio logic of investments allocation), as well as on those issues to be considered when deploying the ASQ offer, in order to trigger a virtuous sequential chain of positive business outcomes.

Socioeconomic domain: Several tussles are foreseen among different stakeholders, mostly concerning the control over complementary resources and the different uses of these resources which involved players may demand from the respective owners.

These tussles point out that conflicting incentives and interests exist in the way the ETICS technology is configured and made available in the services ecosystem. Moreover, most of these socioeconomic impacts appear to be cross-domain, that is, pertaining also either to the Business or the Legal domains, and should be read in a complementary fashion, since they provide pieces of the same bigger ETICS "puzzle".

The major recommendation coming from the socioeconomic analysis is that the objective of ETICS should be to remain an open, fair and stable (though not necessarily static) solution, attracting all the ecosystem stakeholders, as that is probably the only way to ensure its adoption and impact on the market.

Legal domain: Key points for attention from the legal side, which could lead to criticalities in terms of market inefficiency or offer ineffectiveness, were identified and discussed. Legal impacts loosely belong to two interdependent levels: on a higher level, opportunistic behaviours from players controlling unique assets or acquiring a significant market power in the value network; and, on an operative lower level (which focuses on pragmatic issues determined by higher-level opportunistic actions), control over content availability, SLA enforcement, and denial of service causes and consequences.

While many of these actions are labelled market distortions and are therefore theoretically ruled over by authorities and regulators, others are clearly more subtle (e.g. denial of service), and cannot be thoroughly controlled unless stakeholders agree on a set of policies for self-governance (either at a bilateral agreements level, or better, at a marketwise level).

The disruptive introduction of ETICS ASQ could be an occasion to move away from obscure or even unfair practices (provided that monopolistic or oligopolistic positions are discouraged or blocked in the first place),

pursuing the offer's effectiveness while maintaining its efficiency through a necessary degree of competition, and ultimately establishing a cooperative, trusted environment.

Net Neutrality (NN): The activity reported in this deliverable aimed at providing a preliminary view on this multifaceted, complex issue, in order to share knowledge of it among ETICS partners and create a common ground for discussion. This common ground will be revived and utilized in [Del3.5] ("Final business models analysis") as a baseline to better define ETICS relations towards Net Neutrality.

The main outputs obtained in this preliminary analysis have been reported in the related sections (one per objective) in Section 5. Overall, the main finding may be summarized in these points:

- the definition of NN is not well consolidated in literature despite a frequent, and in some case not proper, use of the term. There are various and heterogeneous definitions differing in terms of subject of NN and feature of the services affected. This situation makes it difficult to achieve a common view on several aspects of NN in academic and (mainly) professional worlds. The "pure" NN definition seems sometimes more of a philosophical dispute (e.g., when it does not consider or forbids the introduction of any price differentiation for different level of quality of service) with scarce real-world applicability;
- NN regulation could be necessary in order to obtain an increased overall social welfare. However, the regulation on NN is at an early stage of deployment and all the regulatory bodies are defining their own (sometimes contrasting) view on it. This happens also at the EU level, where probably a coordinated, common and incisive approach could positively affect the current situation;
- there is a clear trade-off between two different groups of impacts carried out by different NN regulation. These impacts in trade-off (at least the majority of cases) are: "network investments sustainability" vs. "innovation in Internet services; democratic participation and access to information; service variety". These impacts are strictly related to two important player categories in the market who are debating on NN issues: NSPs vs. OTTs (content and service providers). NSP are highlighting the importance of differentiating network services to preserve network investments sustainability, while OTTs are supporting the importance of Innovation and democratic participation in order to have easier (and almost free of charge) access to the final customers;
- ETICS ASQ offer may enable a better management of NN issues because provide more flexible tools to manage the network. The extent to which this will happen is still unpredictable, because of unclear effects of as-is and to-be NN regulation (we have seen many contributions clarifying only small parts of the problem), and of uncertainty on how ETICS will really effects network management (probably, much on this point will be clarified with the results from test beds carried out inside WP5-WP6 joint activities).

To conclude, the present deliverable [Del3.4] offered a significant, multifaceted description and discussion on impacts of relevance to the ETICS project, addressed at multiple levels and then simultaneously.

This deliverable further integrates and refines the previous works from [Del3.1], [Del3.2] and [Del3.3] by disclosing the major possible effects, outcomes and implications of choices at an economic and financial level. These details are key, both for business model design (firm-specific level) and value network configuration (ecosystem level).

Indeed, different decisions in the way business model parameters are crafted and aligned (i.e. value proposition choices, value relationship choices, and financial configuration choices – see [Del3.2 – Section 2.2], [Del3.3 – Section 4.1]) may have different implications (and lead to different outcomes) not only at a business, but also at a legal and socioeconomic level.

At the same time, different tendencies in the way the ETICS ASQ IC value network (and, as a consequence, the overall Internet marketplace) is configured by adopting and involved players [Del3.2 – Section 2.3] [Del3.3 – Sections 4.1-4.2], in terms of structure (i.e. activities to be performed and their interrelations), roles (i.e. actors coverage of different sets of activities) and agreements or dynamics (e.g. Bilateral agreements, alliances, federations or open market – see, e.g. [Del3.2, Section 5.3]), may lead to diverging scenarios of triggered impacts and, ultimately, varying ecosystem performances concerning sustainability and social wealth.

Taking this into consideration, the deliverable shall represent an essential input for [Del3.5], whose task will be to finalize the business models analysis.

Section 7.1 closes the deliverable with an update on the status and plans for business recommendations regarding architecture options.

7.1. ARCHITECTURE IMPACTS

ETICS deliverable D3.3 [Del3.3], Section 5, took as input the ETICS draft architecture as defined in deliverable D4.2 [Del4.2]. Partners addressed two sequential service offering phases:

1. the composition phase;
2. and the publishing phase.

For the composition phase, data graphs were drawn that show how information access guides actor behaviour and cooperation opportunities for each architecture option. Additionally, the work elaborated on the publishing phases of the service offering, showing the specifics for each of the proposed architecture options. Qualitative business and economic criteria were finally defined, a preliminary evaluation for each of the architecture arrangements considering these criteria was provided. From a pure economic perspective for mature markets, the fully centralized-push option is preferred. However, despite its deficiencies, the per-NSP centralized pull option is seen as the most probable first step in early markets.

At the time [Del3.3] deliverable was finalized, there was no common understanding on all issues that are particularly related to the neutrality and fair coordination of the NSP coordinator which also participates in the negotiation and service composition. Nevertheless, a few preliminary recommendations that are based on pure economic terms were identified and described, along with potential problems that may arise, as related to these recommendations. The main points currently under discussion are mentioned below, together with the respective crucial open issues.

SLA Composition

In Distributed SLA Composition, the buyer propagates its SLA request to its neighbour(s). In Centralized SLA Composition, the process is instead realized by the central entity. Within the Centralized SLA Composition method it is hard for an NSP to obtain a strategic position due to the simultaneous announcement of the

prices and also due to fact that the destination and the number of NSPs participating in the chain may be unknown to the NSP itself. On the other hand, it may be difficult for an entity to split the SLA request to sub-SLAs even if the Network Capabilities of the NSPs are known. In the Distributed method, edge NSPs may obtain advantageous positions due to the consecutive announcement of the prices.

Open issues:

1. how could SLA composition in Fully centralized and per-NSP centralized be done? There is an issue with the fully centralized composition case;
2. how would the central entity (facilitator, NSP) know how to distribute the e2e budget between NSPs?
3. In terms of additive metrics, how does the NSP know how much delay it will ask from the different NSPs? Or would it make a loose request and see how much delay it would get?

Publishing Phase for Distributed Models

During the Publishing Phase, the NSPs participating in a community (or alliance) publish their Network Capabilities or their SLA offers. In the Fully Centralized models the NSPs publish to the Facilitator, while for the Distributed and the Per-NSP Centralized ones they have to publish to other NSPs. In Direct Publishing the NSPs publish only to their direct neighbours. However, this information has to be distributed to other NSPs as well. Thus each NSP according to rules may include this information with its own and republish it. Enforcement mechanisms may be hence required. In Global Publishing, NSPs publish their information to all NSPs in the community. This can be done either by using a catalogue or in a distributed way where all NSPs are obligated to propagate the information of their neighbours. In Policy Publishing, NSPs may publish to a subset of NSPs in the community. Only centralized entity and all NSPs have all the information (Global publishing), while there is no need for global publishing in Distributed models.

Open issues:

1. how can strategic publishing policies be used to gain unfair benefits?
    - Since the neighbours will propagate information how can we be sure that they will not propagate information that has been indicated as private? Or true?
2. Can this be avoided without having a fully centralised scenario?
    - Catalogue that anyone has access but cannot change others' information?

ETICS architecture is further refined and explained in [Del4.3]. The project plans to continue work on the issues described, in order to finalize and conclude its business and economic-related recommendations for the final and detailed ETICS architecture. The details of the information models for each architecture option need to be further explored, and definite conclusions shall be driven from them. Open issues were identified in the area of: SLA composition; session handling; and the need for natural evolution from pull to push models. Finally, the effect of the recently-defined ETICS community concept and policy rules are to be further explored, and to use as input the most recent updates to the ETICS architecture. WP3 partners plan to execute this analysis and recommendation work in parallel with WP4 and WP5 updates, and report final conclusions in deliverable [Del3.5].

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9. APPENDIX

9.1. MARKET QUANTIFICATION – AIM AND METHOD

The market quantification process aims at understanding the actual market potential for an ETICS related offer, in terms of achieving significant market shares and revenues in relevant competitive spaces. Such competitive spaces may often appear crowded by alternative offers, which, however, are ill-differentiated from an ASQ perspective.

At the same time, through the differential analysis of an as-is (before the introduction of ETICS ASQ) and to-be (right after the introduction of ETICS ASQ transition analysis) scenario, the process discloses how an ASQ offer may impact and transform the Internet markets, enabling their future growths.

In order to activate the analysis, a template was shared among contributors, whose goal was to provide useful guidelines and set a common structure for stand-alone quantifications for the aforementioned markets under scrutiny, thus improving the consistence and similarity of different analyses carried out by several partners with diverse expertise. The template suggested key steps to complete such quantification for each significant market, and listed recommendations and methodological approaches which could be followed by contributing partners.

The key steps to be completed for each significant market quantification were:

1. Briefly define the market and its services delivered;
2. Briefly point out the methodological approach followed for the quantification, and list the main hypotheses set;
3. Quantify the current market size/value (in monetary terms);
4. Quantify the potential growth of the market's size/value (in monetary terms) deriving from the introduction of an ETICS ASQ solution;
5. Estimate the share of the potentially grown market – as identified in step 4 – which could be penetrated and captured by an ETICS ASQ solution;
6. Perform a sensitivity analysis of the results obtained.

As a general guideline, the quantification should be performed with a reasonable trade-off between rigor and completeness; monetary results should be presented and justified in a clear though brief way.

The paragraphs below describe the expected output for each step, also mentioning recommendations and suggestions.

9.1.1. MARKET DEFINITION AND BOUNDARIES

Objectives – provide a brief definition for the market under scrutiny, and for its services delivered.

Description – setting the boundaries of the analysis represents the preliminary stage for any quantification activity. A simplified definition of the market or business area to focus on should result from the juxtaposition of these axes:

- Product/service delivered (product/service category definition);
- Countries/regions considered (geographical definition);
- Type of customers served (customer definition).

Recommendations/suggestions:

- Given the ETICS project international scope and potential extra-European reach, it is suggested to consider a global scale as a geographical definition of the market (i.e. worldwide). Should this not be reasonable/feasible, and should it be necessary to limit the scope of the analysis to a given region, a justification for the choice should be provided;
- Concerning customer definition, indicate whether this market serves:
    - Carriers;
    - OTTs;
    - end users – Business users;
    - a combination of these actors.

9.1.2. Quantification Methodology and Hypotheses

Objective – briefly point out the methodological approach followed for the quantification, and list the main hypotheses set.

Description – describe the methods and techniques employed to grant validity of the outcome, which should into deliver fair trade-off between the rigor of the analysis and the soundness of results on the one hand, and the completeness of the investigation on the other.

Also list any necessary hypothesis set to conduct the quantification process, with specific reference to the estimation phases required in step 4 and step 5 (such estimations, being partly subjective by definition, would probably be based on reasonable assumptions).

Recommendations/suggestions

To be indicated:

- Data gathering methodology. The main sources from which to collect data and information that may be leveraged on are:
    - Primary sources of data (e.g. direct interviews; case studies; internal documents of operators in the market);
    - Secondary sources of data (e.g. research reports and presentations featuring market value and growth trends; white papers; reports from national/international institutions/authorities/regulators; industry newsletters; balance sheets and market shares of key operators involved in the market; data on traffic);
    - Partners are left with some degrees of freedom with reference to the methodology employed, as long as the choice is reasonable and justified.
- Normalization approaches followed in order to make data comparable and to aggregate data (if any):

  - E.g. Data may come from different sources, and may need to be treated to avoid inconsistencies, overlapping and/or uncovered segments of the market;
- Mathematical/Statistical analyses employed to elaborate on data (if any);
- The use of "proxy" values or "indicators" from which to derive the overall market value (if any);
- The use of approximations for the values proposed (if any);
- The choice of leaving aside any market part or segment quantification, together with an explicit justification (if any);
- Potential criticalities, limitations and drawbacks characterizing the approach followed and/or the hypotheses set;
- Other issues affecting the quantification process.

9.1.3. As-Is Market Value Quantification

Objective – quantify the current market size/value (in monetary terms), providing a single number or a reasonably narrow value range.

Description – starting from the data and information gathered, and following the methodology and hypotheses defined in step 2, calculate the current monetary value of the market under scrutiny. The quantification of the current market value – i.e., the market as-is, *before* the introduction of an ETICS ASQ solution – represents the basis for the further elaborations to be performed in step 4 and step 5.

Recommendations/suggestions:

- provide a number or value range as the core output for this step;
- normalize the value in Euro (€);
- if the final number for the overall market quantification comes from the aggregation of several quantifications performed on different market segments (either service-based, geographical or customer-based), indicate clearly how the final number was built;
- if a value range (rather than a single number) for the market size/value is presented, justify this choice. Also try to keep the range narrow, so as to avoid introducing subjectivity at this stage which will propagate to following stages.

9.1.4. To-Be Market Value Quantification after the Introduction of ETICS ASQ Global Market for All ETICS-Related Services

Objective – quantify the potential growth of the market's size/value (in monetary terms) deriving from the introduction of an ETICS ASQ solution.

Description – The widespread assumption within the consortium is that the introduction of ETICS and its ASQ approach would not only gain a market share of the current Internet markets; it would also determine a size/value growth for those markets which are currently lagging behind because of the substantial absence of offers delivering ASQ. The potential growth of the market thanks to the rise of an ASQ offer should be quantified, given that this to-be market is the one that any ETICS solutions would penetrate and operate in.

Recommendations/suggestions

As for step 3, applied to the to-be market.

9.1.5. ETICS Market Shares and Revenues

Objective – Estimate the share of the potentially grown market – as identified in step 4 – which could be penetrated and captured by an ETICS ASQ solution, so as to identify the actual ETICS-related revenues for participating players.

Description – After the quantification of the to-be market as emerging from the introduction of ETICS ASQ offer, the next step of the quantification process deals with the estimation of the market share an ETICS solution could gain, and in turn, the identification of expected revenues for players adopting and participating in ETICS coming from the market under scrutiny. Understanding the achievable revenues would ultimately serve to calculate the expected return on investment for the ETICS project.

Recommendations/suggestions

As for steps 3 and 4, plus the following:

- the estimation could be based on:
  - light competitive analysis (e.g. bargaining power of competitors; market dominance; entry barriers);
  - brief benchmarking with alternative solutions (e.g. basic connectivity) or similar cases;
  - proxies;
  - other methods.

9.1.6. Sensitivity Analysis of Results

Objective – Perform a sensitivity analysis of the results obtained in steps 3-4-5.

Description – A sensitivity analysis investigates the variations of the final outcomes – i.e. the as-is market quantification; the to-be market quantification; and the ETICS-related market share and revenues – when key values used to calculate them are changed, in order to assess the sensitivity of the outcomes with reference to the changed value. Such analysis can highlight the dependence of the result upon variation of its hypotheses and assumptions, granting its solidity.

Recommendations/suggestions:

- Sensitivity analysis can be performed on the outcomes of steps 3-4-5, with different aims:
  - for step 3, to highlight the solidity of the as-is market quantification. This step, however, should be based on final and consolidated data, and as such, should be less dependent from hypotheses and estimations;
  - for step 4, to highlight whether the growth potential for the market may be subject to strong variation due to the modification of one or more key data;
  - for step 5, to highlight whether the ETICS-related market share and revenues are solid and can actually ground a return on investment analysis.
- it could be recommended to look for both positive and negative variations of data, consistently with expected growth trends for the market. A “what-if” analysis should be performed:

- e.g. what if the market growth induced by the ETICS introductions is +5% instead of +10%? What if it is +15% instead of +10%?
- e.g. what if the market share for the ETICS solution is 3% instead of 5%? What if it is 8%?

Conclusions should be provided which synthesize the results of the sensitivity analysis, claiming which are the hypotheses/assumptions/proxies whose variation may have the heaviest influence on the quantification process (and therefore, where opportunities and risks lie).

9.2. ETICS MARKETS QUANTIFICATION – FULL LENGTH ANALYSES

9.2.1. HIGH-DEFINITION (PREMIUM) PERSON-TO-PERSON RICH MULTIMEDIA COMMUNICATION

9.2.1.1. Video Communication

This video communication market study covers in general the consumer as well as the business market, where the solutions and services are ranging from direct video calling over Internet by e.g. Skype to more advanced video conferencing or even high-end telepresence solutions for the executive business market. While there are still many factors that is impeding adoption and take-up of such solutions and services we do observe several factors indicating that there are important shifts in this area that do indicate significant growth potential. A quote from an IDC Market Analysis Report [IDC11] is illustrative of current believes: “Enterprise videoconferencing is on the move and gradually on its way to become the "new normal" of business communications. IDC believes that vendors' enhanced technologies have increasingly delivered to end users experiences worthy of initiating a videoconference over a phone call or conducting business across locations that in the past required travel.

However, we also observe that the size of the current market is rather small, which still make many NSPs reluctant to enter this market with full force. While this study will focus on the business market we include some indications and numbers reflecting the emerging consumer video communication market. The main focus is on fixed network services, while in general we see that adoption trends of fixed wireless (e.g. Wi-Fi hotspots) and mobile broadband together with SW based solutions for personal clients indicate that wireless clients are becoming more and more ready to take part in this game. Up to now, the typical considerations made by business decision makers were focused on a cost vs. savings trade-off where reduced travel costs are the most important driver. Nowadays we observe indications on a shift towards valuation of additional factors such as faster decision making, more inclusive teaming, more intimate customer interactions, and entirely new ways of doing business [Wainhouse11]. In summary, important drivers and enablers are:

- Increased management productivity and efficiency in business transformation
- Globalization. Employees, suppliers, partners and customers can be anywhere on the globe
- Emerging cultural shifts impacting preferences by the workforce. Internet based services used at home such as messaging, voice and video calling influence user expectations in the business area as well.
- Concerns about climate change and desire toward lowering carbon footprint, impacting both business travels as well as tele-commuting.

- Improvements in unified communication and collaboration products and services, where video communication is an integral part

In addition, cost reductions and performance improvements in the Layer 2 and Layer 3 VPN domains, as well as the general improvement in terms of bandwidths and unit price of broadband and basic Internet access all makes video conferencing more attractive to business customers. Moreover, we observe that SW based solutions both on clients as well as for video conferencing infrastructure emerge into the market. The quality of such solutions appears to be competitive with dedicated HW based solutions in a price performance perspective. Hence, SW based clients on PC and Pads will in a few years surpass the installed base of dedicated endpoints. However, the benefits of room and group based solutions will still make dedicated solutions attractive for the foreseeable future.

Other interesting market analysis messages, one originally from a Gartner study and a follow up message supplemented by Baird supports the above: "For example, Gartner expects that by 2015, over 200 million workers globally will run corporate-supplied video conferencing from their desktops. This considerable figure does not consider the massive proliferation of tablets (conservative estimates of 135 million shipments in 2015) and smart phones (a forecasted 1.0 billion shipments in 2015) being used in the workplace as well. We believe this portion of the market will significantly outpace the growth of the traditional video conferencing market and add substantially to IDC's base-line figures." [Baird11].

We also note that there can be special regional or global impacting events that can be wildcards in the evolution of and demand for video communication services. Examples are: Volcanic eruptions producing ash clouds significantly interrupting air traffic; sever flu pandemics resulting in travel advice and even restrictions; and new climate change knowledge regarding CO2 emissions that results in significant CO2e taxation or even travel restrictions.

On the other hand there are still obstacles. A Norwegian research report [Ølnes11] states that the lack of sufficient broadband capabilities is an important issue for the private business sector while being a lesser concern in the public sector, and that lack of information on meeting room and remote party capabilities is also an impediment to increased usage. While the technologies available to consumer customers via their PCs, laptops, pads and Smartphones have matured significantly over the last years so as to make such terminals more suitable for video communication there are still remaining obstacles. Often the broadband service is still not suitable and/or the home gateway or network still causes issues that reduce customer experience.

One observation of great importance to ETICS is that enterprise video conferencing is today dominated by intra-business communication and based on specific business VPN solutions on Layer 3 or Layer 2 (or leased lines). Estimation of the inter-NSP and B2B traffic has been rather difficult as no reliable source has been found. However, a typical number we hear and currently a rough estimate is that 10% of the traffic is B2B.

The aim of this study in terms of quantification is to derive numbers in the following areas.

- Overall end-customer facing revenues by service providers offering Video communication and conferencing as a service
- Inter-NSP traffic and revenues related to inter-NSP ASQ traffic exchange or connectivity.

We naturally observe that the later revenues will be only a fraction of the overall end-customer facing revenues. However, we believe that the inter-NSP ASQ traffic will be an important enabler and boost the end-customer facing markets.

Quantification Methodology and Hypotheses

In this section we briefly discuss the approaches taken to derive the quantification.

First we consider the overall end-customer facing revenues focusing on the offering of video communication as a service. The service provider is here typically a NSP or network service provider or an over-the-top service provider (OTT).

Based on given estimated numbers for 2012 videoconferencing equipment revenue globally [IDC10] [Baird11] we extrapolate the revenue potential as seen by the service provider side. In a simplistic fashion we are considering the market potential by assuming "all-inclusive" services provided in terms of service provisioning and operations, leasing of endpoints, and in terms of associated network and traffic services. More information on this will be provided in the sections below together with some arguments on how revenue can grow as a result of introducing ETICS ASQ services.

The next question we ask is what is the video communication traffic volume generated by the end-customers. The key source in this respect is the Cisco Visual Networking Index (VNI) [Cisco11]. For the Consumer segment the 2012 estimate is that Video calling will generate 659 Petabyte (PB) per month and by far this number is dominated by fixed access. The video calling traffic is however only 2,7% of the total Consumer Internet traffic. The 2010-2015 CAGR is estimated to 41%. A similar number for business video communication traffic is not given. However, in a similar fashion as for the consumer traffic we take as a rough estimate is that 3% of the total Business traffic is contributed by video communication.

Wherever inter-NSP traffic estimates are made we limit the analysis to the (Western) European market assuming this is a rather mature market where ASQ traffic services can be introduced and evolved in the 2013 – 2017 timeframe investigated. The baseline numbers used for inter-NSP traffic estimations are based on generated traffic by the end-customers as given by the VNI numbers. The Western European traffic generated is approx. 25% of the total traffic, that is, 165 PB per month.

Based on the rough estimate of having 3% of the total Business traffic contributed by video communication and given the total business IP traffic is 6011 Petabyte (PB) per month in 2012 we get an approximate number of 180 PB per month of video communication traffic globally. Again, the Western European traffic generated is approx. 25% of the total traffic, that is, 45 PB per month.

The key question for ETICS is how much additional revenue can be generated as a result of introducing inter-NSP ASQ traffic and connectivity into the market. An important starting point to consider is the existing inter-NSP traffic volume, both in terms of Internet (BE) traffic and in terms of managed IP traffic if business IP traffic is considered.

As indicated above, a rough and typical number is that 10% of video communication traffic in the business area is B2B. Similarly we hear that 10% is inter-NSP traffic. Note that the inter-NSP and the B2B traffic are partially overlapping, and the overlap is typically quite high. Hence, in our studies we focus on inter-NPS traffic and anticipate that 10% of the video communication traffic is inter-NSP in 2012 as a baseline. The lack of Internet ASQ traffic services is considered as an important impediment to inter-NSP and B2B video communication in addition to immature interoperation among different vendor equipment. These two factors are much dependent on each other as one is a driver for the other, and today's situation is a bit of a deadlock as described in ETICS Deliverable 2.1 [D2.1].

Hence, if ASQ traffic can be introduced in 2013 we anticipate that the additional traffic generated by end customers as a result of ETICS ASQ traffic introduction is 3% in 2013 for both consumer and business.

Considering the business market, we anticipate as a baseline that this additional overall traffic growth will be up to 15% in 2017. At the same time, considering inter-NSP traffic, we anticipate that this ratio will increase from the 10% as baseline up to 20% in 2017, and moreover that there will be a shift of traffic type from BE Internet to ASQ traffic. This is particular the case for video traffic as the QoE is quite dependent on predictable network performance. In 2017 we assume that 75% of this total inter-NSP traffic will be ASQ based traffic. For simplicity we assume that all inter-NSP and B2B traffic is Internet based.

The underlying arguments for the above growth potentials are based on a few main aspects. The current penetration of video communication equipment or facilities in the business market is as low as 10%. Hence, the current market is positioned rather low on "the growth S-curve" and hence, the potential for growth is in theory quite high. We anticipate that the price pressure will be quite high driven by the introduction of SW based solutions. Coupled with ETICS ASQ traffic based services to ensure end-to-end quality and improved customer experience we can see such a significant growth as anticipated in the below quantification. Next, considering the consumer side the starting point is the Cisco VNI numbers and the estimated 2010-2015 CAGR of 41%. Considering the effect of introducing ASQ traffic is again a difficult task. One aspect that makes it difficult to estimate is that ASQ Internet traffic will not be introduced globally overnight. It will be a local or regional step-vice build out. For simplicity, we argue that the 41% CAGR is too optimistic in a five year perspective without ASQ traffic services available on the Internet. In this time-frame the customers may start experiencing more frequent difficulties (potentially leading to lower QoE rates) due to congestions as a result of NSPs lacking investment sources and the level of over-provisioning will not be as high as we have today. Hence, our baseline for growth rate in 2017 is reduced to 35% without (ETICS) ASQ.

On the other side, if ASQ traffic is introduced gradually in 2013 and that in 2017 there has been a significant global adoption and build-out of ASQ traffic we anticipate that the growth rate for Western Europe could increase up to 45% in 2017. Sensitivity analysis should prove analysis on different evolution scenarios and future year-by-year growth rates. Hence, the effect of ETICS ASQ is anticipated to result in a difference of 10% growth rate in 2017 in regions where ASQ traffic is well established.

The last aspect to consider is the value or revenue generation associated with inter-NSP ASQ traffic or connectivity. For this part we use as baseline price information from "Dr. Peering" [Norton12] that suggests a decline to about or even below $ 1 / Mbs. However, it is important to note that this decrease is heavily influence by Tier1 carriers having global content providers pumping popular content traffic to eyeballs. Hence, this price decrease is "subsidised" by this type of content traffic and the original transit service and pricing is somewhat disrupted. The anticipated price levels for ASQ traffic and their interconnect services are positioned according to ETICS suggestions that the baseline will support the "sending party network pays" model or what is often called "traffic termination charging". By separating the market into respectively

i) inter-NSP between European NSPs

ii) inter-NSP between European NSPs and non-European NSPs. This abstraction level appears to be feasible for our revenue analysis. Further reasoning around anticipated price levels will be provided in the below sections.

End-Customer Facing Market Value Quantification

In this section we estimate the revenue potential of offering Video communication as a service. The service provider can be a NSP, an OTT or a dedicated video conferencing service provider. Note that the aim of the below analysis is to just provide a rough numbers only to indicate possible ranges of the overall market potentials.

We use as a baseline numbers from IDC studies [IDC10] [Baird11]. From these reports we select a baseline number of endpoints sold in 2012 that is slightly higher than the IDC number taking into account the entrance of SW based endpoints are now emerging. The base line numbers are indicated in the box for year 2012 in the tables below.

The next step is to calculate the number of endpoint as the total installed base of traffic and revenue generating endpoints. This is achieved by summing the endpoints over the last five years. The growth rate for endpoints is set higher than the reported estimated growth rate for revenues. Our baseline number in % without ASQ services introduced in this time period is assumed to be 30% per year, while based on the arguments provided above we assume that the growth rate for endpoints is increased + 10% up to 40% in 2017.

Assuming that these are representative number of endpoints for Video communication as a service we suggest various number for monthly recurring fees per endpoint. This can differ depending on a number of factors. Based on some indications in Wainhouse Research report [Wainhouse12] we suggest representative numbers that can help us getting an indication of revenue ranges in the different cases. Our high number is actually lower than typically reported fees for HD endpoints. Note that we assume a full managed service delivered including unlimited video calling, device management, including monitoring and help desk support.

The results and numbers are given in the two following tables, first without ASQ (30% growth) and then with ASQ where the growth rate has been increased steadily to 40% in 2017.

Global Revenues - Video Communicaiton as a Service - **Without inter-NSP ASQ**									
	Y 2009	Y 2010	Y 2011	**Y 2012**	Y 2013	Y 2014	Y 2015	Y 2016	Y 2017
GR %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
Endpoints (EP) Sales per Year (000)	296	385	500	**650**	845	1099	1428	1856	2413
Accumulated EP (5 years)					**2 675**	**3 478**	**4 522**	**5 878**	**7 641**
Total Global Yearly Revenue $ Bill - Video Comm as a Service									
Reveune ($ B) - Monthly fee $ 250	250				8 026	10 434	13 565	17 634	22 924
Reveune ($ B) - Monthly fee $ 175	175				5 618	7 304	9 495	12 344	16 047
Reveune ($ B) - Monthly fee $ 100	100				3 211	4 174	5 426	7 054	9 170

TABLE 63 – VIDEO COMMUNICATION REVENUES ESTIMATION WITHOUT INTER-NSP ASQ

Global Revenues - Video Communicaiton as a Service - **With inter-NSP ASQ**									
	Y 2009	Y 2010	Y 2011	**Y 2012**	Y 2013	Y 2014	Y 2015	Y 2016	Y 2017
GR %	30 %	30 %	30 %	30 %	32 %	34 %	36 %	38 %	40 %
Endpoints (EP) Sales per Year (000)	296	385	500	**650**	858	1150	1564	2158	3021
Accumulated EP (5 years)					**2 688**	**3 542**	**4 721**	**6 379**	**8 750**
Total Global Yearly Revenue $ Bill - Video Comm as a Service									
Reveune ($ B) - Monthly fee $ 250	250				8 065	10 627	14 164	19 137	26 250
Reveune ($ B) - Monthly fee $ 175	175				5 646	7 439	9 915	13 396	18 375
Reveune ($ B) - Monthly fee $ 100	100				3 226	4 251	5 666	7 655	10 500

TABLE 64 – VIDEO COMMUNICATION REVENUES ESTIMATION WITH INTER-NSP ASQ

While the above tables are only providing indicative figures it should be noted that the number of endpoints for the managed service provider domain is too high in both cases for the first year (2013) as this market is still not very mature and video communication is still dominated by selling or leasing just equipment. While for the first year $ 250 in recurring per monthly charge is representative the first year we should expect a significant price decline in the coming years. Hence, the price between 100 and 175 is more representative for the last year (2017). By year 2017 we may see a significant growth in endpoints with SW based clients. If this becomes a success, hopefully where the ETICS ASQ traffic services represent one key driver, we can see a substantial increase in # of traffic generating endpoints. In this case however, the average recurring per monthly charge is likely to drop perhaps even below $ 100. However, as a result of increased usage as indicated in the scenarios of increased traffic as a result of ASQ the recurring per monthly charge can be higher than for the case of not supporting ASQ. Hence, this will improve the case for ASQ even further.

Note also that the above numbers are focusing on the business market. Considering voice and mobile services the consumer market is substantially higher than the business market. If this can be used as an indication of the consumer market potential is questionable. However, as the broadband services develops and ASQ can be delivered end-to-end there are reasons to believe that also the consumer market will find ensured quality video communication as an attractive service. While the per unit or per endpoint monthly recurring charge will be lower in the consumer market the overall revenue potential can be similar or even higher than for the business market.

The market readiness is perhaps better for the business market as their access network connections are often already sufficient for supporting high-quality video calling. The consumer market and broadband access connections are often characterized by the following user experience:

i) The high priority is high quality audio. If you turn on your (HD) web cam you hurt your audio quality

ii) this situation is even worse in the case of multi-party conferencing/calling. This is part of the reasons why the Cisco VNI numbers for the consumer video calling seems to be too optimistic if an “as-is” context is assumed.

To-Be Inter-NSP Market Value Quantification

In this section we are focusing on the generated inter-NSP revenues or value creation based on inter-NSP video communication traffic. First, the business market is addressed and then the consumer market is considered. A key assumption being made is that ASQ traffic and their interconnect services are positioned according to ETICS proposal of adopting the “sending party network pays” model or what is often called

"traffic termination charging". By using this as the baseline model and in order to provide comparable numbers in terms of value creation we also assume that the BE traffic exchanging is based on sending party network pays. While the revenues generated are often only the difference between the value creation in the two traffic directions we focus here on value creation, which captures the value created in both directions.

As already noted above, by separating the market into respectively

i) inter-NSP between European NSPs, and

ii) inter-NSP between European NSPs and non-European NSPs we have a level of abstraction that is feasible for our analysis, also noting that the numbers generated should only be considered as rough and indicative estimates. Anticipating price levels in respect to these categories enable us to avoid detailed and market specific pricing issues, which are rather sensitive issues, both from a business perspective as well as from a competition regulation perspective. Further anticipation of price levels are provided below in relation to the business and consumer markets respectively.

The baseline traffic numbers have been taken from the Cisco VNI predictions [Cisco11]. (See the Methodology section above.)

Furthermore, a key number in the below analysis is the translation from Petabyte per month of two-way traffic (summed traffic) into dimensioning capacity. 1 PB per month of average traffic will result in an average traffic of about 350 Gbs. However, a typical dimensioning rule indicates that 3 times the average is needed in order to handle busy hour traffic. This is potentially a low estimate. This translate into a dimensioning link capacity need of about **1,0 Tbs for each PB per month**. This corresponds with current charging practice where the upper 95-percentile is used as baseline for charging in order to take into account the busy hour capacity needs. This analysis do not go into the potentials of dynamic pricing or bandwidth on-demand at the interconnect level.

Business Market Quantification

The following table shows traffic growth evolution in PB per month for the Business market with focus on the Western European market. As stated above the baseline number is 45 PB per Month of generated traffic by the end user endpoints. We assume for the business market that the inter-NSP traffic is 10% of the total traffic. Moreover, we assume that of this inter-NSP traffic 60% is inter-NSP within Europe, while the remaining 40% is intercontinental interconnection with a European NSP. In the second (middle) part of the table we assume a higher growth rate due to the availability of ASQ. In addition we assume that the fraction of inter-NSP traffic increases over the time period up to 20% when ASQ is introduced. In the last part of the table the inter-NSP traffic is further separated into BE and ASQ traffic.

Video Communication - Traffic evolution estimation						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Baseline Traffic evolution (Without ASQ) - Western Europe						
Traffic Growth %		30 %	30 %	30 %	30 %	30 %
Total Traffic (PB per Month)	45	59	76	99	129	167
Inter-NSP traffic (PB per Month) 10 % of total traffic	4,5	5,9	7,6	9,9	12,9	16,7
Intra-Europe (60%)	2,7	3,5	4,6	5,9	7,7	10,0
Intercontinental with Europe (40%)	1,8	2,3	3,0	4,0	5,2	6,7
Additional growth by intro of ASQ						
Growth in % of total traffic - After ASQ is introduced		31 %	33 %	37 %	39 %	40 %
Total Traffic (PB per Month)	45	59	79	108	150	209
% of Inter-NSP traffic	10 %	12 %	14 %	16 %	18 %	20 %
Traffic (PB per Month)	4,5	7,1	11,0	17,2	26,9	41,9
Intra-Europe (60%)	2,7	4,3	6,6	10,3	16,2	25,1
Intercontinental with Europe (40%)	1,8	2,8	4,4	6,9	10,8	16,8
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Ratio of ASQ traffic		25 %	37 %	49 %	61 %	73 %
Intra-Europe (60%)						
BE (PB per Month)		3,19	4,16	5,27	6,30	6,78
ASQ (PB per Month)		1,06	2,44	5,06	9,85	18,34
Intercontinental with Europe (40%)						
BE (PB per Month)		2,13	2,77	3,51	4,20	4,52
ASQ (PB per Month)		0,71	1,63	3,37	6,57	12,23

TABLE 65 – VIDEO COMMUNICATION – TRAFFIC EVOLUTION ESTIMATION – BUSINESS MARKET

The next step is to make assumptions on the price levels. According to arguments provided in the methodology section above we assume that it is desirable to separate the charging models of the content delivery traffic from the person-to-person communication traffic. The table below show the chosen numbers for the business segment.

Anticipated price level, Inter-NSP traffic - Rough Assumptions_Business							
		$/Mbs		Per PB per Month	Per PB per Month over one Year		
Intra Europe				$ Mill	$ Mill		
	BE	2		2	24		
	ASQ	4		4	48		
Intercontinental with Europe							
	BE	4		4	48		
	ASQ	10		10	120		

TABLE 66 – BUSINESS MARKET FORECASTS ON TRAFFIC EVOLUTION AND PRICE LEVEL

Based on the above inter-NSP traffic numbers separated into BE and ASQ traffic and their given price levels we obtain the following tables for inter-NSP value creation.

Inter-NSP value creation, Without and with ASQ - $ Bill. _ Business Market						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Inter-NSP revenues without ASQ - $ Bill.						
Intra-Europe (60%)	0,06	0,08	0,11	0,14	0,19	0,24
Intercontinental with Europe (40%)	0,09	0,11	0,15	0,19	0,25	0,32
Total	**0,15**	**0,20**	**0,26**	**0,33**	**0,43**	**0,56**
Inter-NSP revenues ASQ - $ Bill.						
Intra-Europe (60%)		0,13	0,22	0,37	0,62	1,04
Intercontinental with Europe (40%)		0,19	0,33	0,57	0,99	1,68
Total		**0,31**	**0,55**	**0,94**	**1,61**	**2,73**
Inter-NSP Revenues, Difference between without and with ASQ, in $ Bill.						
With ASQ - Without ASQ		0,12	0,29	0,61	1,18	2,17
Difference - % increase from without to with ASQ		60 %	113 %	183 %	273 %	385 %

TABLE 67 – INTER-NSP VALUE CREATION – BUSINESS MARKET

The last part of the *TABLE 67* provides the "delta" between the two cases; between

i) the case where ASQ traffic is not supported;

ii) the case where ASQ traffic is supported in the market.

Consumer Market Quantification

In a similar way the below tables addresses inter-NSP value creation coming from video communication services offered to the consumer market.

First, the traffic evolution cases are provided.

Video Communication - Traffic evolution estimation						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Baseline Traffic evolution (Without ASQ) - Western Europe						
Traffic Growth %		35 %	35 %	35 %	35 %	35 %
Total Traffic (PB per Month)	165	222	300	405	547	739
Inter-NSP traffic (PB per Month) 20 % of total traffic	33	44	60	81	109	148
Intra-Europe (85%)	28,0	37,8	51,0	68,9	93,0	125,6
Intercontinental with Europe (15%)	4,9	6,7	9,0	12,2	16,4	22,2
Additional growth by intro of ASQ						
Growth in % of total traffic - After ASQ is introduced		38 %	40 %	42 %	44 %	46 %
Total Traffic (PB per Month)	165	227	318	452	651	950
% of Inter-NSP traffic	20 %	21 %	22 %	23 %	24 %	25 %
Traffic (PB per Month)	33	48	70	104	156	238
Intra-Europe (85%)	28,0	40,6	59,5	88,4	132,8	201,9
Intercontinental with Europe (15%)	4,9	7,2	10,5	15,6	23,4	35,6
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Ratio of ASQ traffic		10 %	19 %	28 %	37 %	46 %
Intra-Europe (85%)						
BE (PB per Month)		36,52	48,21	63,62	83,65	109,04
ASQ (PB per Month)		4,06	11,31	24,74	49,13	92,89
Intercontinental with Europe (15%)						
BE (PB per Month)		6,45	8,51	11,23	14,76	19,24
ASQ (PB per Month)		0,72	2,00	4,37	8,67	16,39

TABLE 68 – VIDEO COMMUNICATION – TRAFFIC EVOLUTION ESTIMATION – CONSUMER MARKET

The next step is to make assumptions on the price levels. It is assumed that the BE traffic pricing must be the same for business and consumer traffic while the ASQ traffic will be at a lower price level for consumer traffic typically reflecting a lower level of protection and service availability for the consumer traffic in general compared with the business traffic. A more detail and perhaps realistic differentiation scheme is for further study (beyond ETICS).

Anticipated price level, Inter-NSP traffic - Rough Assumptions_Consumer					
		$/Mbs	Per PB per Month	**Per PB per Month over one Year**	
Intra Europe			$ Mill	$ Mill	
	BE	2	2	24	
	ASQ	3	3	36	
Intercontinental with Europe					
	BE	4	4	48	
	ASQ	7	7	84	

TABLE 69 – CONSUMER MARKET FORECASTS ON TRAFFIC EVOLUTION AND PRICE LEVEL

Based on the above inter-NSP traffic numbers separated into BE and ASQ traffic and their given price levels we obtain the following tables for inter-NSP value creation.

Inter-NSP value creation, Without and with ASQ - $ Bill. _ Consumer Market						
Year	Base Year (2012)	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Inter-NSP revenues without ASQ - $ Bill.						
Intra-Europe (85%)	0,67	0,91	1,23	1,65	2,23	3,01
Intercontinental with Europe (15%)	0,24	0,32	0,43	0,58	0,79	1,06
Total	**0,91**	**1,23**	**1,66**	**2,24**	**3,02**	**4,08**
Inter-NSP revenues ASQ - $ Bill.						
Intra-Europe (85%)		1,02	1,56	2,42	3,78	5,96
Intercontinental with Europe (15%)		0,37	0,58	0,91	1,44	2,30
Total		**1,39**	**2,14**	**3,32**	**5,21**	**8,26**
Inter-NSP Revenues, Difference between without and with ASQ, in $ Bill.						
With ASQ - Without ASQ		0,16	0,48	1,09	2,19	4,18
Difference - % increase from without to with ASQ		13 %	29 %	49 %	73 %	103 %

TABLE 70 – INTER-NSP VALUE CREATION – CONSUMER MARKET

The last part of the *TABLE 70* provides the "delta" between the two cases; between

i) the case where ASQ traffic is not supported;

ii) the case where ASQ traffic is supported in the market.

Sensitivity Analysis of Results and Concluding Remarks

From inspection of the above we observe that the dimensioning multiplier for taking into consideration the busy hour traffic as compared with the average traffic is a critical number. Changing it will create a significant difference, although the impact is linear with this multiplying factor. Moreover, changes in price levels are also a critical issue. Consider the following price level decrease (From - To):

		$/Mbs
Intra Europe		
	BE	2
	ASQ	4
Intercontinental with Europe		
	BE	4
	ASQ	10

		$/Mbs
Intra Europe		
	BE	1,5
	ASQ	2
Intercontinental with Europe		
	BE	3
	ASQ	5

TABLE 71 – PRICE LEVEL SCENARIOS

The result will determine a similar decrease in inter-NSP value creation from 0,56 to 0,42 bill. USDs for the case "without ASQ offered", and from 2,73 to 1,46 bill. USDs the case "with ASQ offered".

Decreasing the growth rate for the ASQ case with instead a linear increase of 1% each year up to 35% growth for the last year (down from 40% the last year) we get a value creation decrease for the ASQ case down from 2,73 to 2,44 bill USDs.

In summary, we see indications on value ranges of revenue generation in the end customer segment or value creation in the inter-NSP space. While the effect of ASQ can be significant in the end customer segment the large effect is in the inter-NSP space. This is an indication that the ASQ interconnect services can help improving the ROI in particular for the NSPs and hence, put them in a position to invest and build out their networks to meet the added demand resulting from introducing and offering ASQ services.

9.2.1.2. Broadband HD Voice

Despite the advent of data service, traditional PSTN voice services remain very profitable. Alternative operators also provide voice services over the Internet Protocol. In addition to Operators, OTT players also compete on the provision of voice services (e.g. Skype). For the end users, voice is the most personalized way of communicating while for the operators, it is an important source of revenue. Consumer preferences indicate that even if the relative market share for voice decreases over time, revenues will remain constant. In addition, studies show that users appreciate the personal nature of voice communication, and believe it offers a more familiar and emotional connection to another person as compared with text messaging, e-mail or social networking [Ericsonn11].

The same whitepaper argues that high-definition voice is a crucial next step in the voice communication technology and business. One factor in particular supports the operator business case for broadband HD voice: the user acceptance of the technology. 76% of the users that experience this service expressed their interest in adopting it, as compared to the traditional VoIP or PSTN voice service. Broadband HD voice results in better quality, more natural sound and improved intelligibility and voice recognition. The improved user experience encourages subscribers to make more calls, and the average call duration tends to be longer. One study showed 96 *percent of HD voice users* were either very satisfied or quite satisfied with the service, and *21 percent* claimed their calls lasted longer.

The benefits of clear, high-quality voice communication are even more tangible for enterprise users, who have been quick to recognize the potential impact of HD voice in business-critical areas such as conference calls and the fast-growing voice-recognition-services market, where better voice quality can lead to improved efficiency, reduced costs and a more productive working environment. From an operator perspective, enterprise demand is one of the strongest pillars of the business case for HD voice. Once convinced of the merits of a technology, enterprises tend to buy it in bulk, and it is relatively straightforward to introduce HD-voice-capable fixed or mobile devices on a departmental or organizational scale. Enterprise users tend to spend more than private subscribers and operators can differentiate themselves by including HD voice in their enterprise packages.

The arrival of OTT players offering free voice services **has resulted in greater urgency to improve voice services**. The business case for HD voice services lies on four key areas: users make more and longer calls when they have access to the technology; operator offerings can keep pace with OTT services; enterprises can benefit from better voice quality; and the technology supports mobility.

HD-voice services have been launched on fixed and cellular 2G and 3G networks, as well as LTE (e.g. see subsection 9.2.1.2 summarizing the major trends of [Ericsonn11] [Kretkowski07] [UK_Broadband] [Orange09] [AudioCodes] [HostMyCalls] [VoIPdistri].

HD voice can be a valuable offering for all networks, and can play a key role in the evolution of GSM, WCDMA, LTE, CDMA and fixed networks. It works best as an ecosystem where subscribers can make high-quality voice calls from wherever they are to any other location. This comprises a market opportunity for ETICS.

Quantification Methodology and Hypotheses

The main sources from which we collected data and information used in our quantification analysis is the following:

- Market surveys and business reports and product brochures.
- Telegeography.
- The Organization for Economic Cooperation and Development, OECD, web site.
- Articles or quotes from executives in the Internet market, which are published online.
- Specialized Internet blogs.
- Industry white papers.
- Voice market business analysis reports.

These data have been used to estimate the overall VoIP service market features, including its size, growth rate and revenue attained. The methodology used for the market quantification analysis can be summarized as follows:

- Firstly, we have used the aforementioned data that report the users' willingness to use (and pay for) broadband HD voice services, which demonstrate that such services do comprise a portion of the market.
- Then, we use the most conservative estimates regarding the VoIP market size: this comprises the basis of the quantification, thus being conservative in our estimates and projections.
- Subsequently, on top of this number we elaborate on different scenarios regarding the portion of the HD voice services revenue over the global VoIP services market.
- Finally, we derive the quantification results, which provide insight of the market potential of such services for the ETICS solution.

As-Is Market Value Quantification

According to [Malik09] VoIP represents 26% of total fixed lines in Europe and 10% of the total fixed-line revenues in 2008. According to [VoIPnews], the VoIP market is significantly fragmented and it is tough to find reliable and non-controversial numbers regarding the market size and growth rate. This is a significant challenge for any market quantification attempt.

TeleGeography calculated that international Skype traffic accounted for 12% of the world's international long distance traffic during 2009 [OECD07]. This is also confirmed by other sources and is also depicted in the number of Skype users: from 474 million in 2009, to 663 million in 2010 [Ericsonn11]**.** Thus it is expected that such a profitable service will continue to the next step by its provision in high quality. Research has shown that 76% of end users that used HD and non-HD voice services declared that they would inclined to use the high quality ones.

To this end, it is no surprise that operators already offer or plan to offer such services. According to [Mohney11], there are over 70 companies supporting or expected to support HD voice, including service providers such as 3, AT&T, BT, France Telecom/Orange, Neutral Tandem, Ooma, Portugal Telecom, SFR, Skype, Sprint, Tata DOCMO, Telekom Austria, Telecom Italia, Telstra, T-Mobile, and Verizon.

Equipment manufacturers supporting HD voice in their products today include Aastra, Acme Packet, Aculab, Arris, AudioCodes, Avaya, Cisco, CounterPath, D2 Technologies, Dialogic, Digium, Ditech Networks, DSP Group, Ericsson, GENBAND, Gigaset (Formerly Siemens), Grandstream, Huawei, HTC, LG, Metaswitch Networks, Motorola, NETGEAR, Nokia, Panasonic, Polycom, Samsung, snom, Sonus Networks, Technicolor (Formerly Thompson), VTech, and WYDEVoice.

In the next years VoIP will be provided via mobile networks and the revenues are expected to be around the $6 billion mark in 2015 (i.e. roughly 4.5 billion Euros) [Mobileeurope11]. It is also estimated there that business mobile VoIP users will increase tenfold over the next five years. This is the baseline figure on top of which the market quantification of the ETICS services for HD voice services will be conducted.

Other estimates such as those of VoIPnews, predicting that the size of the consumer VoIP market will reach $25 billion are considered as being over-optimistic. Therefore, the quantification is based on rather conservative estimates, in an attempt to limit the inevitable error margin in the respective predictions.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

As already explained, broadband HD voice services can serve as a major source of revenue. This does not necessarily imply that the technological aspects of these services in the inter-domain context are trivial or solved, with the major issue being the lack of signalling exchange among the carriers, thus resulting in the "island-type coverage" issue; this must be addressed if HD voice is to fulfil its potential [Ericsson]: At present, if their operators support HD voice, users can make HD-voice calls using a given network within a given network but HD-voice services cannot be guaranteed over multiple networks, thus not meeting user expectations. "*An inconsistent user experience such as when a single call alternates between HD voice and standard quality as the user moves from one radio access technology to another is likely to disappoint and strain relations between the subscriber and operator*. Interconnection is therefore critical" [Ericsson].

The market is already mature about the need for such interconnection. For instance, Ericsson promotes its vision of a Networked Society (estimating more than 50 billion connected devices by 2020) as an HD voice world in which anyone and anything that can benefit from high-definition voice.

This is complementary to other business services, such as business conference calls or live broadcasting that can be bundled to become more effective. The voice services may be provided by NSPs or even OTTs that collaborate with network providers.

In addition to other inter-domain collaboration issues, the use of ASQ goods is necessary for interconnection between the providers to achieve a mass-market scale. This technology will enable the provision of the HD voice services to end users and business users and will also benefit the providers and the OTTs.

We have set the following boundaries on our analysis:

- We consider the VoIP voice services market.
- We envision HD broadband voice services supported by ETICS ASQ as a percentage of the overall VoIP market.

- Geographically, we consider the global market. In a sense, the direct ETICS revenues are also subject to profit sharing with operators on the path to the overseas content, and this will also be ignored (we are looking at gross revenues, not net profits).
- We consider all possible types of customers, residential, small business or businesses. Our analysis is orthogonal to the type of customer that consumes the ETICS solutions, though business customers may adopt earlier the HD voice services due to the tangible benefits in corporate communication and efficiency.
- As far as the customer definition, the market serves all types of stakeholders, including Carriers, OTT, End users, and Business users. Our analysis is not conducted on a vertical market, but rather considering all stakeholders.

We assume that the introduction of ETICS and its ASQ approach would not only gain a market share of the current VoIP services markets, but it would also result in growth for the demand for HD voice services, due to the critical role of ASQ interconnection for such services. Also the fact that 76% of existing users according to Ericsson would switch to these services allows us to complement the expected market growth with a portion of the users that would switch to adopt HD voice services.

We assume that the overall pie of those services could amount to 1-5% of the existing revenue in the next 5 years. This is a low percentage that is due to the fact that we assume that ETICS could only extract a portion of the overall revenue from the roaming and multinational HD voice sessions, spanning across multiple carriers and domains.

Due to the recession effects, we assume that the attained revenue will follow the existing trend for revenue from voice services, i.e. remain more or less constant. Therefore, the value range for the HD voice services will be in the range of *[45, 225] million Euros* globally.

ETICS Market Share and Revenues

We envision that at least in the immediate future, the ETICS market share would be further restricted from the geographical presence of the ETICS carriers. Therefore we estimate that in the next 5 years, ETICS could capture at most roughly a quarter of the global market value provided in the previous section, i.e. being in the range of *[11.25, 56.25] million Euros*.

This percentage is derived from the fact that we assume that ETICS will be rolled out in 2015 by major European operators, covering mostly the EMEA market, with limited presence in America and Asia: The most conservative estimate of the relative size of this market‘s revenue compared to the revenue attained in the global market is roughly 25% [Eastwood06].

An important factor for the ETICS market share and revenue to be estimated would be the adoption of the ETICS technology also by mobile operators, in order to interconnect their networks and provide HD voice to their (roaming) users and multi-national business customers.

- The positive scenario (for ETICS) would be that ETICS would become the de facto standard for such services, thus securing most of the attained revenue.
- A more conservative scenario would be that ETICS would only be adopted by fixed networks in order to complement their existing business VoIP services (e.g. www.bt.com/business/broadbandandvoice/).

- A bad scenario prescribes that the ETICS rollout would have very limited impact on this market: Mobile operators would insist on keep using "fragmented" IPX island solutions and the adoption of ETICS for fixed network HD voice interconnection will be very limited.

This adoption factor, as captured by three different scenarios, will impact the sensitivity analysis of the quantification results presented in the next section.

Sensitivity Analysis of Results

It is clear that the basic figure for the market quantification is the 4.5 billion Euros estimate for the VoIP services in 2015. This is the figure that if significantly modified will greatly alter all the other results. This is why we have chosen the most conservative estimate that could be found from online resources. The estimates for the market share for the HD voice services and the resulting revenue have been also conservative, so this quantification is a very conservative, almost worst case analysis.

In order to further constraint our results, we perform a sensitivity analysis assuming that the ETICS solution will be able to materialize just a portion of the value provided in the previous subsection. This is due to two main reasons:

a) It remains unclear whether ETICS will be used as the dominant interconnection solution, especially for mobile operators; this is captured by the two scenarios presented in the previous subsection.

b) ETICS operators could only attain a portion of these services value. The exact portion remains unclear, and will largely depend on the value chain configuration and the respective relative market power of the ETICS alliance/operators. As part of this market quantification we refrain from apportioning the revenue among the multiple stakeholders, instead we restrict our attention to the value of the services as a whole, as already explained in the methodology subsection.

Based on the relative success of ETICS due to **a)**, we perform a sensitivity analysis based on three scenarios, one pertaining to a big success of the ETICS solution, one to medium and one to mediocre to further calibrate the quantification of the previous subsection.

This leads to our final quantification results, which are presented in the table below:

ETICS market value range [11.25, 56.25] € million			
Scenario	Best [75% share]	Medium [30% share]	Moderate [5% share]
ETICS revenue range	[8.4, 42.2]	[3.4, 17]	[0.6, 2.8]

TABLE 72 – SCENARIOS ON MARKET VALUE RANGE

Overall, this is a market niche whose size will be crucially affected by the capacity of ETICS to serve as the major interconnection solution also in the mobile telephony industry. In the case that the ETICS/SEFA solution manages to be a competitive/complementary solution to IPX-IMS solutions, then the added value and respective market size and growth will be even more significant. In case it remains a solution oriented to fixed networks, then the premium HD voice services will most likely be adopted as a complementary solution for business users: Though the respective size of this market is not that big compared to the market pie of other ETICS services, it will provide additional motivation for business users to adopt the ETICS solutions and NSPs can use and bundle such services in their product offerings.

9.2.1.3. Social Networking Triggered Rich Media Communication

In order to define the social networking triggered rich multimedia market the Three Dimensional Business Definition framework from Harvard Professor Derek F. Abell will be applied. Derek Abell's model [Nijssen01] analyses the market according to three dimensions: the first dimension relates to the customer groups or segments that can be identified in the market, the second addresses these customers' needs and the third identifies the alternative technologies available to satisfy those needs.

Customers

- Final users who wish to connect to other people via the Internet

Needs

- Showcase one's personal identity [Kabani10]
- Connect with others, build relationships [Kabani10]
- Join interest groups, belong to the community [Kabani10]
- Have fun and excitement [ISG11]
- Be entertained and relieve stress [ISG11]
- Enjoy the competitive spirit [ISG11]

Technologies

A social networking service is an online service, platform, or site that focuses on building and reflecting of social networks or social relations among people. They can share interests and/or activities and people with similar interests, backgrounds or activities make their own communities. A social network service consists of a representation of each user (often a profile), his/her social links, and a variety of additional services [Boyd07].

In order to social networking services, platforms like Facebook use rich multimedia to promote users' interactions and entertainment. People can share comments, photos, videos and other links, as well as chat with friends, play online games, take quizzes, listen to music, join communities, etc. Considering these different functionalities available on social networks, some generate more data traffic than others, and, therefore, are more prone to be affected by the Internet connection quality. Since video and social gaming have higher data traffic rates than text or static image, the market quantification will focus on these two components of rich multimedia on social network environment.

In addition to this, video sharing websites, such as YouTube and Vimeo, are platforms where a fast growing amount of user-generated content is shared and viewed all over the world. As these websites provides video streaming, they generate a lot of data traffic and the user's quality of experience depends on the Internet connection performance.

Finally, a different social service to connect with other people through the Internet is represented by Skype, which is the biggest company to offer VoIP and video calls. This kind of service is highly dependable on connection quality and because of this is relevant to this market quantification.

Revenue Model

There are different revenue modes being used by the companies in this market, the three cited below are the main types:

- Advertising

- Transaction fees
- Subscription

The most common revenue model is the advertising. This model is the main revenue stream for social networks and video sharing websites. Facebook, for example, earns 85% from ads and continuously tries to create newer and more appealing forms of advertising in order to increase value to its advertisers and as a result grow its own revenue. Facebook has introduced new ad formats, for example, Sponsored Stories ad and the “Comment” ad, all leveraged by the social aspect of the platform. Apart from regular banner ads, Facebook also uses video advertising, such as Facebook's official "Sponsored Video" unit, in-banner display ads within apps, interstitials within games and apps and virtual currency ads within games, the latter having better performance than other formats [TubeMogul10]. YouTube now offers several types of ads, including display ads on its home page and on the video pages, ads that promote videos and ads that run in the video stream or pop up on the bottom of a video [Miller10].

Besides advertising, revenues can also come from transaction fees, which are incurred when users purchase digital goods and services from the platform provider or from a third party content provider, such as game developers and movie producers. Transaction fees are the most important source of money for social gaming developers and are also applied by Skype. While social gaming developers earn from selling virtual goods, Skype charges for services other than Skype-to-Skype calls, such as mobile and landline calls (Skype-out), in a pay as you go model.

Finally, the last model is subscription, which is employed by Skype. This model implies paying a fixed monthly rate that allows users to have access to a set of pre-determined services for the period.

Geographical Definition

The geographical scope of this analysis will be defined as global, as the key players examined have worldwide presence.

Quantification Methodology and Hypotheses

The data and information used were collected from secondary sources, such as presentations featuring market value and growth trends, reports from international institutions and industry news.

The market to be quantified comprises four kinds of companies. Firstly, social gaming providers, which can have their own platform to reach the final users or, instead, operate in a third party platform, such as the social network Facebook. The market quantification will take into account the total revenues from both game and platform providers. For instance, for each transaction made during a Zynga’s game on Facebook, Zynga gets 70% of the fee paid by the users and 30% of it goes to Facebook. All game developers that work through Facebook’s interface use this basis, however, other companies, such as the two Japanese Gree and DeNA, have their own social gaming platforms, and therefore, retain all revenues.

There were a few sources of data regarding the social gaming market and its forecast, which differed significantly from each other. Although the information available did not specify the boundaries of each study it was concluded that some considered only the game developers’ side, while one of them also included revenue from the platforms’ side, and, therefore, showed distinctively higher values compared to the rest. The more comprehensive approach was chosen for the following sections.

The second market refers to video sharing website like YouTube. The third and fourth segments are made from both social networks and VoIP providers, represented by Facebook and Skype, respectively. Since

these two companies are leaders in their segments, they will be used as a proxy for their respective market quantification.

The overall market was estimated as the aggregation of these four market segments.

As-Is Market Value Quantification

The market will be split in four parts, which, brought together, will account for the as-is market quantification. Firstly, the market value raised by social gaming will be calculated. Then, it will be estimated how video-related activities bring revenues to regular social networks. Finally, Skype's earnings will account for the value of video and voice calls provided by other social services.

Some companies, such as Zynga, EA Playfish and Wooga, develop games that are played on social network platforms. Zynga is the leader in this market, having almost 40% of market share (39.1% in 2010 according to IHS Screen Digest, 2011) [Warner11]. If the social games developer market were valued based on Zynga's revenue, $1.14 billion [Bloomberg12b], and its market share, this market would be $2.85 billion. Adding $2.00 billion earned by Japanese Gree and DeNA, the two leading social gaming networks, the total market would value $4.85 billion. In 2011 SuperData Research, on behalf of social games platform Viximo, conducted a study that estimated the worldwide social gaming market to be $4.90 billion [Cohen10], which is in agreement with the rough estimation made above, and was selected for the as-is market quantification.

YouTube's revenue in 2011 was estimated to be $1.3 billion by Citi Investment Research and Analysis [Schonfeld11] and $1.6 billion by Barclays Capital Anthony DiClemente [Kafka11]. As Google, YouTube's owner does not release data about the video sharing website's revenues, and these values are only estimates, this analysis will be rather conservative and choose the lowest between them, $1.3 billion. In October, 2011, YouTube delivered almost 44% of the 201 billion videos viewed globally as stated by comScore [Richmond11]. Therefore, the total market for video sharing will be calculated from YouTube's share on the global online video market. In this way, video sharing revenues would result in $2.95 billion.

Facebook is the biggest social network in the world, with 845 million users [Fac11] and although it is not a video provider (e.g. YouTube, Vevo, Netflix, Hulu) [Lasar11] it is ranked among the top 10 video content properties by unique viewers according to comScore Video Metrix. Therefore, Facebook will serve as estimation for the whole video-related value generated through social networking.

In 2011 Facebook had revenues for $3.71 billion, of which $557 million, or 15%, came from payments [SEC12]. Payments derive from its currency system, Facebook Credits, and are used to buy virtual goods for games or make other transactions in the social network, for example, buy gifts and rent movies. Since these payments are mainly used in social games they will be subtracted as they are implicit in the social gaming market estimation. The remaining Facebook's revenue, $3.15 billion, came from advertising. Advertising revenue is strongly correlated to the number of impressions or clicks, which in turn varies according to the time spent on the social network. Because of this, the value of videos on Facebook will be estimated by the time users spend watching them compared to the total time they are engaged on the social platform.

The Social Media Report Q3 2011, released by Nielsen, revealed that Americans spent 53.5 billion total minutes on Facebook and the average user spent 382 minutes in May 2011, when data was collected [Nielsen11]. In the same month, comScore announced that Facebook had 48.2 million U.S. unique viewers who on average spent 19.3 minutes watching videos, giving a total of 930 million minutes, equivalent to

1.7% of total time spent on Facebook [ComScore11]. Using the Americans' behavior for the whole user base the associated revenue is $54.8 million, 1.7% of total advertising.

Finally, Skype will represent social services that enable video and voice interactions among users. There was no data available about its revenue in 2011, therefore, it was estimated to have grown at the same rate as the previous year. Skype revenues increased by 20% from $719 million in 2009 to $860 million in 2010 [Rao11a]. Applying this 20% growth rate, the estimated revenue in 2011 would be $1.03 billion.

Summing all four values obtained above the result is $8.94 billion. Using an exchange rate of 1.00 USD = 0.76 EUR it equals to €6.79 billion.

2011	Social Gaming	Video Sharing	Video - Social Networks	Video and Voice Calls	Total
$, billions	4.90	2.95	0.05	1.03	8.94
€, billions	**3.72**	**2.24**	**0.04**	**0.78**	**6.79**

TABLE 73 – AS-IS MARKET

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Social gaming market is expected to reach approximately $7.4 billion in 2013 from the current $4.9 billion in 2011 [Snider11]. Asia accounts for 40% of the worldwide social gaming market [Snider11], mostly pushed by mobile social gaming platforms Gree and Mobage, both Japanese. Mobage drives 90% of DeNA's revenue [Toto11a], its parent company, which is growing remarkably, jumping from around $592 million in 2010 to $1.39 billion in 2011 [Bloomberg12a], a 134% increase in revenue.

ETICS is a candidate solution to allow E2E assured QoS for LTE subscribers involved in online gaming and social network multimedia. Therefore, since top social gaming providers, for instance, Zinga, are starting to enter the mobile market, it will be assumed that ETICS will push this segment in a similar way the Japanese leaders are doing in their home country. Considering that ETICS ASQ can boost 5% of the world's social gaming market ($4.9 billion) to grow at the same rate as Mobage (134%), it will potentially raise extra $573 million. Adding this value to the $7.4 billion forecast, the social gaming market should be near $8.0 billion.

Social Gaming Market ($, billions)	As-Is	To-Be
Natural Conditions	4.9	7.4
ETICS ASQ	-	5% * 4.9 * 234% = 0.6
Total	4.9	8.0

TABLE 74 – SOCIAL GAMING MARKET

From 2011 to 2012 YouTube's revenue will grow 28% based on Citi Investment Research and Analysis's forecast. It will be assumed that ETICS will incite the whole video sharing market to grow at this CAGR for the next two years. In this manner, this market will value $4.8 billion.

Worldwide social network ad revenues are expected to grow in the next years. eMarketer [Rao11b] estimates that in 2013 it will be equal to $9.99 billion, 80% higher than $5.54 in 2011. Using the same growth to the video on social networks' as-is market it would go from $54.8 million to $98.7 million, representing the natural tendency. However, ETICS adoption would incite further growth. IAB Internet Advertising Revenue Report [PwC11] shows that in the U.S. market, rich media and digital video represent about 10% of the total online advertising revenue. This ad format is what ETICS solution seeks to enhance in the social networking environment. Therefore, this estimation will assume that ETICS ASQ will potentially achieve the same percentage of this ad format on social networks. Since the total ad expenses on social

networks are supposed to be $9.99 billion in 2013, 10% would mean $1.0 billion. Consequently, the total future market in this context will be $1.1 billion.

Skype's video and voice calls quality highly depend on Internet connection performance. From 2007 to 2010 Skype's average monthly paying users have grown almost linearly. If this trend continues, then in 2013 it will reach 13.0 million paying users a month. However, with ETICS, this number should be higher. It will be considered that from 2010 to 2013 the growth would have a CAGR of 20%, same rate that it had from 2009 to 2010. In this case, paying users would be 15.2 million a month. This difference of 2.2 million users would be served by ETICS. In 2010 Skype saw average communications services revenue per paying user of $97.00 [Rao11a], which will be considered to remain constant through 2013. Therefore, ETICS would determine $217.9 million additional to $1.26 billion, totaling $1.5 billion.

Skype's To-Be Market	Paying Users (millions)	Total Revenue ($, billions)
Natural Conditions	13.0	0.013 * 97 = 1.3
ETICS ASQ	2.2	0.0022 * 97 = 0.2
Total	15.2	0.0152 * 97 = 1.5

TABLE 75 – SKYPE'S TO-BE MARKET

Adding all four contributions, the final to-be market will be $15.4 billion. In euros it is equivalent to €11.7 billion.

To-Be Market	Social Gaming	Video Sharing	Social Network	Video and Voice Calls	Total
$, billions	8.0	4.8	1.1	1.5	15.4
€, billions	**6.1**	**3.7**	**0.8**	**1.1**	**11.7**

TABLE 76 – TO-BE MARKET

ETICS Market Share and Revenues

In the social gaming ecosystem few big companies have control of a significant share of the market. The top three players are Zynga, which has 40% market share in Facebook's gaming platform, Gree and Mobage, two Japanese mobile social gaming platforms whose revenues reach around $2.0 billion [Toto11b] of the $4.9 billion current market. As Zynga earned $1.14 billion, these top companies together represent roughly 64% of the market. Zynga, Gree and DeNA, parent company of Mobage platform, are in the run of further developing their customer bases and services. Therefore, it is probable that they would be interested in investing some money to provide better quality of experience to their users through ETICS solution. If ETICS partners were able to penetrate in 50% of their operations and receive 5% of their revenues, it would earn $118.6 million of the $7.4 billion to-be market portion. Adding 5% of revenue from the ETICS driven to-be market ($0.6 billion), equal to $28.7 million, it results in $147.3 million for ETICS partners.

The same rational will be applied to the video sharing market, which was estimated to be $4.8 billion by 2013. Assuming that ETICS solution will be adopted by the leader YouTube, which has 44% of market share, and will be deployed in half of YouTube's video deliveries, ETICS partners will gain $53.0 million (5% of YouTube's revenue that is associated to ETICS services).

The social network rich media market will be mainly constituted by the potential growth pushed by ETICS, equal to $1.0 billion. Assuming that from that revenue ETICS can get 5%, its revenue would be $50.0 million.

Skype's revenue is currently generated primarily from paying users, who accounted for only 6% of the monthly connected users in 2010 [SEC11]. Since the revenue is driven by a few customers who see enough

value on Skype's services to pay for them, it is likely that they would also pay an extra fee for higher quality provided by ETICS. For this reason, ETICS will be considered to reach a considerable penetration among them, for example, 40%. Applying this percentage to the 13.0 million paying users prior to ETICS, it results in 5.2 million. Adding the 2.2 million users due to ETICS, it totals 7.4 million customers who will spend on Skype's services.

On average, Skype's paying user spends $97.00 a year, equivalent to $8.08 per month. If ETICS gets $2.00 monthly for each paying user, 25% of the user's expense, then it will earn $178.2 million a year. Since $97.00 is only an average, it is possible that ETICS solution attracts those customers that spend more than $97.00, and, in this case, ETICS' premium price would be even lower than 25% of their monthly budget.

Finally, summing the above revenues from each market segment the total revenue for players adopting ETICS solution is $428.5 million. Converting it to euros, the value becomes €325.7 million.

ETICS Revenue	Social Gaming	Video Sharing	Social Network	Skype	Total Revenue
$, millions	147.3	53.0	50.0	178.2	428.5
€, millions	**111.9**	**40.3**	**38.0**	**135.4**	**325.7**

TABLE 77 – EXPECTED REVENUE FOR PLAYERS ADOPTING AND PARTICIPATING IN ETICS

Sensitivity Analysis of Results

The to-be market used several hypotheses. First of all, it was assumed that ETICS could induce 5% of the current social gaming market to grow at a higher rate than its expected natural growth.

Social Gaming	ETICS' Impact on 2%	ETICS' Impact on 5%	ETICS' Impact on 8%
To-Be Market - $, billions	7.6	8.0	8.3

TABLE 78 – SENSITIVITY ANALYSIS OF THE SOCIAL GAMING TO-BE MARKET

The video sharing market could grow at a more optimistic or pessimistic CAGRs.

Video Sharing	YouTube's CAGR of 21%	YouTube's CAGR of 28%	YouTube's CAGR of 35%
To-Be Market - $, billions	4.3	4.8	5.4

TABLE 79 – SENSITIVITY ANALYSIS OF THE VIDEO SHARING TO-BE MARKET

Moreover, the rich media ad penetration on social networks could be lower or higher than 10% of the total ad revenue.

Social Networks	Rich Media Ads 5% Share	Rich Media Ads 10% Share	Rich Media Ads 15% Share
To-Be Market - $, billions	0.60	1.10	1.60

TABLE 80 – SENSITIVITY ANALYSIS OF THE SOCIAL NETWORK TO-BE MARKET

The video and voice calls market could also present different values depending on Skype's CAGR from 2010 to 2013 pushed by ETICS solution. In the base scenario it was said to be equal to the previous year's growth rate, 20%.

Video and Video Calls	Skype's CAGR of 15%	Skype's CAGR of 20%	Skype's CAGR of 25%
To-Be Market - $, billions	1.3	1.5	1.7

TABLE 81 – SENSITIVITY ANALYSIS OF THE VIDEO AND VOICE CALLS TO-BE MARKET

Finally, aggregating the four above segments for the pessimistic, base and optimistic cases, the to-be market can vary as follows.

Total	Pessimistic	Base Scenario	Optimistic
To-Be Market - $, billions	13.9	15.4	17.0
To-Be Market - €, billions	**10.5**	**11.7**	**12.9**

TABLE 82 – SENSITIVITY ANALYSIS OF THE TOTAL TO-BE MARKET

However, not only the to-be market quantification was based on assumptions, but also the ETICS market share and revenues. ETICS penetration on the top three players' operations could be better or worse than 50%.

Social Gaming	ETICS' Penetration of 35%	ETICS' Penetration of 50%	ETICS' Penetration of 65%
ETICS Revenues - $, millions	94.4	147.3	199.8

TABLE 83 – SENSITIVITY ANALYSIS OF THE SOCIAL GAMING ETICS' REVENUE

The same can happen to the video sharing market.

Video Sharing	ETICS Penetration of 35%	ETICS Penetration of 50%	ETICS Penetration of 65%
ETICS Revenues - $, millions	33.3	53.0	77.0

TABLE 84 – SENSITIVITY ANALYSIS OF THE VIDEO SHARING ETICS' REVENUE

In the social networks environment no other hypothesis was made during the market share and revenues calculation. Therefore, the following table represents the three case scenarios based only on the possible changes on the to-be market previously demonstrated.

Social Networks	Pessimistic	Base Scenario	Optimistic
ETICS Revenues - $, millions	25.0	50.0	75.0

TABLE 85 – SENSITIVITY ANALYSIS OF THE SOCIAL NETWORK ETICS' REVENUE

On the other hand, ETICS share of video and voice calls market could be lower or higher than the assumed 40% among Skype's paying users.

Video and Voice Calls	ETICS Penetration of 30%	ETICS Penetration of 40%	ETICS Penetration of 50%
ETICS Revenues - $, millions	102.8	178.2	256.5

TABLE 86 – SENSITIVITY ANALYSIS OF THE VIDEO AND VOICE CALLS ETICS' REVENUE

Adding all ETICS revenues for the pessimistic, base and optimistic cases, the total result in the three different scenarios are shown below.

Total	Pessimistic	Base Scenario	Optimistic
ETICS Revenues - $, millions	255.4	428.5	608.2
ETICS Revenues - €, millions	**194.1**	**325.7**	**462.2**

TABLE 87 – SENSITIVITY ANALYSIS OF THE TOTAL ETICS' REVENUE

It is also important to assess the influence each assumption has on the quantification process. Each variable was varied by 10% alone, while all others remained the same as in the base scenario. In this way, it is possible to see the individual impact of them on the final result.

10% Change in	ETICS' Impact on Social Gaming To-be Market	Video Sharing To-Be Market	Rich Media Ads' Share	Skype's CAGR	ETICS' Penetration on Social Gaming	ETICS' Penetration on Video Sharing	ETICS' Penetration on Video and Voice Calls	Total
Impact on ETICS Partners' Revenue	0.67%	0.62%	1.17%	4.34%	2.77%	1.24%	2.92%	13.78%

TABLE 88 – ASSUMPTIONS IMPACT ON THE QUANTIFICATION PROCESS

The most important assumptions, with higher impact on the quantification, were the ones concerning the video and voice calls and also the ETICS' penetration on the social gaming market. The assumed value for Skype's CAGR was used to predict the amount of new paying users ETICS solution would create. These paying users have direct effect on ETICS partner's revenue, since they will pay a premium fee for better QoS, and show the heaviest influence on the market quantification's final result. Besides that, assumptions regarding ETICS' penetration directly impact on the natural markets for social gaming and video and voice calls, which comprise more than 50% of the total to-be market.

9.2.1.4. Multimedia Applications Solutions

It will be interesting to look globally at the multimedia market and its growth; in particular the following service taxonomy is utilized from the source data provided by IDC [IDC12].

Business Area	Segments	Services	Definition
MULTIMEDIA APPLICATION SOLUTIONS	Mob TV Multimedia Applications & Integration	Mob TV Multimedia Applications Consulting & Integration	Consulting, planning, design, custom design and engineering, and integration of Mob TV multimedia applications *and multiscreen*
		Mob TV Multimedia Middleware	Software & platforms associated Mob TV *or multiscreen* multimedia middleware solutions
		Mob TV Multimedia Product-attached services: Installation and Maintenance	Installation & maintenance including sw & platform upgrades/support associated with Mob TV */multiscreen* multimedia solutions
	IPTV Multimedia Applications & Integration	IPTV Multimedia Applications Consulting & Integration	Consulting, planning, design, custom design and engineering, and integration of IPTV/*(and evolving managed networks)* multimedia applications
		IPTV Multimedia Middleware	Software & platforms associated IPTV *(and evolving managed networks)* multimedia middleware solutions
		IPTV Multimedia Product-attached services: Installation and Maintenance	Installation & maintenance including sw & platform upgrades/support associated with IPTV *(and evolving managed networks)* multimedia solutions
	Multiscreen Multimedia	Multiscreen Multimedia	A platform that allows to extend reach to TV, PC and Mobile with Multi-Screen Multimedia Services
	Cable TV Multimedia	Cable TV Multimedia	Services supporting the build-out of infrastructure required to provide video services via IPTV technologies to television sets.

TABLE 89 – BUSINESS DEFINITION PER SEGMENT

The table above identifies the possible business services for each segment of the multimedia application solutions. The multimedia market is not presented in relation to the QoS aspects, which may need a specific analysis. However, within the global multimedia market it is envisaged that a part of it can address QoS needs and create a market for QoS enabled services for multimedia. This percentage is not yet identified in this analysis.

This business is mainly oriented to the market of system integration & providers and, therefore, indirectly linked to NSP/OTT businesses.

The geographical scope of this analysis will be worldwide, with specific data for Europe, Americas, EMEA and APAC.

Finally, the report is targeting the Carrier's market, therefore, the customer community served is both residential and enterprise, but strongly oriented to residential customers.

Quantification Methodology and Hypotheses

The methodology here adopted is to address a specific market segment of multimedia services and to review existing market growth forecast till 2016, organised per market areas, in order to identify key aspects and trends capable to justify new technologies for the collaboration among actors on ASQ services.

To be noticed that, due to the nature of e2e services, any geographic areas with apparently low growth might be compensated by crossed areas having major growth. Therefore, the worldwide market trend is the reference one for the ETICS.

As-Is Market Value Quantification

International Data Corporation (IDC) provided a Multimedia Market View on historical and forward looking sizing. The worldwide market is presented in the following table.

CORPORATE MARKETING

Market Sizing

MARKET VIEW

Multimedia Carrier Markets Summary
February 2012

In B EUR
Exchange rates: 2011-2016: €1 = $1.35

	Worldwide						
	2011	2012	2013	2014	2015	2016	CAGR 11-16
Multimedia Applications	1.60	1.96	2.21	2.54	2.95	3.49	17%
Market Size Growth YoY		22.8%	12.3%	15.4%	15.9%	18.3%	
IPTV Multimedia	0.56	0.66	0.72	0.80	0.83	0.93	11%
Market Size Growth YoY		18.9%	8.6%	11.0%	4.1%	12.8%	
IPTV Multimedia Applications	0.26	0.31	0.33	0.37	0.39	0.45	12%
Market Size Growth YoY		19.4%	8.2%	10.0%	7.3%	14.9%	
IPTV Multimedia Product-attached	0.09	0.10	0.10	0.10	0.09	0.10	2%
Market Size Growth YoY		13.7%	2.0%	0.5%	-7.3%	4.7%	
IPTV Multimedia Middleware	0.21	0.25	0.28	0.33	0.34	0.38	13%
Market Size Growth YoY		20.5%	11.7%	15.8%	4.1%	12.6%	
Mob TV Multimedia	0.70	0.85	0.89	0.96	1.08	1.24	12%
Market Size Growth YoY		20.4%	5.3%	7.8%	12.7%	14.8%	
Mob TV Multimedia Applications	0.33	0.40	0.42	0.45	0.50	0.57	11%
Market Size Growth YoY		21.0%	3.5%	9.3%	9.9%	14.2%	
Mob TV Multimedia Product-attached	0.12	0.14	0.16	0.17	0.20	0.24	15%
Market Size Growth YoY		15.7%	16.4%	9.4%	14.3%	20.4%	
Mob TV Multimedia Middleware	0.25	0.31	0.32	0.33	0.38	0.43	11%
Market Size Growth YoY		21.7%	2.7%	4.9%	15.7%	12.8%	
Cable TV Multimedia	0.15	0.16	0.17	0.19	0.23	0.26	12%
Market Size Growth YoY		8.1%	8.2%	12.9%	18.3%	14.6%	
Multiscreen Multimedia	0.19	0.30	0.43	0.60	0.81	1.05	40%
Market Size Growth YoY		54.0%	42.3%	39.7%	36.2%	29.8%	
Total Multimedia Market Size	1.60	1.96	2.21	2.54	2.95	3.49	17%
Market Size Growth YoY		22.8%	12.3%	15.4%	15.9%	18.3%	

TABLE 90 – WORLDWIDE MULTIMEDIA MARKET SIZE

It is possible to see that the total market will show a CAGR of 17% from 2011 to 2016. Currently, the multimedia carrier market is equal to €1.6 billion, from which 44% belongs to mob TV multimedia, followed by 35% of IPTV.

However, this condition will change. By 2016 multiscreen multimedia will account for 30% of the market, having a CAGR of 40%, while IPTV will decrease to 27% and mob TV to 36%. Cable TV multimedia's share will remain stable, around 8%.

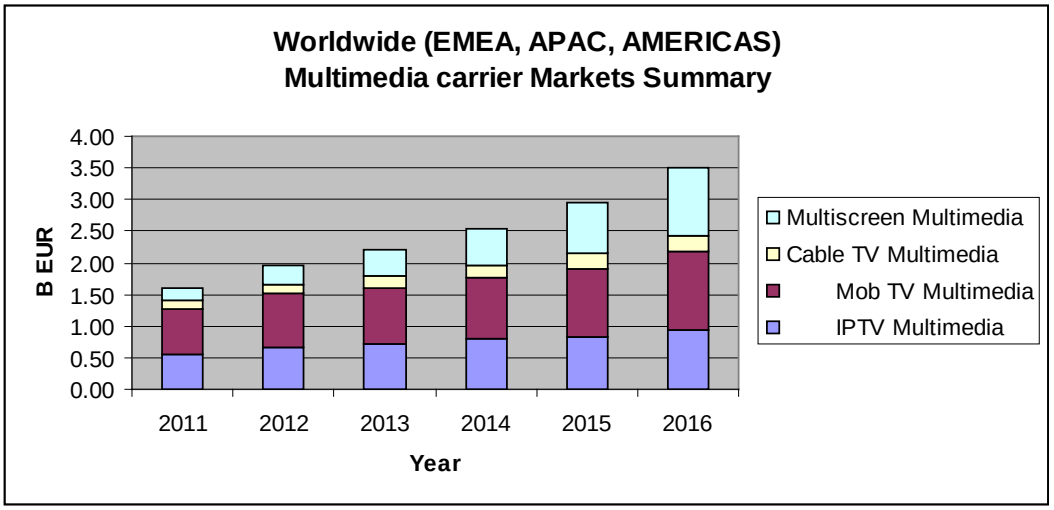


TABLE 91 – WORLDWIDE MULTIMEDIA CARRIER MARKETS SUMMARY

IDC's Multimedia Market View also showed data split by regions. Nowadays EMEA controls 26% of the world's market, APAC 52% and the Americas 22%. However, the consumption's behaviour is very different in each region.

Firstly, IPTV is the dominant segment in both EMEA (45%) and the Americas (38%) today, while APAC is led by mob TV (64%). In the Americas, mob TV has a really small share, only 12%, and this value will not grow in the next years.

Furthermore, the multiscreen multimedia is supposed to grow a lot in both EMEA (42% CAGR) and the Americas (45% CAGR), reaching market shares of 44% and 54%, respectively, but its share in APAC will remain low through 2016, when it will account for only 12% of the region's market.

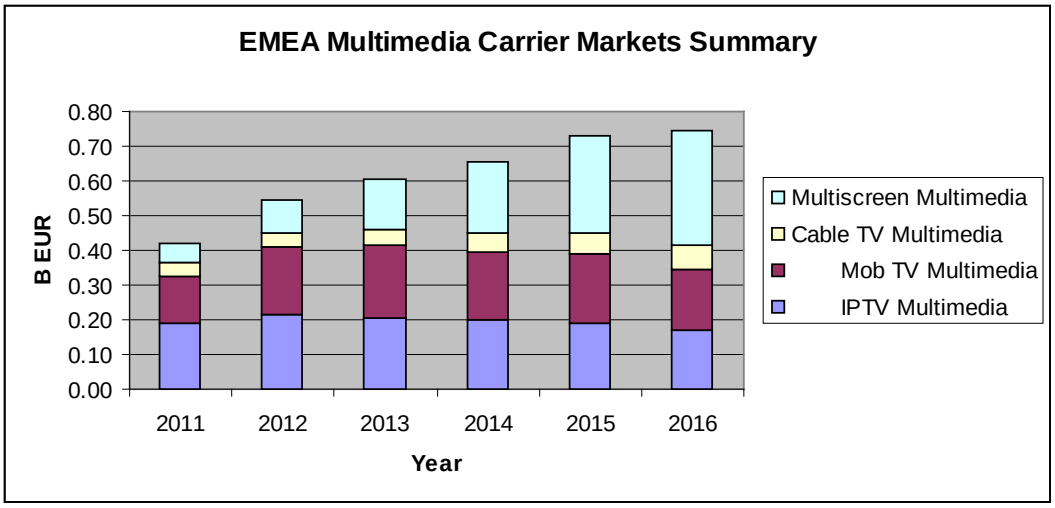


TABLE 92 – EMEA MULTIMEDIA CARRIER MARKETS BY SEGMENT

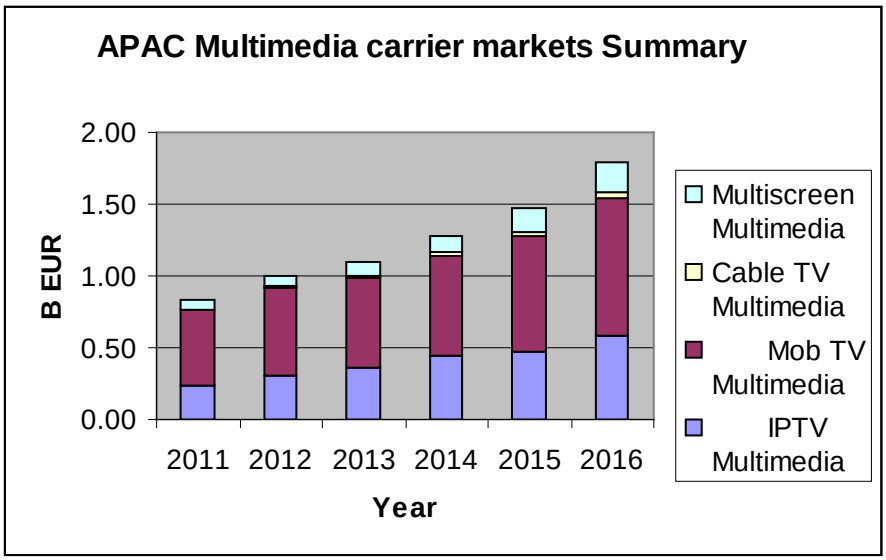


TABLE 93 – APAC MULTIMEDIA CARRIER MARKETS BY SEGMENT

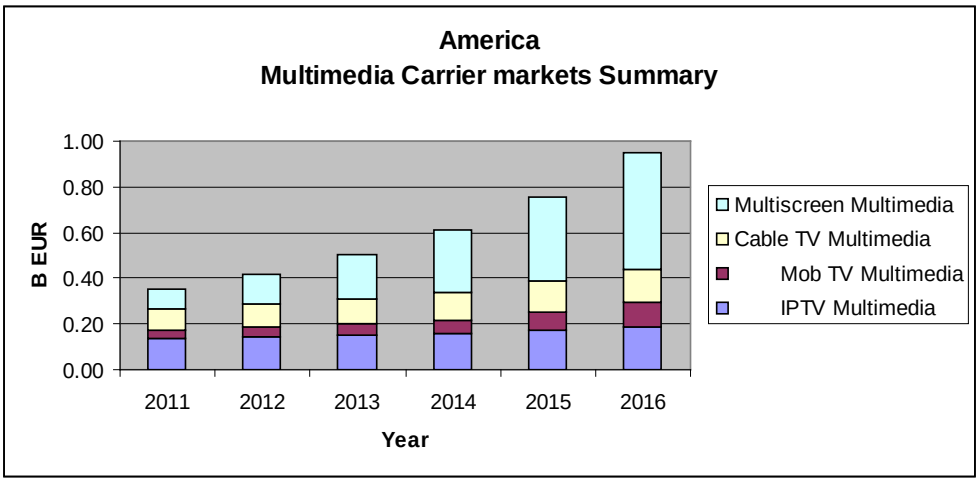


TABLE 94 – AMERICAS MULTIMEDIA CARRIER MARKETS BY SEGMENT

Europe represents 98% of EMEA's market, so it drives that market and has the same trends presented in *TABLE 92*.

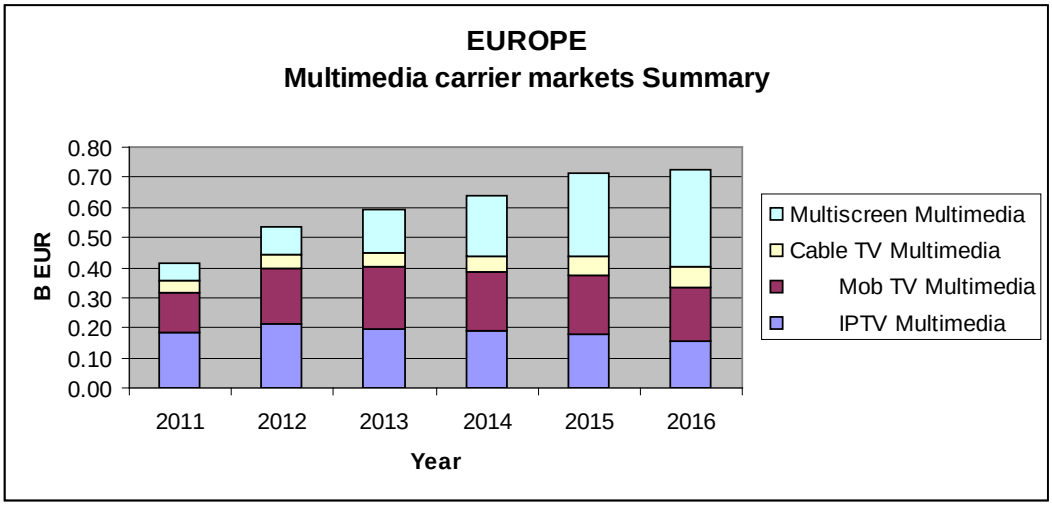


TABLE 95 – EUROPE'S MULTIMEDIA CARRIER MARKETS BY SEGMENT

The Americas will show the highest CAGR during the period 2011 to 2016, pushed by the multiscreen multimedia segment, which will grow at CAGR of 45% and reach 54% of market share. EMEA's CAGR will also be driven by the multiscreen market, since it will have a 42% CAGR and by 2016 it will account for 44% of the region's market.

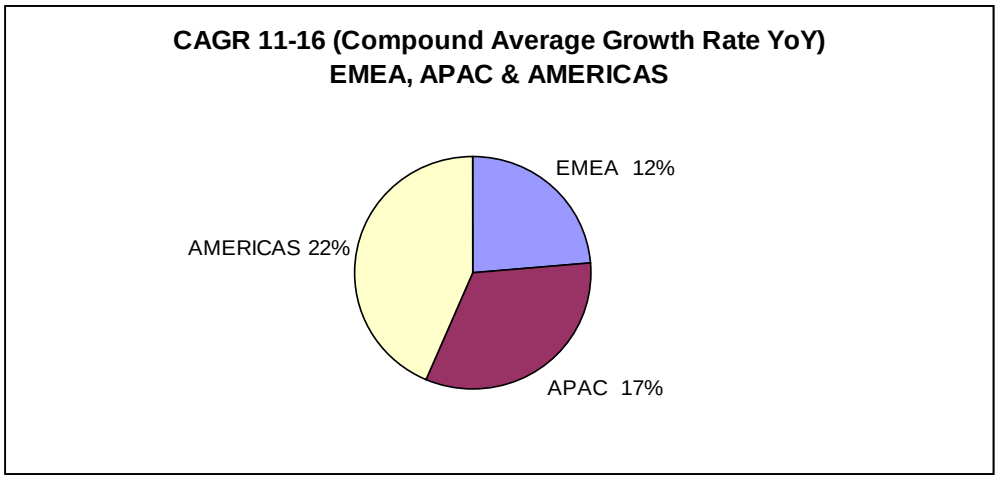


TABLE 96 – CAGR 11-16 BY REGION

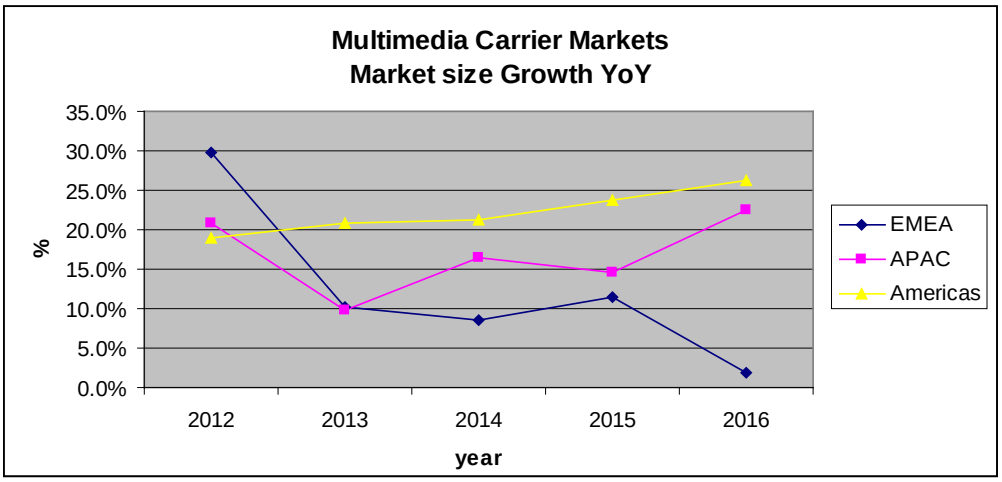


TABLE 97 – MULTIMEDIA CARRIER MARKETS GROWTH

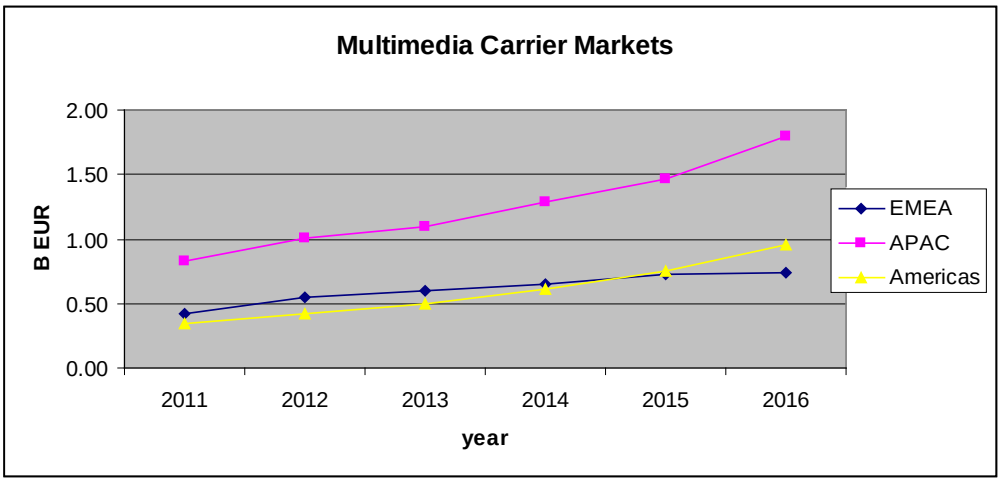


TABLE 98 – MULTIMEDIA CARRIER MARKETS EVOLUTION

From 2013 on, the Americas will have the highest growth rate and will grab market share from EMEA.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

The market analysis and forecasts presented in the previous section only address the multimedia market without giving a precise overview of the services that are related to the needs of QoS and ASQ solutions proposed by ETICS.

A possible cross check can be made by the evaluation of the market and growth of a specific QoS enabling technology, like MPLS within the IP market. The following table shows the IP market size including figures for the MPLS segment.

IP Markets Summary
October 2010

In B EUR	October 2010 Worldwide						
	2009	2010	2011	2012	2013	2014	CAGR 09-14
MS WAN	0.44	0.28	0.19	0.14	0.10	0.07	-30%
Market Size Growth YoY	-28.0%	-37.0%	-30.1%	-26.6%	-26.5%	-29.7%	
Business TDM Access	0.19	0.16	0.12	0.10	0.08	0.07	-19%
Market Size Growth YoY	-30.3%	-16.5%	-22.6%	-15.4%	-22.1%	-16.7%	
IP	6.31	7.02	7.52	7.97	8.51	9.26	8%
Market Size Growth YoY	-9.0%	11.1%	7.3%	5.9%	6.8%	8.8%	
IP Core Routing	1.83	1.94	2.05	2.14	2.24	2.46	6%
Market Size Growth YoY	-19.8%	5.7%	5.7%	4.5%	4.7%	9.6%	
IP Edge Routing	4.48	5.08	5.48	5.83	6.27	6.80	9%
Market Size Growth YoY	-6.5%	13.3%	7.9%	6.4%	7.6%	8.6%	
IP/MPLS Edge Routers	4.10	4.68	5.06	5.43	5.90	6.46	10%
Market Size Growth YoY	-6.6%	14.1%	8.1%	7.3%	8.8%	9.5%	8.4%
BRAS	0.38	0.40	0.42	0.40	0.36	0.34	-2%
Market Size Growth YoY	-4.9%	4.9%	4.9%	-5.1%	-8.9%	-7.3%	
Carrier Ethernet Switches	1.47	1.58	1.68	1.81	1.95	2.11	7%
Market Size Growth YoY	-12.7%	7.5%	5.9%	7.8%	7.9%	8.0%	
Mobile Packet Data	1.69	1.83	1.97	2.25	2.62	2.86	11%
Market Size Growth YoY	23.0%	8.0%	7.9%	14.3%	16.3%	9.1%	
SGSN/GGSN for GPRS/EDGE	0.78	0.73	0.60	0.51	0.43	0.38	-13%
Market Size Growth YoY	7.0%	-7.2%	-17.7%	-15.5%	-15.3%	-10.3%	
SGSN/GGSN for W-CDMA and TD-SCDMA	0.66	0.78	0.95	1.12	1.23	1.27	14%
Market Size Growth YoY	39.0%	18.4%	20.9%	18.7%	9.8%	3.1%	
PDSN	0.25	0.30	0.32	0.33	0.34	0.34	7%
Market Size Growth YoY	25.0%	20.2%	5.1%	3.5%	4.3%	1.2%	
EPC	0.00	0.02	0.11	0.30	0.62	0.86	0%
Market Size Growth YoY	0.0%	0.0%	499.9%	163.3%	107.3%	38.6%	
IP Deployment	0.48	0.52	0.54	0.58	0.62	0.67	7%
Market Size Growth YoY	-7.6%	7.1%	4.6%	6.6%	7.9%	7.6%	6.7%
Total IP Market Size	10.59	11.38	12.03	12.85	13.89	15.03	7%
Market Size Growth YoY	-9.0%	7.4%	5.7%	6.8%	8.1%	8.3%	

TABLE 99 – WORLDWIDE IP MARKET SIZE

An interesting forecast is related to the IP/MPLS technology with a YoY average growth of about 8.4 % and CAGR 09-14 of 10%.

This market is addressable in part by ETICS and the relative markets per region are the following:

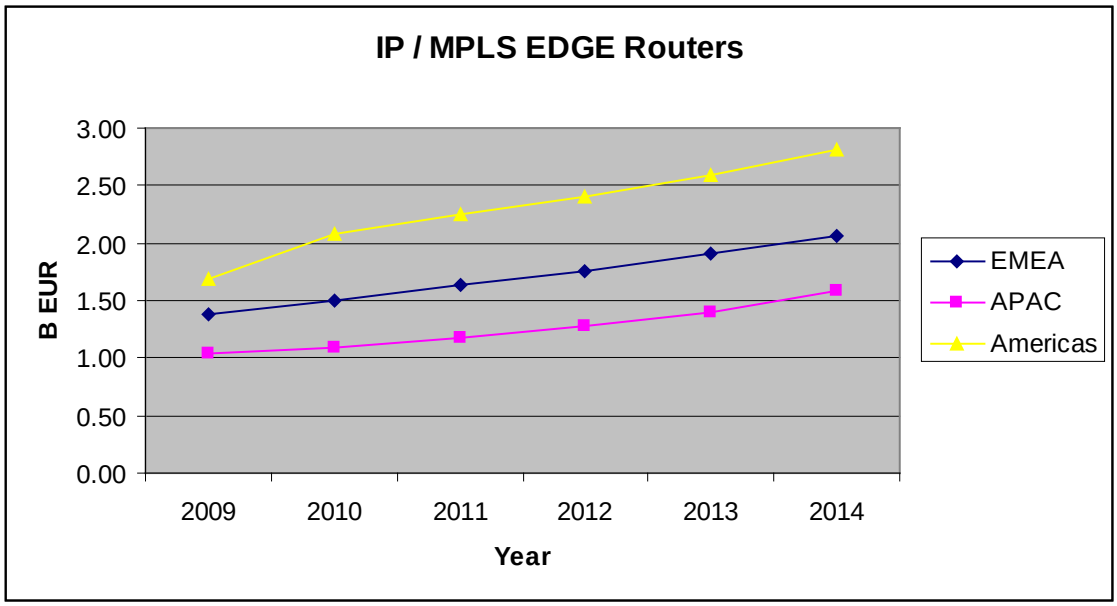


TABLE 100 – IP/MPLS EDGE ROUTER MARKET EVOLUTION BY REGION

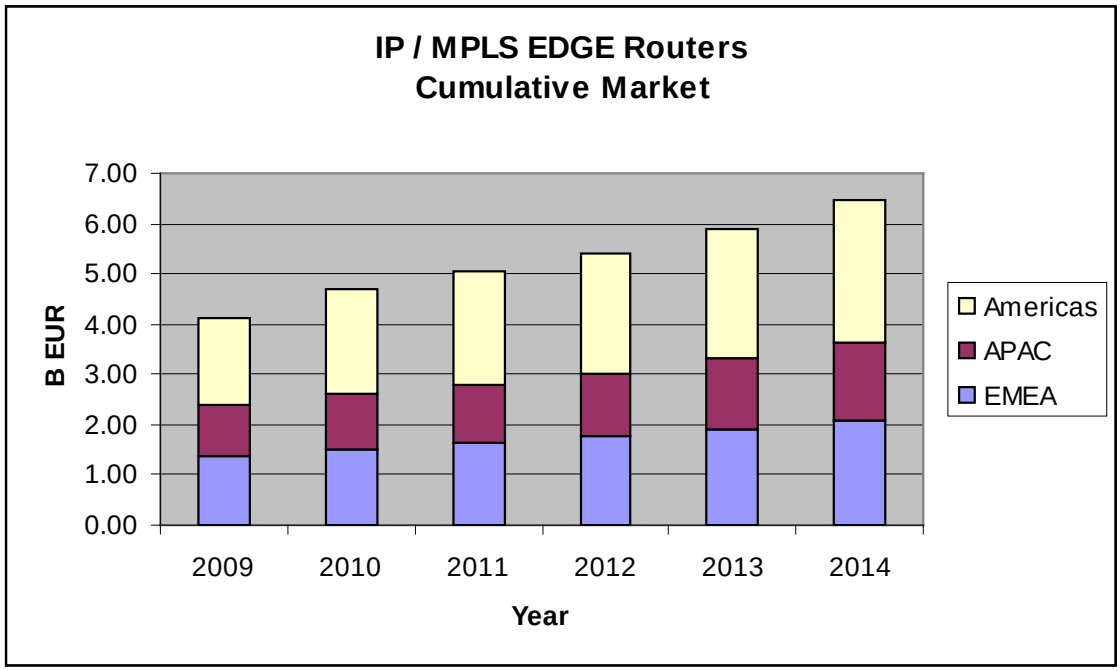


TABLE 101 – IP/MPLS EDGE ROUTERS CUMULATIVE MARKET

It is possible to correlate the multimedia market described in the previous section (As-Is Market Value Quantification) with the IP/MPLS market. In *TABLE 99* it can be seen that in 2013 the IP/MPLS market will be €5.9 billion of a total IP market equal to €8.51 billion. Hence, about 70% of the IP market will be for MPLS (QoS) in 2013.

Applying the same ratio to the Multimedia Carrier Services, equal to €2.21 billion, the MPLS served market will be €1.55 billion (2013) worldwide.

ETICS Market Share and Revenues

The multimedia carrier market is strongly oriented to residential customers. Therefore, ETICS market share and revenues will be based on the likelihood that end users pay a premium price for receiving higher QoS in video related services.

A primary market research conducted by Alcatel-Lucent surveyed end users on three application categories: online gaming, Internet TV/video (ITV), and Voice over Internet Protocol (VoIP). The objective was to measure the importance of QoS to existing end users' applications. The study found that end users note appeal, need, and willingness to pay for incremental quality of service across those applications. Finally, according to the examination of the current demand-price elasticity for QoS services, 15% to 20% of subscribers expressed a strong interest and willingness to pay [Brunetti11]. Therefore, this outcome will be used in the estimation of ETICS market share.

In order to be more conservative, the market share will be equal to 15%. If the to-be market is €1.55 billion, then ETICS would be able to get €232.1 million.

Sensitivity Analysis of Results

Two assumptions were carried during this analysis. The first involved correlating the ratio of the multimedia market that is QoS oriented to the MPLS within the IP market. Therefore, since MPLS covered 70% of the IP market, this figure was used in the quantification process of the ASQ multimedia applications market. However, the multimedia market could have lower or higher penetration of ASQ services. Secondly, ETICS' penetration was determined as 15%, but this is not deterministic.

Therefore, varying the values of these hypotheses, both the to-be market and ETICS revenues will change. For a 60% and 80% QoS reach in the multimedia market, the to-be market differs as follows.

To-Be Market	60%	70%	80%
€, billions	1.33	1.55	1.77

TABLE 102 – SENSITIVITY ANALYSIS OF THE TO-BE MARKET

If ETICS market share was 10% or 20%, revenues for ETICS solutions would be as presented in the table below.

ETICS Revenues	10%	15%	20%
€, millions	132.6	232.1	353.6

TABLE 103 – SENSITIVITY ANALYSIS OF ETICS REVENUES

Both assumptions direct impact on the final result. However, the impact of an equal variation in both hypotheses' values at the same time is higher for the optimistic scenario than for the pessimistic, since their values are multiplied, instead of summed. For example, 10% decrease and 10% increase in each assumption results in 21% increase in the upper bound and 19% decrease in the lower bound of ETICS revenues, compared to the base scenario.

9.2.2. OFF-NET (PREMIUM) CONTENT DELIVERY

9.2.2.1. Without CDN

Prior to proceeding with the market quantification, we briefly define the basic terms and market under study.

Off-net content delivery denotes the delivery of content to the end users of a certain network whose origin resides outside that network's domain. Thus, this is content which is originated outside the customer's serving NSP and delivered by means of inter-NSP connectivity.

The term *premium* denotes that these services are of high quality and differentiated by the majority of best-effort content.

Also, for the market quantification of this section, we assume that this market is limited to the services that are provisioned without the presence of CDNs as seen from the inter-NSP perspective. That is, there is no CDN federation or CDN interconnection involved, nor any partner CDN on-net co-location making the actual content source on-net. However, the content delivery source may be from a CDN but this is not of any relevance as seen from the inter-NSP perspective.

Having defined the basic terminology, we now proceed to define the services where this market quantification will be focused:

Premium video: According to [Nielsen10], HDTV is improving the TV viewing experience for as many as 30% of online customers globally. 3DTV is expected to have an impact on 12% of global online customers. Moreover, one in five end users is expected to own a TV set with Internet connection in the next 5 years. It is also expected to be combined and bundled with social networking services.

The major problem with CDNs is that "*global CDNs cannot offer any performance or capacity guarantee. Simply because they do not control the last mile. Global CDNs kind of 'dump' their traffic over the fence into ISP networks and then assumes that the ISP has enough capacity to transport HD video, radio and TV to the viewer. Global CDNs don't really control delivery, they deliver blind. Shoot and forget. It's best effort*" [JetStream11]. Thus, for both live video streaming and non real-time video that can be cached by existing CDNs, there are current and emerging unmet market needs that could be served by the ETICS solution.

This is complementary to the current efforts in the business to apply some sophistication by means of adaptive streaming combined with some traffic isolation and proprietary prioritization platforms such as [SecureMedia11]. Overall, real-time premium video comprises an attractive service for the off-net without CDN market.

Mobile premium content: Mobile video is already used by 11% of global online customers, rendering this market a highly dynamic and profitable market segment. Mobile premium content is used here in the same way with the previous category and we do not include premium content (such as ringtones, music etc.) which is cacheable content that can be delivered by means of CDNs.

We use these two market services for the quantification due to the explosive growth of video traffic [cisco11]; video traffic is expected to quadruple by 2015. Both these services have significant end user demand and customers already purchase such services [OCEAN10]. Therefore, we focus on the niche services of this market that provide the best value for ETICS and whose market potential is indisputable.

Quantification Methodology and Hypotheses

The main sources from which we collected data and information used in our quantification analysis can be classified to the following categories:

- Market surveys and business reports.
- Related product brochures.
- Articles or quotes from executives in the Internet market, which are published online.

- Specialized Internet blogs.
- Industry white papers.
- Business analysis and market reports.

The precise references used as the major source of information are provided as the ultimate section 8.

These data have been used to estimate the overall market features, the prominent services of interest, i.e. those that mostly contribute to the revenue attained in this market, the respective market size and services growth rate and revenue attained.

The methodology used for the market quantification analysis can be summarized as follows:

- Firstly, we have used the aforementioned data that report the prominent services that are popular for the users, demonstrating that users are indeed willing to purchase (and in fact some already purchasing) such services. To this end, we provide data from multiple sources demonstrating that such services do comprise a portion of the market and that the growth and potential of these services is high.
- Then, we use the most conservative estimates regarding the overall market size and the candidate services that this market consists of: this comprises the basis of the quantification, thus being conservative in our estimates and projections.
- Subsequently, on top of this number we assume the percentage of those services that could be provisioned without (federation of) CDNs undertaking the premium content delivery role, thus deliberately ignoring services where CDNs constitute the standard way of provisioning content transport services today.
- We perform a sensitivity analysis on the revenue that could be attained under either optimistic or pessimistic market scenarios. This reflects the potential adoption of ETICS as a major or respective minor solution for the efficient provisioning of off-net premium content delivery services without CDNs.
- Finally, we derive the quantification results, which provide insight of the market potential of such services for the ETICS solution.

As-Is Market Value Quantification

According to [Cisco11], Live Internet TV comprises currently roughly 10% of the total Internet video traffic. This percentage is expected to remain constant throughout the evolution of this market, as depicted below:

By Category (PB per Month)							
Short form	697	931	1,254	1,665	2,208	2,976	34%
Long form	2,936	4,984	6,932	9,255	11,980	15,879	40%
Internet video to TV	342	838	1,626	2,786	4,165	5,911	77%
Live Internet TV	480	777	1,185	1,754	2,477	3,417	48%
Ambient video	93	258	521	860	1,207	1,523	75%
Internet PVR	40	78	134	237	387	581	71%
Mobile video	85	213	493	1,028	1,933	3,333	108%

TABLE 104 – GLOBAL CONSUMER INTERNET VIDEO 2010-2015 [Cisco11]

Given the range of adaptive video solutions, the rise of mobile video and the premium video services that are not captured by the Live Internet TV category, we assume that a conservative percentage of the

premium off-net content delivery services could amount to 15% of the Internet global video content delivery market. The total size of this market is $1Billion market in 2013 and its evolution is depicted in the figure below [Rayburn11b]. This figure depicts the current video content delivery networks market, which is dominated by CDNs; on top of these figures - which are used to capture the market trend for also "without CDN" traffic and quantify the end user market demand for video services that is indifferent to the way these services are provisioned - the aforementioned 15% percentage has been chosen to include all kinds of video content delivery services that could be potentially provisioned without CDNs ensuring the premium transport/service delivery and for which no additional specific data could be found.

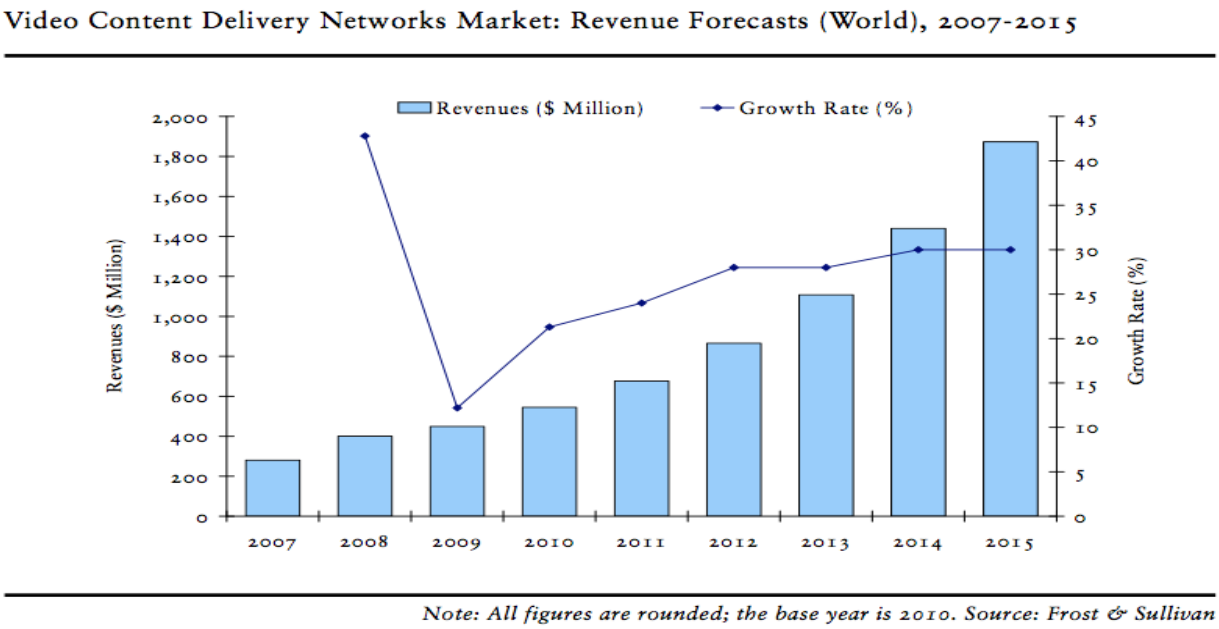


FIGURE 10 – THE VIDEO CONTENT DELIVERY NETWORKS MARKET

Thus, the as-is market value quantification is globally $150 million, which converted to Euros amounts to €112 million in 2013. The market revenue forecast for 2015 is roughly €168 million.

We use the (€112 million, €168 million) pair of values as the basis of our quantification in order to capture the overall video content delivery market evolution in the [2013, 2015] interval. This is the interval when ETICS is first rolled out upon the completion of the project and with an added two-year period where ETICS can be made a mature and commercially available market solution.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Premium off-net content delivery services can serve as a major source of revenue, due to the high end user demand and the significant added value due to the improved QoE. They can be materialized through ASQ connectivity goods. As already explained, traffic delivery by global CDN over BE Internet interconnect is typically not providing a sufficient solution for premium content delivery. However, it remains questionable however whether the NSPs will adopt some types of ETICS solutions as the preferable market solution to ensure these services, or they will prefer some alternative proprietary solutions. In order for ETICS solutions to become the market solution to ensure such services, this would require that the last mile is taken care of by the operators and ETICS solutions are used in order to fetch content and provide connectivity across domains, also possibly complementing current IPX solutions. Such a scenario would be likely to arise in a mature market setting.

We have set the following boundaries on our analysis:

- We consider the premium off-net content delivery services market.
- Geographically, we consider the global market and then specialize to the European region where ETICS is most likely to be deployed in the near future.
- We consider all possible types of customers, residential, small business or businesses. Our analysis is orthogonal to the type of customer that consumes the ETICS solutions.
- We use very conservative estimates on the size of the services that could be delivered by means of inter-NSP collaboration, i.e. without the presence of CDNs undertaking the premium content delivery transport role. In case that ETICS becomes a competitive solution, compared to the CDN approach, the respective market share will greatly increase since ETICS could acquire a segment of the market that is currently dominated by CDNs.

We assume that the introduction of ETICS and its ASQ approach would not only gain a market share of the current market, but it would also result in significant growth for the demand for off-net premium video services, due to the critical role of ASQ interconnection for such services. In particular, we assume a 10% increase of the overall "pie" of such services; hence, the inter-NSP premium off-net content delivery market value interval for 2013 and 2015 becomes the value pair: (€123 million, €185 million) from the (€112 million, €168 million) value pair of the previous subsection (As-Is Market Value Quantification).

ETICS Market Share and Revenues

We envision that at least in the immediate future, the ETICS market share would be further restricted from the geographical presence of the ETICS carriers. Therefore we estimate that ETICS could capture at most the EMEA region are respective revenues. We thus estimate that ETICS market share for off-net premium content delivery could be roughly 20% of the values (€123 million, €185 million) for 2013 and 2015 respectively, thus the ETICS market share could be roughly €25 million in 2013 and €37 million in 2015.

This percentage is derived from the fact that we assume that ETICS will be rolled out by 2015 from major European operators, covering mostly the EMEA market, with limited presence in America and Asia. An important factor for the ETICS market share and revenue to be estimated would be the adoption of the ETICS technology also by mobile operators, in order to interconnect their networks and provide premium content delivery services to their (roaming) users and multi-national business customers.

- The positive (for ETICS) scenario would be that ETICS would become the de facto standard for such services, thus attaining most of the attained revenue. It could also bring additional revenue due to higher growth rates of this market segment, coming from the high satisfaction of users that are served via the ETICS solution, resulting in higher market penetration and adoption rate of the ETICS solution.
- A more conservative scenario would be that ETICS would only capture the market share estimated so far in this analysis.
- A bad scenario prescribes that the ETICS rollout would have very limited impact on this market and a very small portion of market share would be extracted.

This adoption factor, as captured by three different scenarios, will impact the sensitivity analysis of the quantification results presented in the next section.

Sensitivity Analysis of Results

In order to further constraint our results, we perform a sensitivity analysis assuming that the ETICS solution will be able to:

a) **Pessimistic:** ETICS fails to become the dominant solution, it has limited impact on this market and the market share it accumulates is extremely small, i.e. 10%.

b) **Baseline:** Materialize the entire value reported in the previous section. This is due to the fact that ETICS becomes the dominant solution for off-net content delivery services in the EMEA region and the market growth rate remains as reported in the previous sections.

c) **Optimistic:** ETICS manages to expand to other regions and/or is used widely for additional off net content delivery services that are not captured in this quantification. We set a high value, i.e. 50%, on top of the current estimate in order to capture the most beneficial for ETICS scenario.

This leads to our final quantification results, which are presented in the table below:

Scenario:	Pessimistic	Baseline	Optimistic
ETICS revenue (€, million):	[2.5, 3.7]	[25, 37]	[38, 56]

TABLE 105 – ETICS MARKET SHARE AFTER STEP 5: APPROXIMATELY (€25, €37) MILLION IN 2013 AND 2015

9.2.2.2. CDN – Market Overview

Market Definition and Boundaries

The present section considers the international CDN market and aims at quantifying its size and development.

The boundaries of the analysis are as follows. We consider:

- all CDNs in international market;
- all existing CDNs independently of location;
- all possible types of CDNs: on-net, off-net, pure-play and non pure-play CDNs, CDN management platforms.

As the present analysis is not limited to any country and due to the global nature of Internet, it has a global scope.

Quantification Methodology and Hypotheses

This section introduces the sources of the data and the methodology used for the analysis accomplished.

The main sources used in the present quantification analysis are as follows:

- market surveys, articles published online (technical magazines, news, etc.) [AccuStream] [AccuStreama] [AccuStreamb] [Frost&Sullivan] [Labovitz11] [Rayburn11a] [Rayburn11c];
- web-pages of CDNs [Cisco];
- web-pages of governmental organizations;

Quantification of the Current Market

The present section introduces the key players in the international CDN market and reports its players' maturity and competitiveness (see FIGURE 11).

Key players in the content delivery field (both On-net and Off-net)

- Pure-Play CDNs

  Accelia

  Abacast (has exited the video delivery business, focuses on radio streaming)

  Advection.net

  Akamai

  Amazon CloudFront

  BitTorrent

  CacheFly

  ChinaCache

  CDNetworks (exited the video delivery business in 2010, focuses on web acceleration)

  EdgeCast

  EdgeStream (not sure if they are actually in business)

  Fastweb

  Highwinds

  Limelight Networks

  Mirror Image

  NetDNA

  PEER1

  Prime Networks

  Technicolor

  Windows Azure

- Non Pure-Play CDNs (NSPs/carriers)

  AT&T

  Bharti Airtel (partnered with Limelight)

  Bell (working with Limelight)

  Broadmedia

  BT

  Deutsche Telekom (partnered with EdgeCast)

Global Crossing (reselling Limelight and EdgeCast)

Internap (acquired VitalStream)

Interoute (acquired Virtue Media Services)

Korea Telecom

KPN

Level 3 (acquired CDN assets of SAVVIS, acquired Servecast)

NaviSite (reselling EdgeCast)

Ngenix

NTT Communications

Orange France Telecom

Pacnet (licensed EdgeCast)

PCCW

Reliance Globalcom (partnered with Internap)

SingTel

Tata Communications (acquired BitGravity)

TeliaSonera

Telecom Argentina

Telecom Italia Sparkle (reselling CDNetworks)

Telecom New Zealand (AAPT) (partnered with EdgeCast)

Telefonica

Telstra

Telus (reselling EdgeCast)

Verizon

- CDN Management Platforms/Transparent Caching Platforms

  3Crowd

  Aflexi

  Alcatel-Lucent

  Blue Coat (formerly named CacheFlow)

  Broadpeak

  BTI Systems

  Cisco

  Conviva

Ericsson

Fabrix.tv

Huawei

Jet-Stream

Juniper

Octoshape

Oversi

PeerApp

Verivue

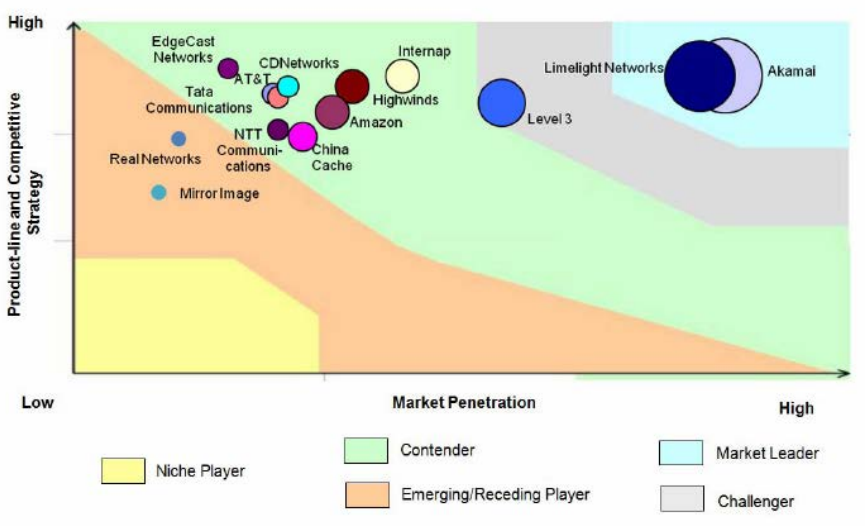


FIGURE 11 – VIDEO CDN MARKET: WORLD COMPETITIVE LANDSCAPE, 2010 [FROST&SULLIVAN]

Estimation of Market Share

The present section discusses current trends and revenue distribution in the international CDN market. In 2008 the share of content providers in total Internet revenue was 60%. Nowadays the proportion is growing.

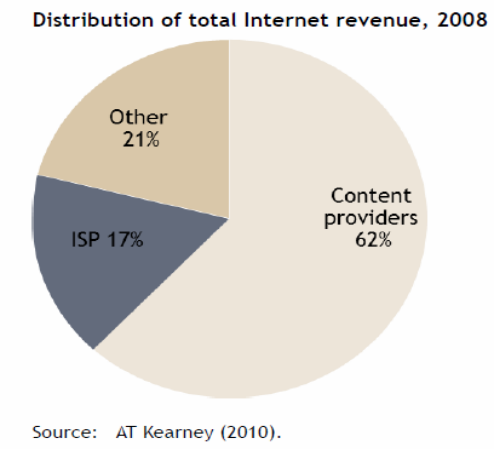


FIGURE 12 – TOTAL INTERNET REVENUES DISTRIBUTION – CDN MARKET

In 2009 the following changes took place in the market.

- $1.5 billion revenue was due to CDNs
- 26.7% growth in CNDs' contracts quantity
- 8.2% CDN revenue growth
- Pricing was down on average about 45%

In 2010 the following trends were observed.

- $2.7 billion global CDN revenue
- The U.S. market accounted for 55.6% of the total global revenue.
- Pricing was down on average about 25%.

In 2011 the following trends were reported.

- Following the market's rapid evolution and appetite for delivery efficiency, reach and scale, CDNs have channelled R&D investments and global sales initiatives into value added services (i.e. site and application acceleration, content transformation, cloud, analytics, mobile and workflow).
- 49.7% of sector revenue was generated from media and entertainment accounts, including professional video, UGC video, streaming music, video advertising and mobile video, along with movie, TV, music and podcast downloads.
- The U.S. market accounted for 65% of the total global revenue
- Pricing was down on average about 45%. 2011 has seen the lowest pricing decline for video delivery services in the last three years.
- 45-50% volume growth in the sector.

Current market trends

- Wholesale bandwidth costs continue to decline, while retail prices are stabilizing. Considerably more bytes are being delivered to an expanding universe of fixed and mobile devices. These market trends are expected to improve both CDN gross margins and produce double-digit top line increases through 2012.
- Major providers like Akamai and Limelight Networks generate up to 30% of revenue through international contracts.
- Solutions diversification including site acceleration, adaptive bit rate streaming, tighter integration with OVPs (open virtual platforms) for publishing standardization, automation and monetization support.
- The analytics of companies' reports and extensive Q&As focus on transit and retail pricing, underlying market forces, billing models by content vertical (i.e. pro and UGC video), account type (including audio, video, dynamic site acceleration, advertising and download media), CAPEX (up 24.8% in 2010), servers deployed, R&D, mobile initiatives, strategic imperatives, partnerships, and the impact of cloud computing.
- Fundamental shift from connectivity to content

- Representative traffic volumes

Global transit:	5 -15 Tbps
Large cable:	2 - 5 Tbps
PTT:	0.5 - 3 Tbps
Large CDN:	0.5 - 3 Tbps
Regional / Tier:	2 0 - 0.5 Tbps

- Consumer video is responsible for the majority of the traffic growth between 2007 and 2012, see *FIGURE 13*.

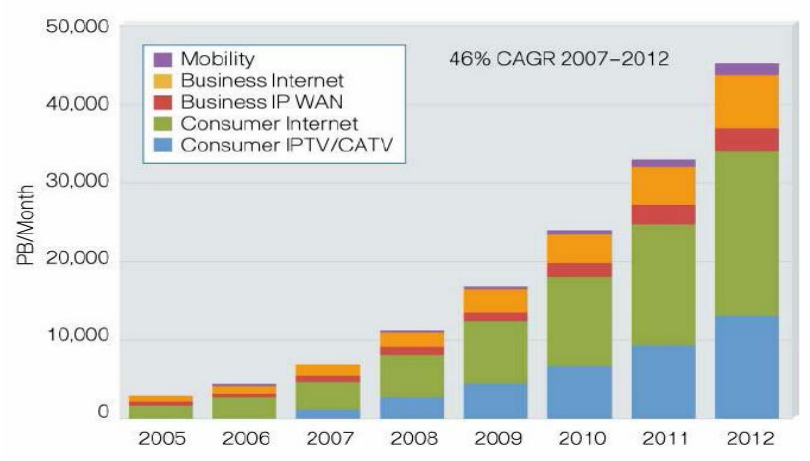


FIGURE 13 – TRAFFIC BREAKDOWN IN RECENT YEARS [CISCO]

Quantification of the Potential Growth

- Wholesale bandwidth – prices continue to decline, while retail prices are stabilizing. Considerably more bytes are being delivered to an expanding universe of fixed and mobile devices. These market trends are expected to improve both CDN gross margins and produce double-digit top line increases through 2012.
- Revenue is expected to grow by 30% through 2014 as can be seen in
- *TABLE 106* and *FIGURE 14*.

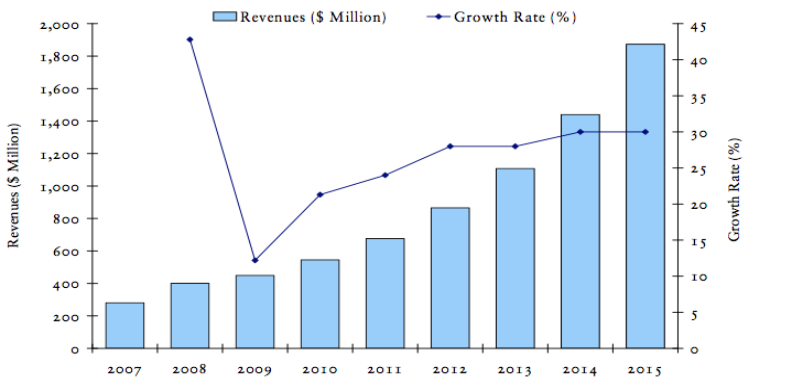
Video Content Delivery Networks Market: Revenue Forecasts (World), 2007-2015

Year	Revenues ($ Million)	Revenue Growth Rate (%)
2007	280.6	---
2008	400.7	42.8
2009	449.6	12.2
2010	545.5	21.3
2011	676.4	24.0
2012	865.8	28.0
2013	1,108.2	28.0
2014	1,440.7	30.0
2015	1,872.9	30.0
Compound Annual Growth Rate (2010-2015): 28.0%		

Note: All figures are rounded; the base year is 2010. Source: Frost & Sullivan

TABLE 106 – REVENUE FORECAST IN VIDEO CDN MARKET [FROST&SULLIVAN]

Video Content Delivery Networks Market: Revenue Forecasts (World), 2007-2015

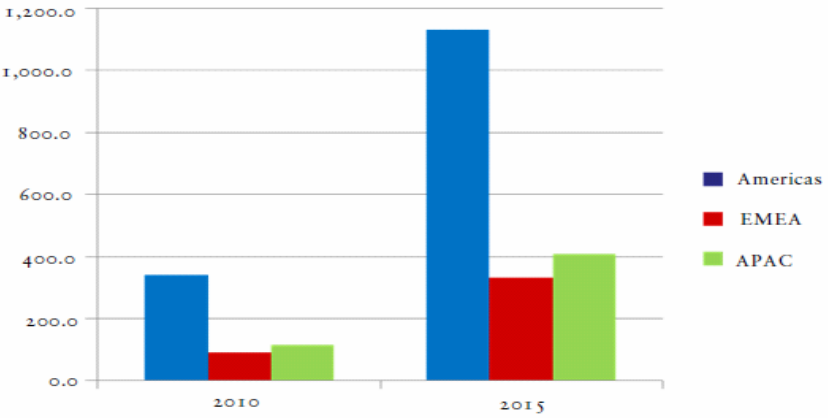


Note: All figures are rounded; the base year is 2010. Source: Frost & Sullivan

FIGURE 14 – FORECAST IN VIDEO CDN MARKET [FROST&SULLIVAN]

- The U.S. market accounted for the largest share of the total global revenue. This trend will remain unchanged, see *FIGURE 15*.

Video Content Delivery Networks Market: Video CDN Revenue Estimates Across Regions (World), 2010 and 2015



Source: Frost & Sullivan

FIGURE 15 – REVENUE FORECASTS IN VIDEO CDN MARKET ACROSS REGIONS [FROST&SULLIVAN]

- 60% volume growth is expected by 2015. This growth is explained by the growing majority of the video content.
-
- Solutions diversification (including site acceleration, adaptive bit rate streaming, which increases viewing time, combined with less emphasis on bandwidth overage fees billed by CDNs, plus tighter integration with OVPs (open virtual platforms) for publishing standardization, automation and monetization support) are expected to beneficially impact monthly recurring revenue (MRR).
- Measurement and Trends, see *TABLE 107*.

Measurement Name	Measurement	Trend
Market age	Growth stage	---
Revenues (2010)	$545.5 million	Increasing
Potential revenues (2015)	$1872.9 million	Increasing
Base year market growth rate (2010)	21.3%	Increasing
Forecast period market growth rate (CAGR)	28.0%	Increasing
Price range	$0.15 to $2.0 (per GB)	Decreasing
Price sensitivity	High	Stable
Competitors (active market competitors in base year)	15+	Decreasing
Companies entering the market (2008-2010)	7+	Increasing
Companies exiting the market (2008-2010)	3+	Increasing
Degree of competition	High	Increasing
Customer satisfaction	Medium	Stable
Customer loyalty	Medium	Decreasing
Market concentration (percent of base year market controlled by top three competitors)	49.6%	Decreasing

Note: All figures are rounded; the base year is 2010. Source: Frost & Sullivan

TABLE 107 – MEASUREMENT AND TRENDS [FROST&SULLIVAN]

Analysis of Market Trends

The analysis of the available data allows concluding that CDN international market is still on its growth stage and continues growing at 25% rate on average.

In spite of a considerable price decrease revenues are still increasing. The growth of traffic volumes and video content are the main drivers of revenue growth from almost $546 million in 2010 to $1873 million forecasted by 2015. Video traffic is estimated to be responsible for the growth from $60 million revenue in Europe in 2010 to $400 million in 2015.

The degree of competition in the CDN market is high and still increasing. There is a small group of market leaders that account for the largest part of the revenues Market concentration is almost 50% [Frost&Sullivan]. They are followed by the single challengers trying to fight for market share and a huge group of emerging players. The increasing competition and a big quantity of market participants lead to the medium but stable customer satisfaction and decreasing customer loyalty.

9.2.2.3. With CDN

In order to define the premium content delivery with CDN market the Three Dimensional Business Definition framework from Harvard Professor Derek F. Abell will be applied. Derek Abell's model [Nijssen01] analyses the market according to three dimensions: the first dimension relates to the customer groups or segments that can be identified in the market, the second dimension addresses these customers' needs and the third dimension identifies the alternative technologies available to satisfy those needs.

Customers

- Over-the-top (OTT) content providers

Needs

- Improve the service quality experienced by the users while accessing their contents
- Provide users with assured performance even when data traffic and number of users increase
- Have the content delivered with security, protected against unauthorized access and modification
- Maximize reliability of the service, responsiveness to possible outages and performance, typically the response time perceived by the end users.
  [Pathan07]

Technologies

Content Delivery Networks (CDN) provide better performance through caching or replicating content over some mirrored Web servers, also called surrogate servers, which are strategically placed at various locations in order to reach proximity to the users. When clients make a request, they are redirected to the nearest surrogate that is responsible for delivering the requested content [Pathan07]. Server's nearness is based on expected latency, which is determined by geographical proximity, server load and network conditions. Once CDNs deliver content from the edge of the Internet, they are able to speed content delivery, circumvent bottlenecks and provide protection from sudden traffic surges that can bring down servers. In addition, replication of content across delivery locations improves the availability of content, especially during sudden surges in demand [Hosanagar08].

CDN players distribute all content formats (web pages, static content), different forms of video and contents such as business applications and software, gaming, mobile services and music. Video is the most dominant portion of CDN spending, with an average share of 43% according to ATLANTIC-ACM (2011). Given its importance and the fact that video delivery is affected by interconnection quality, this market quantification will focus only on video delivery from OTT providers.

Revenue Model

There are two revenue modes being used by the companies in this market:

- Volume-based
- Bandwidth pricing

The pricing model based on the volume of GB delivered used to be the most common among customers hiring CDNs for video delivery [Rayburn07]. This revenue model consists of paying for the amount of GB delivered over the course of a month and the fee charged for a unit of GB usually drops as total volume increases. Back in 2009 roughly 80% of the content owners had contracts based on per GB delivered pricing [Rayburn11c].

However, another way of charging for video delivery, on a per Mbps sustained model, is increasing. This bandwidth pricing model charges for the volume of traffic pushed at a given time instead of total bits consumed. The charge is based on the 95th percentile of the customer's peak traffic. Nowadays about 60% of contracts are priced on a per Mbps basis [Rayburn11c].

The leading players in this market are Akamai, which has about 60% of market share, Limelight Networks, Level 3 and EdgeCast.

Geographical Definition

Since main players have global access the quantification process will consider the worldwide market.

Quantification Methodology and Hypotheses

The data and information used were collected from secondary sources, such as presentations featuring market value and growth trends, reports from international institutions, industry news.

Values for the as-is market quantification and for the natural growth on the to-be market analysis were retrieved from projections made by Frost & Sullivan, a business research and consulting firm. In 2011 the company has released its 2010 CDN report, as well as some extra data presented during the Content Delivery Summit 2011. However, their forecasts differ a little one from the other. Since the first reports information about 2010 and was published in February 2011 and the latter was presented in May 2011, it will be considered that the most recent available data should be more realistic, and, therefore, will be used in the next sections.

As-Is Market Value Quantification

There have always been reports describing the total CDN market and estimating its size, however, they did not specify what percentage of the revenue came from the delivery of video, one of the fastest growing segments of the overall CDN industry. Fortunately, since 2008, Frost & Sullivan has been breaking out the size of the market specific to video.

According to a Frost & Sullivan forecast presented during the Content Delivery Summit 2011, the video CDN market would have been $752.8 million in 2011. This number will be used as the as-is market value for OTT content delivery using CDNs. Converting it to euros, the result becomes €572.1 million.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Firstly, it will be accounted the future video CDN market due to its natural growth. By the end of 2013 it is expected to reach almost $1.5 billion, showing a CAGR of 40% [Frost&Sullivan11].

In addition to this, ETICS ASQ should drive a further growth in this market. In order to quantify this extra increase, the dissatisfaction of users while consuming online video services will be assessed and will serve as a proxy, as an improvement in quality provided by ETICS solution could potentially impact on those consumers not currently content with the services.

The Open ContEnt Aware Networks (OCEAN) project, funded by the European Commission, delivered a report giving an overview of the current state of the market of online video in the open Internet, based on both desk research and inputs of a survey of 1200 end-users in UK, USA and France (2010). This report presented the satisfaction of Internet users regarding the quality of service of five different types of videos: free short clips (Youtube), streaming platforms, catch-up TV, premium video-on-demand (VoD) and live streaming. Satisfaction was measured in four levels (very satisfied, satisfied, unsatisfied and very unsatisfied) regarding three dimensions: image quality, time the video takes to start and seamless display. *TABLE 108* shows the average percentage of very unsatisfied users.

Type of Online Video	Image Quality	Time The Video Takes to Start	Seamless Display	Average
Short Videos	3%	7%	10%	7%
Streaming Platforms	3%	8%	4%	5%
Catch-up TV	2%	5%	9%	5%
Premium VoD	0%	0%	0%	0%
Live Streaming	6%	7%	5%	6%
Total	-	-	-	**4.6%**

TABLE 108 – AVERAGE (USA, FRANCE AND UK) % OF VERY UNSATISFIED USERS

In the same way, just unsatisfied customers were also identified.

Type of Online Video	Image Quality	Time The Video Takes to Start	Seamless Display	Average
Short Videos	18%	29%	35%	27%
Streaming Platforms	20%	38%	30%	29%
Catch-up TV	9%	21%	26%	19%
Premium VoD	5%	13%	5%	8%
Live Streaming	21%	31%	22%	25%
Total	-	-	-	**21.5%**

TABLE 109 – AVERAGE (USA, FRANCE AND UK) % OF UNSATISFIED USERS

The survey was conducted only among American, French and UK users, but it will be considered that its results represent the global picture. It will be assumed that very unsatisfied users practically do not contribute to video CDN revenues and the unsatisfied ones could consume more video over the Internet. ETICS will push the future market ($1.5 billion) to an additional 10.0% growth by achieving the very unsatisfied users and inciting half of the unsatisfied ones to consume 50% more. The total to-be market will be $1.63 billion. In euros, the to-be market is €1.24 billion.

ETICS Market Share and Revenues

ETICS market share will be estimated in a value range, considering pessimistic and optimistic bounds. The pessimistic assumption is that ETICS will only be able to gain part of the new revenues due to the high degree of competition and concentration in this market, with top players controlling the biggest share of the market. Therefore, the increased market value will be split between well-established traditional CDNs (Akamai, Limelight and Level 3) and ETICS' players.

Assuming ETICS will serve only the market corresponding to the very unsatisfied customers who will increase video demand with ETICS ASQ launch, the lower bound would then be equal to $68.4 million.

The upper limit will consider that ETICS could either develop a "proprietary" CDN solution or reduce CDN's relevance by creating an Assured Service Quality pipe, possibly cannibalizing part of the market for traditional CDN providers. In this manner, ETICS would be able to absorb all increased demand, $148.4 million, and potentially gain market share in the existing CDN ecosystem. Top CDN providers Akamai, Limelight, Level 3 and CDNetworks controlled more than 80% of the video delivery market global revenues in 2009 (Dan Rayburn). Market leaders still concentrate the largest part of revenues, so it will be inferred that ETICS would compete for the remaining 20% of the market. If ETICS achieved 10% of this available market (2% of the total) it would add $29.7 million to the $148.4 million, meeting $178.1 million.

In conclusion, ETICS' revenue would fall into the range from $68.4 to $178.1 million. In euros this interval is €52.0 to €135.3 million.

Sensitivity Analysis of Results

This step will present a sensitivity analysis of the hypotheses adopted both in the to-be market and in ETICS market share estimations. In the base scenario ETICS would push a 10.0% growth. For this analysis it will be varied to 7.5% and 12.5% for pessimistic and optimistic scenarios, respectively. In the base scenario's lower bound, ETICS market share was assumed to be 4.2%, which was lowered to 3.1% for the pessimistic situation.

On the other hand, like the upper bound of the base scenario, the optimistic case encompasses the total market's increase and a further market share in the current market. This share was 2% in the base scenario and will be 4% for the optimistic limit in this analysis. In this way, ETICS total market share increases from 10.9% to 14.7%.

The final results are presented in the table below.

ETICS Revenues	Pessimistic	Base	Optimistic
€, millions	38.1	52.0 to 135.3	186.1

TABLE 110 – SENSITIVITY ANALYSIS

An intermediate scenario would be the one where only the to-be market growth is changed, again to 7.5% and 12.5%.

ETICS Revenues	Pessimistic	Base	Optimistic
€, millions	50.8	52.0 to 135.3	163.5

TABLE 111 – SENSITIVITY ANALYSIS OF INTERMEDIATE SCENARIO

The assumption regarding the extra growth ETICS create in the market has heavy influence in the optimistic limit, because the increase is directed accounted in the upper bound of ETICS revenues. On the other hand, the lower bound is more affected by ETICS market share.

9.2.3. INTER-PROVIDER ASQ CONNECTIVITY FOR BUSINESS CUSTOMERS

9.2.3.1. Virtual Private Network (VPN)

In order to define the Virtual Private Network (VPN) market the Three Dimensional Business Definition framework from Harvard Professor Derek F. Abell will be applied. Derek Abell's model [Nijssen01] analyses the market according to three dimensions: the first dimension relates to the customer groups or segments that can be identified in the market, the second dimension addresses these customers' needs and the third dimension identifies the alternative technologies available to satisfy those needs.

Customers

- Business customers, enterprises

Needs

- Fast, secure and reliable way to share information across computer networks
- Services available from any location anytime

- Connection with remote sites, partners and customers, regardless of access differences and geographic distances
- Expanded business reach (national and international), scalability
- Bandwidth hungry and mission-critical ICT applications anywhere
- Application assurance
- Virtualized data centres

Technologies

A Virtual Private Network (VPN) is a private network that uses a public network (a carrier's network or the Internet) to provide remote offices or individual users with secure access to their organization's network. VPNs often secure data with firewall and encryption technologies to prevent disclosure of private information to unauthorized parties.

There are three important VPN technologies: trusted VPNs, secure VPNs, and hybrid VPNs. In trusted VPNs, customers use private circuits leased from a trusted communications provider, which assures them that the circuits are exclusive. Trusted VPNs ensure integrity and privacy of data transfers but do not provide any encryption capabilities. Therefore, customers are able to have their own IP addressing and their own security policies.

Secure VPNs, on the other hand, require traffic to be encrypted and authenticated and are most important when communication occurs across an infrastructure that is not trusted (e.g. over the public Internet). Finally, it is also possible to use a secure VPN over a trusted VPN, and it is called a hybrid VPN.

While secure VPNs are used by companies that want to ensure security of their sensitive information transmission, companies who use trusted VPNs do so because they want to know that their data is moving over a set of paths that has specified properties and is controlled by one ISP or a trusted confederation of ISPs.

Technologies used in each kind of VPN are shown below:

Trusted VPN: ATM circuits, frame-relay circuits and Multiprotocol Label Switching (MPLS).

Secure VPN: IPsec with encryption (most dominant), IPsec with Layer 2 Tunneling Protocol (L2TP), SSL 3.0 or Transport Layer Security (TLS) with encryption, Layer Two Forwarding (L2F) or Point-to-Point Tunneling Protocol (PPTP).

Nowadays, IP VPN services, which includes MPLS based IP VPNs and IPsec VPNs, have become the preferred network choice for enterprises requiring QoS and SLAs [Researchandmarket10].

Revenue Model

The revenue model used in the IP VPN market is the port charge, a monthly recurring charge for VPN connectivity. Prices vary according to the bandwidth speeds to access VPNs.

Geographical Definition

The quantification process will consider the worldwide market.

Quantification Methodology and Hypotheses

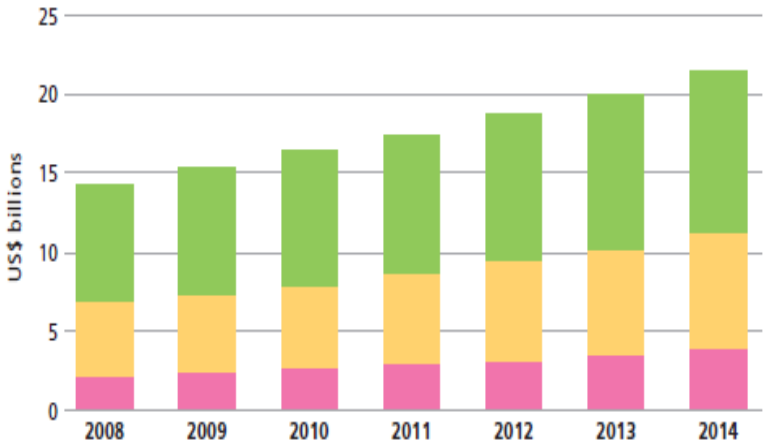
The data and information used were collected from secondary sources, such as presentations featuring market value and growth trends, reports from international institutions, industry news.

Although both MPLS and IPsec VPNs are deployed by companies requiring QoS and SLAs [Researchandmarket10], this analysis will be carried out based exclusively on the MPLS VPN market. This approach was chosen because data publicly available regarding the whole IP VPN forecast do not provide detailed information about the market coverage and therefore, it is not possible to be certain if the values comprise only NSP revenues (ETICS' target) or also non-NSP revenues. MPLS IP VPN services, on the other hand, surely need a provider to be performed.

The to-be market will only consider the expected growth for the MPLS VPN market without ETICS introduction, because it is hard to predict if or how ETICS solution will be able to incite an additional market growth. Evidences suggest that customers are satisfied with the present connection capacities. TeleGeography, a telecommunications market research and consulting firm, states that although carriers continue to expand their offering of high capacity IP VPN ports, customer demand remains strongest for connections under 10Mbps. According to new data from TeleGeography's Enterprise Network Pricing Service, 88% of ports sold by carriers between Q1 2011 and Q1 2012 were 10Mbps or less. 54% of ports sold in the developed markets of North America, Europe, and Asia were less than 2Mbps, while 34% were between 2Mbps and 10Mbps [TeleGeography12].

As-Is Market Value Quantification

Ovum is an independent analyst and consultancy firm specialized in global coverage of IT and telecommunications industries. In 2008 the company released the Worldwide IP VPN Forecast report [Alcatel-Lucent09a], which provided specific data about the worldwide MPLS IP VPN service revenue alone, shown below.



	2008	2009	2010	2011	2012	2013	2014
Large enterprises and government (1,000+ employees)	7,602	7,967	8,367	8,806	9,286	9,804	10,342
Mid-size enterprise (250-999 employees)	4,726	5,048	5,413	5,829	6,306	6,847	7,443
Small to medium businesses (20-249 employees)	2,127	2,338	2,578	2,849	3,154	3,491	3,850

Source: Ovum, Worldwide IP-VPN Forecast, 2008

FIGURE 16 – WORLDWIDE MPLS IP VPN SERVICE REVENUE

According to this forecast, the current market is $18.7 billion (2012), which, in euros, is equivalent to **€14.2 billion**.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

The future MPLS VPN market will be conservatively estimated by its natural growth. The same report used for the as-is market quantification stated that the future market in 2013 will be $20.1 billion [Alcatel-Lucent09a], or **€15.3 billion;** while it will be $21.6 billion in 2014 [Alcatel-Lucent09a], equal to **€16.4 billion**.

ETICS Market Share and Revenues

A study conducted by Ovum-RHK (The Adoption of WAN Optimization as a Managed Service, 2008) showed that enterprises were willing to pay for WAN optimization as a managed service. It interviewed 150 enterprises located in Europe and the United States of America, including a mix of small, medium and large enterprises. A very significant 30% of enterprises claimed that they would pay extra for improved quality of service (QoS) to guarantee performance of mission-critical applications [Alcatel-Lucent09b].

This value will be used to estimate the maximum bound of ETICS market share. Therefore, 30% of the total future MPLS IP VPN market results in $6.5 billion revenues for ETICS partners. However, not all VPNs may be used for QoS reasons. Hence, in order to be conservative, it will be assumed that ETICS can get 80% of the potential 30%, reaching 24% market share. ETICS revenues would then be in the range of $4.8 to $5.2 billion. The same range in euros is **€3.7 to €3.9 billion**. Since it is not taken into account that ETICS solution will charge an extra fee for ASQ, this revenue will probably be higher depending on price setting.

Sensitivity Analysis of Results

A sensitivity analysis will be carried out in order to see how the to-be market estimation and ETICS market share assumption can influence ETICS revenues.

First of all, a 15% negative and positive variation to the to-be market was made. The pessimistic scenario, however, is considerably pessimistic as it takes away a further 15% to an already conservative estimation of the to-be market, and, therefore, is unlikely to occur. Moreover, if ETICS really boosts any market growth, then the to-be market will be higher than the baseline, set as the natural growth without ASQ, and closer to the optimistic scenario.

To-Be Market	Pessimistic	Base Scenario	Optimistic
€, billions	13.0 to 14.0	15.3 to 16.4	17.6 to 18.9

TABLE 112 – SENSITIVITY ANALYSIS OF THE TO-BE MARKET

Then, ETICS market share was varied in the optimistic case to reach the maximum bound and in the pessimistic to achieve 60% of it. The impact on ETICS revenues is shown below.

ETICS	Pessimistic	Base Scenario	Optimistic
Market Share	18%	24%	30%
Revenues (€, billions)	**2.3 to 2.5**	**3.7 to 3.9**	**5.3 to 5.7**

TABLE 113 – SENSITIVITY ANALYSIS OF ETICS REVENUES

9.2.4. CONSUMER CLOUD SERVICES

9.2.4.1. Gaming as a Service

In order to define the Game-as-a-Service (GaaS) market the Three Dimensional Business Definition framework from Harvard Professor Derek F. Abell will be applied. Derek Abell's model [Nijssen01] analyses the market according to three dimensions: the first dimension relates to the customer groups or segments

that can be identified in the market, the second dimension addresses these customers' needs and the third dimension identifies the alternative technologies available to satisfy those needs.

Customers

- End users who have electronic devices that enable Internet connection at sufficient speed

Needs

- Entertainment and fun
- Games available to be played on different platforms, such as PCs, tablets, laptops, TVs and mobile phones
- Real-time multiplayer game interactions
- Access to games without the need of a video game console
- The end users' hardware capabilities do not affect game performance or quality of experience
- Accessibility to a broad range of games
- No maintenance required
- Game upgrades can be obtained without additional expenses for the users

Technologies

In order to satisfy the abovementioned needs, two different online services are available.

Firstly, there are the browser games, which are played over the Internet using just a web browser. Hence, they are portable and can be played on multiple different devices or web browsers. Furthermore, they run isolated from the user's hardware and do not require any client software to be installed apart from the web browser, which is the case of client-based games. In contrast to browser games, client-based games, also called downloadable games, are executed on the user's machine, once the user needs to install client software that connects to the game server.

Finally, recent technologies, such as cloud computing, enabled the development of a new type of online gaming that allows direct and on-demand streaming of games onto a computer. This new form of game, called cloud gaming, refers to the providing of online games to end consumers through a Cloud Computing Provider, whose function is to supply Game Providers with hosting and storage capabilities. In this way, the game content resides on a company server rather than on the end user's device, and all the processing needs are run by the server, which is accessed from a thin client installed in the player's computer. Since the game is executed by the server, the game's performance is independent of the capabilities of user's device as the latter only receives the audio-visual output stream of the game, but the performance is heavily affected by the network connection capabilities. Therefore, cloud gaming can be accessed from different devices with Internet connection without requiring a specific console, reducing costs and increasing its accessibility.

Although both browser and cloud games are similar in the sense that they are portable to many electronic devices and do not require local execution, they are not identical. While browser games are relatively low-bandwidth, cloud gaming consumes much more data, since they offer popular games of higher quality which are typically played on consoles or downloaded to a PC. For example, cloud gaming platform Onlive partners with top game publishers such as Take-Two, Ubisoft and THQ, and its competitor, Gaikai has partnership with Eletronic Arts and Sega. However, technologies such as cloud computing to gaming ecosystem are still partially defined and the number of titles ported to the cloud gaming format is currently

very limited. On the other hand, browser games are usually developed as stand-alone games to be played through the Internet, by companies like Bigpoint and Gameforge.

Revenue Model

There are different revenue models being used by the companies in this market:

- Subscription
- Revenue sharing system
- In-game advertising
- Virtual item sales
- Subscription tiers

Some cloud gaming providers use subscription, a monthly fee that gives users unlimited access to some or all games available on their platforms. Main cloud gaming companies such as Onlive, Playcast and G-Cluster use this revenue model. However, Onlive and G-Cluster do not run business based only on subscriptions, they also rent or sell access to a single game, for an additional price. Gaikai, on the other hand, uses a model based on a revenue sharing system between developers, publishers, retailers and affiliates, and does not charge anything to the players. This revenue sharing model consists of charging publishers and developers for providing online demos of their games and also online retailers for the network time to run demos on their websites, but sharing the revenue with affiliates, which are websites that have traffic interested in buying games and therefore host the demos.

In addition to cloud gaming, client-based games also apply the subscription model. They charge users for the connection to allow multiplayer interactions. Nevertheless, not all client games require payment. Some are free to play and users can download the game software for free (e.g. Dofus). Other possible cases are when gamers are charged for the client but not for the connection (e.g. Guild of Wars) or charged for both (e.g. World of Warcraft). Finally, on free games there is also the opportunity to have an enhanced experience by paying for the connection (e.g. Dofus) or for the client (e.g. any Android game).

Browser games are usually free-to-play and rely on revenues from in-game advertising, virtual item sales and subscription tiers. Subscription tiers, differently from the subscription model applied by some cloud gaming providers, give users access to premium features or extra game content not available for the regular gamers who play for free. Some big players in the casual browser-based space are Bigpoint, Gameforge, Nexon, Wooga, Zynga, Innogames, Jagex and Artix Entertainment.

Geographical Definition

Since browser-based and cloud-based games considered together are played all over the world, the market estimation will have a global scale.

Quantification Methodology and Hypotheses

The data and information collected were from secondary sources, such as presentations featuring market value and growth trends, reports from international institutions, industry news.

The cloud gaming segment is hard to be quantified individually for the reason that it is a developing recent market with a small number of players, and, therefore, numerical data regarding revenues is not yet publicly available. On the other hand, browser and client games constitute an established segment that comprises a huge number of large and small companies spread all over the world, which makes it too complex to be estimated by an approximation of players' market shares and there is no specific information about these

entire segments alone. With the above in view, the market quantification will not come from the aggregation of quantifications performed on the segments separately, instead, the overall online game market size forecast by DFC Intelligence will be used for the game-as-a-service market estimation.

As-Is Market Value Quantification

According to DFC Intelligence's last report on Online Game Market Forecasts released in June 2011, the overall worldwide revenue for online games (for both PC and consoles) was $15.7 billion in 2010 [Brightman 11]. DFC provided that estimation including revenue from subscriptions, online usage, online advertising in games and digital downloads.

To-Be Market Value Quantification after the Introduction of ETICS ASQ

Some European pay-TV providers are starting to offer video-streamed gaming on demand (GoD) direct to the TV. Two telecommunications operators, SFR and Portugal Telecom, provide cloud gaming services from G-cluster and Playcast, respectively. It is expected that other IPTV providers close deals with cloud gaming companies in order to get a value-added service uptick and differentiated sales to increase customer base. Apart from GoD through pay-TV, another potential increase in the market could come from games played on smartphones, however, since this growth is hard to quantify, this analysis will not take it into account.

Cloud gaming is still a new service on the IPTV market and ETICS ASQ solution could increase its penetration. SFR and Portugal Telecom's expectation is that GoD penetration could one day equal VoD take-up in the IPTV space: an opportunity commonly cited at around 5% of the total customer base [CurrentAnalysis11]. Assuming that ETICS ASQ would enable customers to have better quality of experience in gaming and this would make cloud gaming penetration reach 5% of the overall IPTV subscriptions.

RNCOS research report, "Global IPTV Market Forecast to 2014", from January 2011, said that global IPTV subscribers will rise to around 109 million in 2014 [RNCOS11]. It was considered that the subscription fee for cloud gaming service would be €9.99/month. However, since other values are presented in dollar, this fee was converted to $13.14/month.

# IPTV Subscribers (millions)	# GoD Subscribers (millions)	$ millions/month	$ billions/year
109.00	5.45	71.64	0.86

TABLE 114 – IPTV'S GOD REVENUE IN THE TO-BE MARKET

Another potential growth would come from smart TVs. Like IPTV, smart TVs are making deals with cloud gaming providers in order to offer GoD applications. OnLive will be built into the new generation of Google TVs and Gaikai will be integrated into LG's smart TVs. In-Stat Research Firm predicts that by 2014 the total smart TV sales will increase to 123 million [Kausar11]. If considered that ETICS could incite 15% of smart TV buyers to subscribe cloud gaming services, then the market growth would be $2.21 billion. The monthly fee used for this estimation was $9.99, which is the price of the regular unlimited package available on OnLive.

Smart TV Sales (millions)	# GoD Subscribers (millions)	$ millions/month	$ billions/year
123.00	18.45	184.32	2.21

TABLE 115 – SMART TV'S GOD REVENUE IN THE TO-BE MARKET

Moreover, ETICS could also promote and accelerate the migration from physical and downloadable games to the cloud computing services. According to First Research, consumers spend about $45 billion annually on video game software [First11]. If ETICS only grabs 5% of this industry, by shifting consumers from software to cloud games, then ETICS solution would reach $2.25 billion.

Finally, there would be a natural growth of online games market, with a CAGR of around 10.8%. This CAGR was calculated from DFC's forecast of total online games revenues reaching $29 billion by 2016 [Brightman11]. Using the same CAGR until 2014, the game-as-a-service market would value $23.64 billion.

To-Be Market	GoD - IPTVs	GoD - Smart TVs	Shift to the Cloud	Natural Growth	Total
$, billions	0.86	2.21	2.25	23.64	28.96
€, billions	**0.65**	**1.68**	**1.71**	**17.96**	**22.01**

TABLE 116 – GAAS TO-BE MARKET VALUE

As a result, the to-be market would be equal to $29.0 billion or, converting it to euros, **€22.0 billion**.

ETICS Market Share and Revenues

A global study of broadband quality, "Broadband Quality Score III", ran by Oxford Saïd Business School and Universidad de Oviedo in 2010 [Cisco10], ranked countries according to their ability to meet changing quality requirements. Applications were divided in two categories: large usage & maturing in growth were considered the applications of "today". Those that were small in usage but were growing exponentially were considered applications of "tomorrow". The three elements defined to assess broadband quality were: download throughput, upload throughput, and latency.

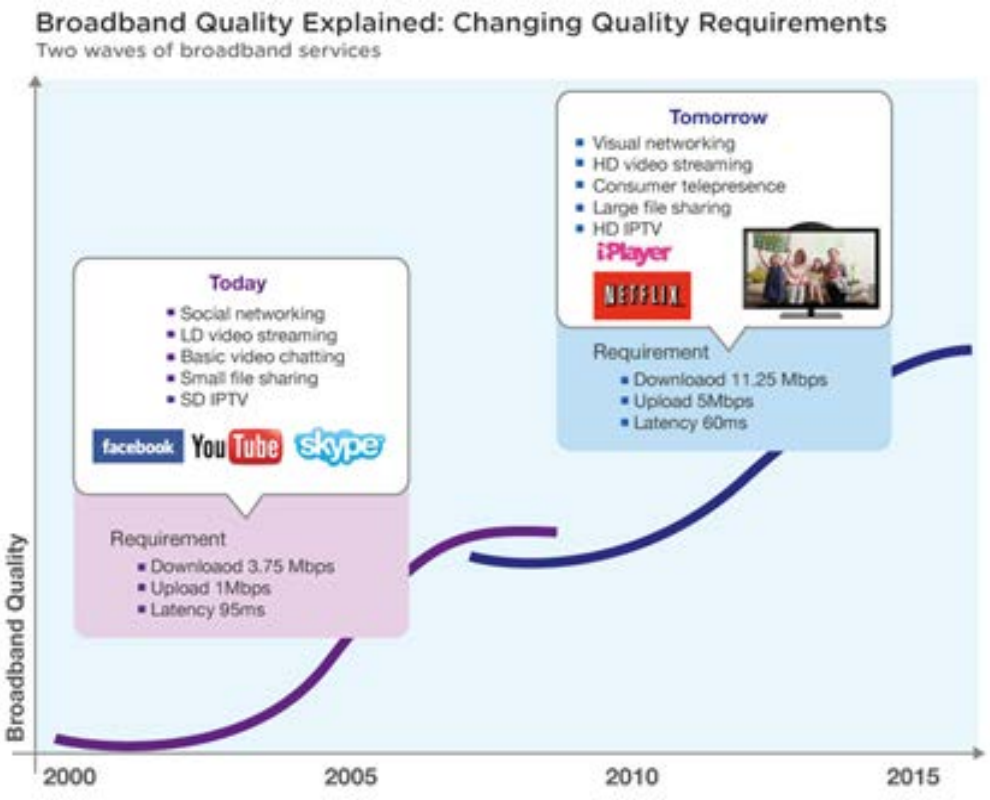


FIGURE 17 – CHANGING BROADBAND QUALITY REQUIREMENTS

The study classified the countries in five different classes: ready for tomorrow, comfortably enjoying today's applications, meeting needs of today's applications, below today's application threshold and basic apps.

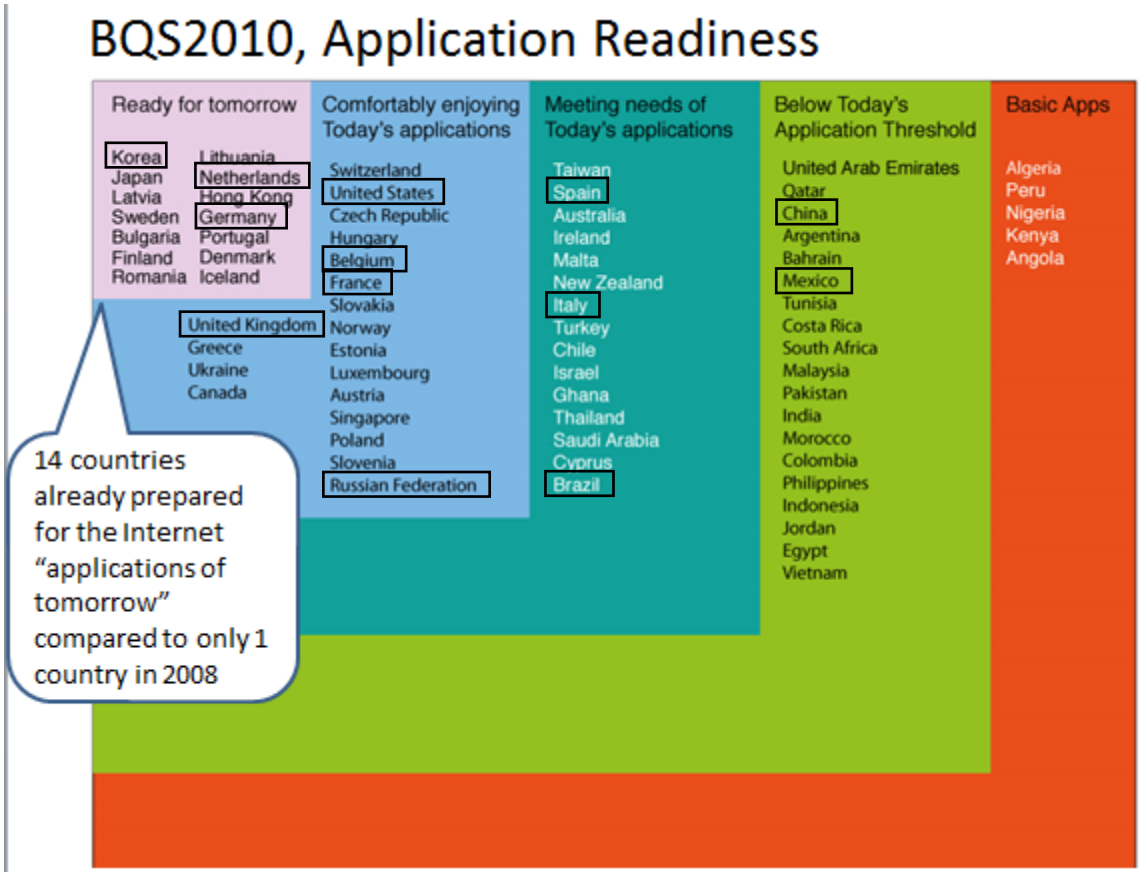


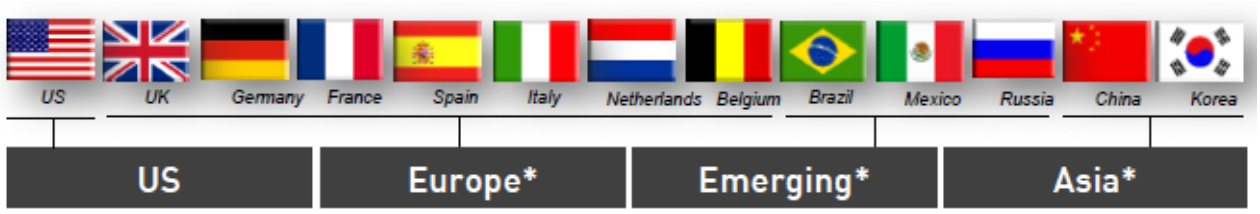
FIGURE 18 – COUNTRIES APPLICATION READINESS

ETICS solution's benefits will come when the ISP has to connect to a remote cloud game server in another NSP network. Therefore, ETICS solution can help to maintain the QoS of high-quality broadband access. In this way, it can be considered that ETICS will gain more market share where the quality level of broadband is higher. Hence, some assumptions of ETICS penetration were made based on the classification aforementioned and the values attributed are shown below. It is important to mention that this penetration is considering only the network service that could be improved by ETICS because it is hard to predict how ETICS can act as a GaaS platform provider and its extra market share, therefore, a conservative approach will be adopted and the analysis will not include the latter area of activity.

Broadband Quality Classification	ETICS Penetration
Ready for Tomorrow[1]	35%
Comfortably Enjoying Today's Applications[2]	25%
Meeting Needs of Today's Applications[3]	15%
Below Today's Application Threshold[4]	7.5%

TABLE 117 – ETICS POTENTIAL PENETRATION ACCORDING TO BROADBAND QUALITY

The Newzoo's Trend Report on MMO Games [Newzoo11] provided the MMO revenues divided in four regions: USA, Europe, emerging countries and Asia, according to the figure below. The data provided by Newzoo will be used as a proxy for each region's total market and their sum will give the global market.



* As aggregate of the countries shown above.

FIGURE 19 – COUNTRIES ANALYSED PER REGION

In order to calculate the average ETICS penetration in a region, the penetration in each country belonging to it will be weighted by the number of Internet users, which was obtained from Internet World Stats' data. However, since China and Korea have very distinct broadband qualities, and consequently, ETICS penetration rates, they will be analysed separately instead of aggregated as Asia.

The table below shows the number of Internet users in each country and the respective penetration ETICS could get among them.

Region	(USA)	Europe: United Kingdom (UK), Germany (Ger), France (Fra), Spain (Sp), Italy (It), Netherlands (Neth), Belgium (Bel)							Emerging: Brazil (Br), Mexico (Mex), Russia (Rus)			Asia: China (Chi), Korea (Kor)	
Country	**USA[2]**	**UK[2]**	**Ger[1]**	**Fra[2]**	**Sp[3]**	**It[3]**	**Neth[1]**	**Bel[2]**	**Br[3]**	**Mex[4]**	**Rus[2]**	**Chi[4]**	**Kor[1]**
Internet Users (M)	245.0	51.4	65.1	45.2	29.1	30.0	14.9	8.1	76.0	34.9	59.7	513.0	40.3
ETICS (%)	25%	25%	35%	25%	15%	15%	35%	25%	15%	7,5%	25%	7.5%	35%
ETICS (%)	25%	26%							17%			7.5%	35%

TABLE 118 – PENETRATION BY COUNTRY AND REGION

Considering the MMO market split by region [Newzoo11] and the corresponding ETICS penetration it is possible to assess ETICS revenues in each region as well as ETICS global revenue, which would be $1.92 billion. Since the total MMO market is $9.62, ETICS adoption would reach a 20% market share.

Region	USA	Europe	Emerging	China	Korea	World
MMO Market ($, billions)	2.55	2.08	0.68	3.21*	1.11**	9.62
ETICS Penetration	25.0%	25.9%	17.0%	7.5%	35%	**20%**
ETICS MMO Market ($, billions)	0.64	0.54	0.12	0.24	0.39	1.92

*one third of the global revenue [Yan10]; **Asia's revenue minus China's

TABLE 119 – ETICS MMO REVENUES BY REGION

This 20% market share in the MMO market will be used as a proxy for ETICS penetration in the whole game-as-a-service market.

($, billions)	Total	Penetration	ETICS' Participation
Natural Market	23.64	20%	4.71
ETICS Growth	5.32	100%	5.32
Total	-	-	10.03

TABLE 120 – GAAS ETICS MARKET SHARE

From the to-be market quantification, the game-as-a-service market achieved by natural growth was valued at $23.64 billion. ETICS would serve 20% of that, which is equivalent to $4.7 billion. If this market share is summed to the potential market growth driven by ETICS solution, equal to $5.3 billion, then total ETICS reach would be $10.0 billion, or, in euros, €7.6 billion.

ETICS Market (dollars)	ETICS Market (euros)	ETICS Revenues (euros)
$10.0 billion	**€7.6 billion**	**€381.3 million**

TABLE 121 – GAAS ETICS MARKET REVENUES

However, ETICS players, mainly NSPs, will not receive this absolute revenue. Instead, they will be able to apply a premium price for advanced network services and gain a little portion of the GaaS market supported by ETICS solutions, for instance, 5%. Therefore, assigning this percentage to ETICS players, their revenue would be **€381.3 million**.

Sensitivity Analysis of Results

The detailed ETICS's market estimations may change with a variation of the used assumed parameters. In order to shed some light on such variations, this last step proposes a sensitivity analysis were optimistic and pessimistic scenarios are portrayed, so as to define a range the estimated values could swing between. The first of them regarded the potential penetration games on demand could achieve among IPTV subscribers.

GoD's Penetration on IPTVs	2%	5%	8%
To-Be Market - IPTV ($, billions)	0.34	0.86	1.37

TABLE 122 – IPTV'S GOD TO-BE MARKET

In a similar way, GoD could reach more or less smart TV buyers.

GoD's Penetration on Smart TVs	10%	15%	20%
To-Be Market - Smart TV ($, billions)	1.47	2.21	2.95

TABLE 123 – SMART TV'S GOD TO-BE MARKET

Finally, the percentage of the games software sales that could migrate to the cloud gaming market can vary.

Games Software's Shift to the Cloud	2%	5%	8%
To-Be Market - Software's Shift ($, billions)	0.90	2.25	3.60

TABLE 124 – SOFTWARE'S SHIFT TO THE CLOUD TO-BE MARKET

Adding these three portions of the growth led by ETICS introduction it is possible to calculate the total to-be market pushed by ETICS in three different situations.

($, billions)	Pessimistic	Base Scenario	Optimistic
To-Be Market – Total ETICS	2.72	5.32	7.92

TABLE 125 – SCENARIO ANALYSIS ON GAAS PENETRATIONS

In addition to this, ETICS' share of the natural GaaS market ($23.64 billion) can also change. It was calculated as 20% previous section (ETICS Market Share and Revenues), but increasing or decreasing by 40% ETICS' penetration in each country according to the broadband quality classification, ETICS market share becomes 28% and 12%, respectively. The whole analysis considered only the network service, but ETICS

could also become a provider of GaaS platform, which would increase its market share. This opportunity would be represented by the optimistic scenario.

ETICS' Market Share	12%	20%	28%
ETICS Served Market ($, billions)	5.6	10.0	14.5
ETICS Partner's Revenue ($, millions)	277.3	501.7	726.0
ETICS Partner's Revenue (€, millions)	**210.7**	**381.3**	**551.8**

TABLE 126 – SCENARIO ANALYSIS ON GAAS MARKET SHARE

Having been able to observe the best and worst case scenarios, it is now important to identify which hypotheses have heavier influence on the final revenue addressed to ETICS partners.

In order to understand these influences, the variables were modified one at a time, keeping all other values constant and equal to the base scenario. The impact of a 10% change in each assumption on the final result of this market quantification is showed below.

10% Change in	GoD's Penetration on IPTVs	GoD's Penetration on Smart TVs	Games Software's Shift to the Cloud	ETICS' Market Share
Impact on ETICS Partners' Revenue	0.86%	2.20%	2.24%	4.70%

TABLE 127 – ASSUMPTIONS' IMPACT ON THE QUANTIFICATION PROCESS

If only one assumption is prone to vary, ETICS' market share has the greatest influence on the results. However, since it is probable that two or more values change, the assumptions made regarding the new market pushed by ETICS combined have higher impact, 5.30%, than ETICS' market share.

9.2.5. All ETICS-Related Services and Content (Israel)

In this section we consider the Israeli Internet market, aiming at quantifying its ETICS-related size, for any type of service or content. The Technion is an Israeli partner in ETICS, and thus Israeli market quantification data is available for us.

The following sets the boundaries of the analysis:

- We consider any Product/service delivered.
- Geographically, we consider the Israeli Internet market only, and its direct contribution to the ETICS-related revenues; namely, Israeli end-points that are paying for ASQ links to serve them. In this analysis we ignore the indirect revenue generated via a profit-sharing arrangements resulting from consumers outside of Israel that are utilizing ETICS solutions to access Israeli content. In a sense, the direct ETICS revenues are also subject to profit sharing with operators on the path to the overseas content, and this will also be ignored (we are looking at gross revenues, not net profits).
- We consider all possible types of customers, residential, small business or businesses. Our analysis is orthogonal to the type of customer that consumes the ETICS solutions.
- Our analysis considers ETICS ASQs that are terminated in Israel, and are paid for by the Israeli end points (the customers). Due to the global nature of the Internet and the small size of Israel in the global Internet, most content that is consumed in Israel, is hosted or originated outside of Israel. Our Israeli analysis, therefore, has a global scope.

- As far as the customer definition, the market serves all types of stakeholders, including Carriers, OTT, End users, and Business users. Our analysis is not conducted on a vertical market, but rather considering all stakeholders.

Quantification Methodology and Hypotheses

In this section we describe our estimation methodology of the Israeli ETICS-related market, the sources of information, and the relevant data. This data will be used by the estimation process.

In our quantification analysis we utilize two methods that are independent from each other. In the first one, we estimate the ETICS market from the supplier point of view (the operators, the carriers, the ISPs). In the second method, we aim at quantifying the total ETICS market from the demand side, coming from the consumers of the ETICS ASQs. Each analysis will be conducted independently, and we will then compare and evaluate the results.

Data gathering methodology – The main sources from which we collected data and information used in our quantification analysis is as follows:

- Market surveys, articles or quotes from executives in the Internet market, which are published online (technical magazines, news, etc.). Some of these sources are in Hebrew. The scope of the information might be global or local to the Israeli market; when needed, interpolation or extrapolation will be conducted; [FNN] [ISR] [NYP09] [NYC08] [shooky101] [Ynet] [Catalist].
- Government information sources that are available online.
- The Organisation for Economic Cooperation and Development, OECD, web site[OECD11].
- The Israeli Central Bureau of Statistics [CBS].

Relevant data collected – The following contains relevant data that is collected from all sources, along with evaluation of such data. This market data will be used in the evaluation process, in the next section.

The Israeli communication networks have experienced an ever-growing consumption of information during the recent years. It is estimated that the current household consumption rate is at 20 GB per month, and it is expected to grow 33% annually. The Smartphone revolution makes this trend significantly stronger. A recent report by Allot Communications (www.allot.com) reveals that the median consumption of data services over cellular networks increased by astonishing 77% within one year, with video being the most significant contributor to this growth (93%, primarily from YouTube).

The consumption of cellular data in the Israeli market was tripled during the last year. Israel is positioned as the first in the world with respect to the amount spent in social networks. Smartphone sales make about 60% of the total sales of mobile handsets in Israel. Currently, about 1,000,000 Israelis own a Smartphone (61% I-phone, and 39% Android)

The same report from Allot Communications identifies that 32% of the worldwide cellular operators are adapting a so-called "aware-charging application" strategy, in which applications are charged at different rates. Vodafone, for example, reported that it was able to save 31% of cost associated with the increase in data consumption by adopting this strategy.

Allot Communications is a lead international technology provider of Deep Packet Inspection solutions, DPI, which are the means to associate each IP packet to a specific application in real-time (i.e., at wire speed), and control its flow, by means of blocking, delaying, or prioritizing. The company is in the best position to

identify such global trend. It is no wonder that Allot Communications enjoys significant increase in its international sales, which is primarily due to the installation of its products in this application.

The Israeli Central Bureau of Statistics reports that there are 7,836,000 residents in Israel. The average household size is 3.74, and therefore, the number of households in Israel is currently estimated at about 2.1 millions.

In the year 2010, the penetration of high-speed Internet in Israel was at 85%. In the OECD countries, Israel is positioned as 16th out of 32, with respect to penetration of high-speed Internet. Consequently, there are about 1.8 million households with high-speed Internet in Israel. On average, the Internet access speed in Israel is estimated at 3.82Mbps (about 41GB/day).

The Average per Bit Delivery Cost, APBDC, is a common method by which ISPs calculate their cost. The 2011 APBDC for large US carriers is at 2-5 cents per gigabyte. The APBDC is constantly going down, but at the same time, users consume more bandwidth. Consequently, in the US, the cost of bandwidth per user stays at around $1/month. Considering a $20-$50/month broadband connection, the bandwidth cost is within the range of 2%-5% of the revenue.

The OECD broadband portal provides some broadband prices per country. In Israel, broadband prices per megabit of advertised speed per second, in the end of 2010, was within the range of $2-$11.7.

In the US, commercial HDTV services started in 1996 in North Carolina and later in Washington DC [WRAL06].

A US survey, conducted by Nielsen in February 2009 and posted in the New York Post, shows that 33.3% of US homes have HDTV -- up from just under 20% a year earlier.

Nielsen says it hasn't seen anything like it since the 1960s, when colour TV was first introduced. "Despite the recession, Americans seem willing to continue to spend their hard-earned money on this new technology," said Steve McGowan, Nielsen's head of client research.

In a different online post, Nielsen reported that at the end of 2008 Washington DC showed the highest HDTV adaptation rate in the US with 31.1% take rate, following closely by Boston (30.5%), and New York (30.2%).

In Europe, first HDTV broadcasts launched in 2004, in Belgium, and later spread throughout Europe. The number of European HD channels and viewers has risen steadily since the first HDTV broadcasts. SES's 2010 annual Satellite Monitor market survey reveals that 20 million households, which accounts for 27% of all European digital satellite TV homes, are watching HD satellite broadcasts [ASTRAresearch].

In Israel, HDTV broadcasts began in 2007 by Yes, a digital satellite broadcasting company that is a subsidiary of Bezeq (the incumbent telephone company). Nowadays, 18 HD channels are available (most of them are international channels).

Hot, the incumbent cable TV Israeli company, started HD broadcasting in early 2008, and is now offering 14 HD channels.

As-Is Market Value Quantification

In this section we estimate the size of the high-speed Internet market prior to the introduction of the ETICS solutions. We are estimating the 2011 market.

From information gathered in previous section (Quantification Methodology and Hypothesis), the total high-speed Internet market prior to ETICS is made from 1.8M households (85% of the total 2.1M households). Each household consumes 20GB/month (=670MB/day), totaling 1200 TB/day for the whole market. Each broadband consumer pays $2-$11.7/per Mbps per month, with a typical connection of 3.82Mbps. In our estimate we will be using the average price per Mbps, $6.9. Lastly, we will be using a USD to Euro exchange rate of 0.75. The current value of the Israeli market just prior to the introduction of ETICS solutions is provided in *TABLE 128*:

	Total number of high-speed households (in thousands)	Total bandwidth (in TB/day)	Total annual market (in million €)
Total high-speed Internet prior to the introduction of ETICS	1800	1200	367

TABLE 128 – QUANTIFICATION OF THE TOTAL ISRAELI HIGH-SPEED INTERNET MARKET IN 2011, PRIOR TO THE INTRODUCTION OF ETICS

Going forward, the total number of households in Israel is expected to grow 2%-3%/year. The percentage of broadband-consuming household is also expected to grow, accommodating the late adapters. Both of these growth factors are not significant. On the other hand, the total bandwidth is expected to grow 33% annually. The bandwidth growth is not expected to affect the monetary estimation (Internet access prices are not going to be significantly changed, as previously noted).

To-Be Market Value Quantification after the Introduction of ETICS ASQ

As explained earlier, our analysis quantifies the ETICS market using two methods. The first method considers the operators point of view, while the second estimates the ETICS market from the consumer demand. Both estimates are conducted independently, estimating the total available ETICS market. We will now present each of them, and then compare them.

ETICS Market Quantification from the Supply Side (the Operators Rational)

First, we assume that the 32% global adaptation rate of the aware-charging application strategy is similarly represented in Israel; namely 32% of the Israeli market implements an aware-charging application strategy. We also conservatively assume that this rate is not growing (knowing that in reality, it will be growing for the same reasons it reached this 32% figure).

We further assume that this 32% of the market, in which aware-charging application strategy is implemented, is affecting 32% of the total Israeli Internet traffic. While the 32% figure is related to the data consumption over cellular market, there are about 1 million Smartphones in Israel, which account for significantly more than 32% of total households, and, therefore, this assumption is realistic.

We now argue that ETICS ASQ IC solutions can be more appropriate and legal means to cope with the mass content and reduced profitability, rather than the aware-charging application strategy. We believe that operators will be much more comfortable offering a premium service for a premium charge, rather than implementing the grey-zone aware-charging application strategy. We therefore conclude that 32% of the total Israeli high-speed Internet traffic is the total available ETICS market. This means that from the total of 1.8 million broadband Internet household, each at 20GB/month, ETICS market is estimated at 0.576 million households, collectively consuming (576K X 20GB/month) =11,520TB/month=384TB/day.

ETICS Market Quantification from the Demand Side (the Consumers Rational)

From the demand side, we can assume that Assured connections are primarily used to increase the quality of Internet video (and we know that video applications are responsible for most of the bandwidth increase)

We can assume that the adaptation rate of ETICS solution should follow the same patterns of the upgrade from SD to HD television services (which are also motivated by improvement of video quality).

We further assume that the HDTV adaptation rate in Israel follows the same digital satellite HDTV adaption rate in Europe. Implicitly, we assume that the digital satellite HDTV adaptation rate represents the total HDTV adaptation rate (including terrestrial HDTV).

Implementing this rational, the total available ETICS market in Israel is 27% of all broadband-connected households (27% X 1.8 million) =0.486 million households. Again, each household consumes 20GB/month, and thus this translates into (486K X 20GB/month) =9,720TB/month=324TB/day.

Summary of the ETICS Total Available Market

We presented two methods for estimating the ETICS total available market, one from the operator point of view, and the other from the consumer point of view. The estimations of both methods are showing the total available market, assuming 100% penetration. The analysis quantifies the number of households and the amount of bandwidth that is controlled by the ETICS solutions.

We now want to convert these estimates into monetary terms. Using the OECD broadband portal, the price per megabit per second in Israel at the end of 2010 was in the range of $2-11.7$. It is fair to assume that the ETICS bits will be charged higher than the best-effort bits. At the same time we recall that, regardless the diminishing bandwidth cost, a $1/user/month is the rule of thumb bandwidth cost figure that roughly stays unchanged over the years. Likewise, Internet prices are not expected to be changing significantly. Therefore, we will assume that $10 will be the price per ETICS megabit per second (the high-end of the current best effort range). Also, recall that the average high-speed connection in Israel is 3.82Mbps. Finally, we will be using a 0.75 USD/Euro exchange rate.

The results of both methods are summarized in *TABLE 129*, estimating the total available ETICS market, in terms of number of households, the amount of bandwidth, and the annual Euro amount.

Both methods reach a comparable estimate. The difference between them is due to the estimated percentage of total households that are supplied with or consumed the ETICS solution (32% in the supply model, and 27% in the demand model). We aim to consolidate both estimates into one figure, and thus will use the average (29.5%). The consolidated total available ETICS market in Israel is shown in the last line of *TABLE 129*.

Analysis Method	Total number of ETICS-consuming households (in thousands, %)	Total ETICS-controlled bandwidth (in TB/day)	Total annual ETICS market (in million €)
Supply side	576, (32%)	384	198
Demand side	486, (27%)	324	167
Consolidated Estimate	**530, (29.5%)**	**353**	**183**

TABLE 129 – ETICS TOTAL AVAILABLE MARKET IN ISRAEL

Lastly, we want to conduct a sanity check for these estimates. We want to look at the total available high-speed Internet market prior to the introduction of ETICS, and the total of same market (best effort) with full ETICS penetration (assuming this happens overnight). The result of this sanity check is summarized in *TABLE 130*. The first line, total high-speed Internet prior to the introduction of ETICS, is taken from *TABLE 128* of previous section (As-Is Market Value Quantification).

The total high-speed best-effort Internet market, assuming an instant 100% ETICS penetration, is made from of 1.27M households (70.5% of broadband households), consuming 20GB/month each, and paying $6.9/Mbps per month, with a typical connection of 3.82Mbps.

The total ETICS market is copied from the last row of *TABLE 129*.

Market	Total number of households (in thousands)	Total bandwidth (in TB/day)	Total annual market (in million €)
Total high-speed Internet prior to the introduction of ETICS	1800	1200	367
Total high-speed best-effort Internet assuming 100% ETICS penetration over night	1270	847	259
Total ETICS market	**530**	**353**	**183**

TABLE 130 – TOTAL AVAILABLE MARKETS AT THE TIME ETICS SOLUTIONS ARE AVAILABLE (A SANITY CHECK)

As seen in *TABLE 130*, the ETICS market estimation makes sense. The total number of households from ETICS and from best-effort services sum up to the total number of high-speed households. The same holds for the total bandwidth column (in which the ETICS and best-effort bandwidth sum to the total bandwidth prior to the introduction of ETICS). As far as the monetary estimates, the revenues from ETICS and best-effort services sum up to 442M Euros, more than the estimated 367M Euros estimate of the total market just before ETICS happened. This is due to the fact that ETICS services are priced higher than best effort ($10Mpbs vs. 6.9Mbps, as estimated in this analysis).

ETICS Market Share and Revenues

We now aim at quantifying the size of the yearly ETICS market, as it develops from the introduction of the ASQ solutions.

We first assume that the first year for the availability of the ETICS solutions and services is 2013. We consider the 33% annual bandwidth increase per household, as per our information. However, this annual bandwidth increase does not affect the monetary estimates, as earlier noted. We assume that the adaptation of the ETICS solutions will take a few years. We assume a 5-year process, in which 5%/year of the total available ETIC market is supplied, reaching 25% of the total available ETICS market within 5 years. This is clearly a conservative estimate.

The results of this ramp-up estimate are shown in *TABLE 131*:

Year	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)
Penetration rate	5%	10%	15%	20%	25%
ETICS-consuming households (in thousands)	27	53	80	106	133
ETICS-controlled bandwidth (in TB/day)	31	82	162	288	470
ETICS annual market (in million €)	9	18	26	36	46

TABLE 131 – 5-YEARS RAMP-UP OF ETICS MARKET

Please note: In this estimate (*TABLE 131*) we did not consider two additional factors. We did not account for growth of the number of households in Israel (in reality it is growing at a slow rate of 2%-3%/year). We also ignored the anticipated growth of the households connected via high-speed Internet. We assume the rate stays at 85% (where in reality, we know that this rate will be gradually growing, accommodating the late adapters). Both of these factors grow the estimated ETICS market, which means that our estimate is on the conservative side.

Sensitivity Analysis of Results

In this section we perform sensitivity analysis for the estimates provided.

The estimates provided in section (As-Is Market Value Quantification), regarding the high-speed Internet 2011 market are based on multiple sources and are quite accurate. We feel very confident about them; clearly estimating the past is a less-risky task.

We first want to evaluate the impact of ETICS solutions becoming available significantly later than anticipated (2013), possibly due to standardization, technology maturity or market awareness. We note that our data and the analysis do not indicate any significant changes in prices, number of Israeli households, or number of broadband households. On the other hand, bandwidth is expected to grow 33% annually. The bandwidth growth is not affecting pricing or the number of household, and therefore can be ignored in this analysis. We therefore conclude that our estimates are appropriate for later years, as long as we interpret Year 1 as the first year ETICS solutions are available.

A second significant assumption we made in section (To-Be Market Value Qualification after the introduction of ETICS ASQ) is that the total available ETICS market is made from 29.5% of the total high-speed market. We derived and justified this estimate deploying two independent methods, and thus believe it is an educated and appropriate estimate. However, in the event this estimate is significantly wrong, it will affect the year-to-year ETICS-related revenues. Our sensitivity analysis shows that a mistake in 5% in the estimation of the total available market is propagated into a 5% change in the year-to-year ETICS market revenues shown in section (ETICS Market Share and Revenues). This direct error propagation limits the impact of any possible mistake we will be making here.

The third significant assumption we made is in section (ETICS Market Share and Revenues), assuming a 5%/year ETICS uptake, totaling 25% from the total available ETICS market within 5 years. Again, we might be

wrong (and probably will be wrong here). An estimate error here is directly propagated on a yearly basis, which means that a 5% estimation mistake in a given year is propagated into a 5% change in ETICS revenues for this year, and for subsequent years. This 5% estimate is really a rough estimate, we could be wrong by 100% easily (showing 10%/year ETICS market uptake), which amounts for additional 46 million Euros of ETICS-related revenues at year 5. Clearly this is the most sensitive area of our estimate.

9.3. EXAPLES OF EU COMMISSION RESPONSES TO CARTELS

Some cases in which European Union Commission imposed heavy fines on companies involved in a cartel are represented, with regard to the technology sector, by the DRAMs and LCD cases. With regard to the first case, the overall cartel was in operation between 1 July 1998 and 15 June 2002. It involved a network of contacts and sharing of secret information, mostly on a bilateral basis, through which players coordinated the price levels and quotations for DRAMs (Dynamic Random Access Memory), sold to major PC or server original equipment manufacturers (OEMs) in the European Economic Area. DRAMs is a common model for "dynamic" semiconductor memories for personal computers (PCs), servers and workstations.

The European Commission fined DRAM producers €331 million for price cartel including a reduction of 10% for the companies' acknowledgement of the facts. The addressees of the decision were: Micron, Samsung, Hynix, Infineon, NEC, Hitachi, Mitsubishi, Toshiba, Elpida and Nanya. Micron, however, was not fined because it revealed the existence of the cartel to the Commission.

Most recently, the European Commission fined six producers of liquid crystal display (LCD) panels a total of €648 million for operating a cartel between October 2001 and February 2006. The companies are Samsung Electronics and LG Display of Korea and Taiwanese firms AU Optronics, Chimei InnoLux Corporation, Chunghwa Picture Tubes and HannStar Display Corporation.

During the four years mentioned, the companies agreed prices, including price ranges and minimum prices, exchanged information on future production planning, capacity utilization, pricing and other commercial conditions. The cartel members held monthly multilateral meetings and further bilateral meetings. In total they met around 60 times mainly in hotels in Taiwan for what they called "the Crystal meetings".

These agreements had a direct impact on customers in the European Economic Area because the vast majority of televisions, computer monitors and notebooks incorporating those LCD panels and sold in the EEA comes from Asia.