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Abstract:

This master's thesis focuses on the Telecom market of the European Union as the EU digital agenda moves towards a Single Market of Telecommunications in Europe. For this objective to be achieved the EU has set two major goals, namely the elimination of roaming fees among European members and a common net neutrality policy. This regulatory path combined with the emergence of OTT services is forcing Telecom operators to reshape their business models and strategies.

This work will analyze more specific issues related to the two topics of net neutrality and international roaming including, zero-rating, wholesale and retail prices and the effect of the eurotariff among others. This work will focus mainly on the SMS and voice markets that are the main sectors in the line of fire of both the EU Commission and OTT players.

Taking the technological and market developments with respect to OTTs into consideration and the introduction of roaming price caps, this work will look into the main challenges and the strategic actions that traditional Telecom operators face and take, and how this development is shaped by and affecting the regulatory development at the EU level.

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1 INTRODUCTION

With the emergence of over-the-top (OTT) services, Telecom operators are facing significant challenges that have led to an ongoing battle between them and OTT companies that are taking over markets such as mobile voice, media, messaging, cloud services while using their infrastructure (Menon, N. et al. 2012). Services such as Youtube, Skype, Facebook and Netflix constitute a significant percentage of the traffic of Telecom operators' networks, consuming a great amount of bandwidth while substituting for conventional Telecom services.

Especially in the case of SMS and voice services, data released by Telecom operators indicate an important decline in the peer-to-peer SMS messaging due to applications such as WhatsApp that shift users' habits towards instant messaging and social networking (Menon, N. et al. 2012). The situation is a bit better for mobile voice but still operators are losing ground to VoIP applications such as Skype and Viber.

This situation has stirred concerns for Telecom operators, who are now in the look for new strategies and changes in their business models in order to counteract the impact of OTT services to their revenues, while simultaneously they are subject to demand for faster networks with additional capacity to provide all these innovative services, which in turn calls for large investments in a time when Telecom revenues are being challenged.

The above challenges need to be faced while in Europe, the changes in the European regulatory field call for more adjustments from Telecom operators. The network neutrality debate that started more than a decade ago in the United States, has been transferred over to the European continent where two countries, namely the Netherlands[1] in 2011 and Slovenia[2] in 2013 have passed net neutrality laws in their national legislation.

Currently the European Union is discussing net neutrality, especially since the Netherlands are strongly lobbying for it (Westerink, J., personal communication, March 23, 2015), but without any harmonized European regulatory framework created yet. Depending on how strict these rules are, such regulatory decisions can potentially affect, in different ways and on different levels, operators' networks, their revenues as well as competition in the Telecom market.

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[1] https://www.bof.nl/2011/06/27/translations-of-key-dutch-internet-freedom-provisions/
[2] https://wlan-si.net/en/blog/2013/06/16/net-neutrality-in-slovenia/

Furthermore, roaming charges, a revenue stream that provided extra inflow of cash for operators, especially for the touristic countries of southern Europe, is the target of the EU in an attempt to further promote the idea of a unified, integrated digital market for the countries of the European continent. Since 2007 EU regulation has mandated the lowering of roaming charges across Europe. In 2014 the EU parliament voted for the end of roaming charges in the EU. Yet to be approved by the EU Council, the deadline for this to happen, proposed by the EU parliament is December 2015 (Gentner, A., 2014). In a draft of the regulatory package by the EU Council (EC) that came out in September 2014 there was no mention of the date and as it was later announced roaming fees will remain until 2018[3].

These regulatory developments, and more specifically the elimination of roaming charges and the decisions on net neutrality, will be yet another challenge that will shape the future strategies of European Telecom operators in an attempt to reposition themselves in this constantly changing business ecosystem, under the EU's intentions to create competition out of national borders, on a continental level, while protecting maintaining an open internet that respects the European citizens' rights and protects them from harmful practices. Identifying all the different challenges and seeing the possible ways in which they might affect the future of the Telecom sector will be the main focus of this project.

At this point it should be noted that the different issues are explored from the point of view of Telecom operators. When referring to Telecom operators in this project, it is in most cases operators that own network infrastructure, which means that wholesale buyers are not always included in this phrase. This choice does not signify a preference for the operators' views on the various subjects. It is an approach to the market through the eyes of Telecom operators that in the past few years are undergoing changes in their business models and strategies in light of their declining revenues. Europe is the home of some of the largest Telecom companies in the world making them more accessible for research, than native OTT companies, which Europe is more lacking on.

Moreover, in order to draw conclusions on the topics listed in the subsequent problem formulation, it is necessary to specify and define the interrelations between the three basic variables in this equation; the technology, the market and finally the regulatory frameworks in the EU. The forces exercised by each one of these three pillars, affect the other two in

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[3] http://www.reuters.com/article/2015/03/04/eu-Telecomunications-idUSL5N0W62K220150304

different ways. The above framework based on which the analysis of this project will be done will be further elaborated upon in the next chapter.

To begin with, the rapid technological advancements of the last couple of decades, especially the growing popularity of the internet, the innovative ideas and their quick commercialization, have led to converging technologies and subsequently traditional Telecom providers, were from the beginning a fundamental lever, being the ones who started providing internet communication. Traffic takes place in their network and so in an era where IP communication is the base of a growing set of services, they need to be able to keep up with the needs of these technologies and internet-enabled features that are currently supporting, to a great extent, global trade, entertainment, banking, e-governance services and many, many more.

But besides having to support their own networks with new investments for upgrading to newer and better technologies, that improve their services, Telecom providers have started facing service-based competition from the actual services, such as OTT services, that need and use their networks to offer alternative ones, through the development of new business models, producing revenue over the Telecom infrastructure available. OTT providers have gained ground in the fields of mobile voice, messaging, media and cloud services, causing disruptions to the Telecom market (Menon, N. et al. 2012). On the other hand, the emergence of OTTs has made operators' networks more valuable as they have increased user demand for more and better broadband.

All this is happening within the correspondent national and international regulatory framework imposed by governments, trying to ensure healthy competition and quality service provision for citizens. The influence of regulation on the Telecom market is indicated by the recent example, mentioned above, of EU regulation on excessive roaming charges, within the European continent, affecting an important revenue stream that Telecom providers would not want to lose. TDC, Denmark's largest Telecom operator, saw their stock price drop by 8.5% in the summer of 2014, the biggest plunge since May 2010. TDC announced that the drop is a consequence of the fear of reduced revenues from regulation on roaming and broadband prices[4].

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[4] http://www.bloomberg.com/news/2014-08-07/tdc-shares-drop-as-regulation-seen-squeezing-2015-sales-profit.html

Net neutrality regulation is another example that shows how regulation could affect Telecom revenues, depending on which decision is made on the matter. If regulation allows Telecom operators to make a distinction between different types of traffic (from bandwidth-consuming OTT services for example), either by introducing charges for such traffic, or by prioritizing their own services, it would possibly be a great deal more difficult for OTT providers to substitute traditional Telecom services. On the other hand, a net neutrality decision could mean that Telecoms have no say in the traffic that goes over their network and so be obliged to allow and guarantee that all traffic goes through, without profiting, as opposed to their OTT competitors. Lobbying against such decisions could be part of their strategy, thus shaping the market conditions to their favour.

The interactions between technology, market and regulation and the possible outcome scenarios deriving from these interactions, shape to a great extent the developments in the European Telecommunications market, bringing changes in the strategies of OTT and Telecom operators and leading the evolution of their surrounding ecosystem. Once these interactions are clearly defined in this project, the road will be clear for an extensive analysis of the plans and strategies to assess the development of European Telecom companies in the future. At the same time OTT operators, whose primary goal is, in some cases, not to profit in the short term, but to maintain a growing and in extension valuable user base, are also planning their next strategic moves to secure their presence in the Telecommunications sector.

This project sets off to explore the two most prioritized, focal points for the completion of the Telecom Single Market under works right now in Europe. The European Commission releasing a statement about the goals and upcoming policies regarding the Digital Single Market in Europe states: "A first essential step is the adoption of the Telecoms Single Market package which the Commission expects will provide clear and harmonized rules for net neutrality and will set in motion the final elimination of roaming surcharges in particular for data" (European Commission, 2015). The importance of these two topics was also signified by the European Commission's Vice President Ansip who stated: "*The Commission's position is clear. We need to abolish roaming charges as soon as possible. We need strong net neutrality rules and more coordination on spectrum[5]*".

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[5] http://europa.eu/rapid/press-release_SPEECH-15-4659_en.htm

The Telecoms Single Market is one of the three basic pillars for the Digital Single Market and its importance as an EU priority is irrefutable.

Figure 1: The three pillars of the Digital Single Market[6].

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[6] http://europa.eu/rapid/press-release_IP-15-4919_en.htm

1.1 MOTIVATION

The unification process of Europe is close to a new landmark. And just as trade, people and capital are not limited by national borders anymore, communication is a subject that interests almost every European citizen, company and country. This subject is gaining more traction with growing internal European mobility due to education, tourism and labour market. Part of the EU agenda for a Single Digital Market is aiming for competition all over the EU among Telecom operators. This has been a gradual change but at the moment we are witnessing a major transition, as time approaches when Telecoms must face the loss of revenue streams such as the roaming fees stream, while withstanding the pressure of OTT services and the developments in an era where most of the traffic is done over IP and net neutrality laws are under heavy discussion all over Europe. Evidently, this is not just an issue of replacing some revenue streams with others for Telecom operators. It is a paradigm shift in the way traditional Telecoms are perceived today in Europe: a market with high barriers of entry, controlling communications on national levels and enjoying all the profits.

In this new competitive environment operators need to ensure survival, having to compete, not only with other operators, but a whole new set of players, in the regulatory frame that the EU and national governments mandate. Motivated by the upcoming regulatory changes in Europe and this next step for European integration, as well as the growing interest in how Telecoms are reacting to the latest developments in the field of SMS and voice services, the authors will try to look in depth the interrelations between the technologies, the regulatory decisions and the market settings that will shape the future strategies and changes in the business models of operators in the immediate future. This is a topic that attracts more and more the attention of consulting firms and researchers in Europe and the size and scope of this project allows for an extensive look into the subject.

This subject interests the authors of this work because they feel in their everyday lives the need to overcome the communication barriers created by the Telecom Companies in the European Union to communicate with their friends and family spread all over Europe. Also because this is a fast changing market and the amount of academia work done on the subject is not so extended, it gives a better substance to the knowledge acquired during the master's education and can also be used in the authors' future careers.

This master's thesis has a deep focus on the topics of net neutrality and roaming not only because the authors believe these topics are extremely important to answer questions,

related to an impending future, where a common market of Telecommunications is a reality in Europe, but also because the European Union agrees making these topics basilar stones of their digital strategy for European Union. One of the top ten EU Commission priorities is to create a "Single Digital Market" and this priority cannot possibly be achieved without addressing these topics[7].

The Commission claims that a borderless digital market in the EU would generate 250 thousand million euros of additional growth in Europe. For this to be achieved it is necessary to have common rules of Telecommunications services, copyright, data protection, or the management of radio spectrum. In addition, it is being clearly expressed that EU Citizens should not have to pay roaming fees within the borders of other European Union countries[7].

The relations between market, technology and regulation constitute the main issues that will be discussed as they represent the main variables that come into play when one tries to study the relations between OTT and Telecom companies.

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[7] http://ec.europa.eu/priorities/digital-single-market/index_en.htm

1.2 PROBLEM FORMULATION

Main research question: Taking the technological and market developments with respect to OTTs into consideration and the introduction of roaming price caps, what are the main challenges and the strategic actions that traditional Telecom operators face and take, and how is this development shaped by and affecting the regulatory development at the EU level? The market in question is the voice and messaging markets regulated by EIS EU regulatory package.

More specifically the issues that are going to be investigated are:

- Roaming and Net neutrality, which are top EU priorities for the creation of the Single Digital Market in Telecommunications, with an emphasis on the role of regulation in Europe.

- Using two cases studies, the Netherlands for net neutrality and Spain for roaming, is the approach used to position these two issues at a European level and draw conclusions about the implications of regulation for these two issues on the market that need to be dealt with in order to create a Single Market of Telecommunications.

- The trends in terms of OTT and Telecom business models and their convergence and the role that net neutrality will play in order to enable innovation at the application level.

- The regulatory trends regarding OTTs and their impact on the Telecom market. Also the possibility of net neutrality being broadened to include neutrality in the OTT platforms to make sure that all the content is available to the users.

1.3 DELIMITATIONS

The controversies in the sector of Telecommunications and OTT are pretty common in the agenda of the various news outlets. The point of contention between these two, in some areas, substitute and in others complementary industries is focused on four different subjects: messaging, voice, video and cloud services.

This work will be focused on two of these subjects that nowadays are usually grouped together: voice and messaging. These were the two main sources of income for the Telecom companies in the last decades but now it is changing more and more their revenues, partly due to the data packages that allow the OTT services to prosper.

The controversies in this topic are wide and differ from continent to continent and from country to country. This work will focus on the European Union, because, besides the OTT challenge, operators face the attempt for the creation of the European Single Digital Market, meaning that they are being and are about to be subject to more regulation, such as net neutrality laws or the elimination of roaming fees. Although a common market of Telecommunications is one of the goals of the current European Commission, both net neutrality issues and the termination of roaming fees are not issues that have been clarified or resolved yet, though there is no doubt that they will be dealt with in the near future.

There were many different technologies that could be discussed and studied in this work both academic and commercialized. But due to the different choices made from one geographical region to another and the types of industries, the technologies that will be studied are limited to the ones used widely in Europe so far, namely GSM, LTE and technologies on top of such networks such as VoIP, VoLTE as well as the roaming processes within them. GSM was the protocol that was used since the beginning of mobile communications in Europe and it ensured compatibility for the devices of European citizens and facilitated interconnection for networks themselves. The protocols that followed to improve mobile communications and provide 3G and 4G services, although to a great extent different than GSM, a 2G technology, were a continuation to the GSM legacy and provided the transition to the IP era for mobile communications.

The reason for focusing on these specific mobile technologies rather than the fixed ones, is that mobile is growing more than any other type of communication and this is a trend that is verified every year. ETNO in the annual report for 2014 mentions that "*Mobile is the dominant form of access, with the number of subscriptions approaching the 800 million mark*

in Europe" (ETNO, 2015) as the world is moving from PTSN/ISDN fixed lines to IP-Based communication and mobile phones. For the area of focus of this project, which is voice and SMS, this is an important development that contributes even more to the substitution of traditional Telecom services with OTT services, also when it comes to roaming.
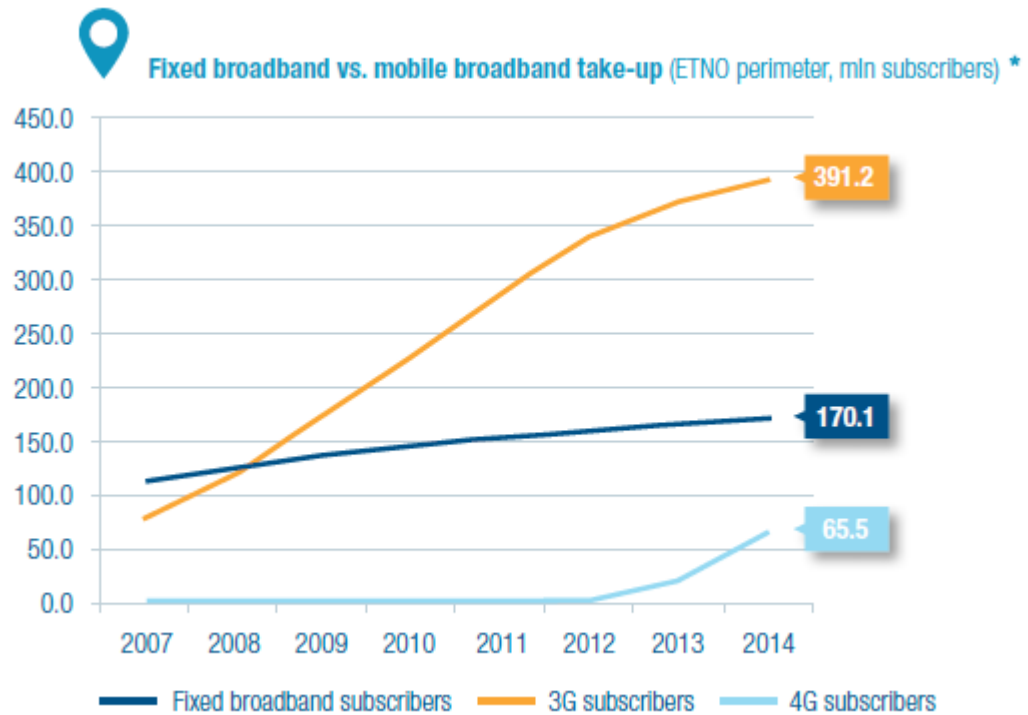
Figure 2: Source: (ETNO, 2015)

In the net neutrality discussion, which is a more general discussion about the open internet, mobile technologies are one of the most controversial areas in this debate, as the implementation of net neutrality rules regarding traffic management from Telecom providers could significantly affect the implementation of the latest mobile technologies. The reason for that is that in order to have more capacity and higher speeds in mobile networks, where radio spectrum is a scarce resource, traffic management is extremely critical, especially since all the latest technologies involve traffic prioritization for certain types of traffic in order to achieve the desired efficiency and high performance of the network.

The termination of roaming fees is also part of the issues investigated in this paper. This means that data on roaming would provide useful information that would allow for more concrete conclusions and a better look into the trends regarding the roaming sector but "mining" such data is not always an easy task and operators do not publish such figures.

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Consequently the analysis and calculations on roaming as well as for the roaming case study about Spain were performed based on data supplied by regulators and consulting companies and in many cases data were provided only for two or three years back.

2   THEORETICAL FRAMEWORKS

This chapter aims at describing the theories combined in this project in order to formulate an analytical framework that facilitates the approach of the subject under research and sets the ground for an extensive analysis and fruitful discussion later on in the work.

In the first section, there will be a description of the theories that helped the writers form the analytical framework that was used to describe the interactive forces that shape the environment in the Telecom-OTT ecosystem, namely the technology, the market and the regulatory framework enforced by the EU and national governments. For this approach the principles of political economy and institutional analysis were used. Those two are referred to and described in the beginning of this chapter.

The next two theoretical frameworks are used to analyse more specifically the two major participants in the market under research; the Telecom operators and the OTT providers. First the Telecom operators will be analysed under the prism of Multi-sided Platforms (MSPs) and as such their position in the market and their relationship with technology and regulation will be investigated.

Finally the Resource-Based View (RBV) approach is used to analyse the most important resources of OTT companies and Telecom providers and investigate which ones provide competitive advantages against the other that are sustainable and keep the company alive in the long-run and not just short-term.

2.1 POLITICAL ECONOMY AND INSTITUTIONAL APPROACHES – THE BASIS OF THE ANALYTICAL FRAMEWORK

In the Introduction chapter the major components of the system under analysis were presented together with the interrelations between them, forming the base for this work's forthcoming analysis and discussion. Taking into account the environment in which Telecoms and OTTs thrive, compete and collaborate, this approach is based upon the science of Political Economy within which a set of approaches have been developed and are still being applied today (Gamble, A. 1995).

At the same time, this project takes a closer look at the structures and mechanisms (for example, the EU and the rules and laws it imposes to ensure a healthy and prospering European Digital Market) that surround the Telecom-OTT market and how they affect the relationship between them. Such an approach can be part of the realm of Institutional analysis, another approach that deals with how institutions and their function affects and interacts with organizations (North, D. C., 1990).

2.1.1 The Political Economy Approach

This set of approaches studies the interrelations between the socio-political and economic systems. It puts into perspective the market processes and developments within the framework that society's laws and rules provide and analyses the political institutions' decision effects and interactions with the economy, for example a government's fiscal or market protection policies (The SAGE Glossary of the Social and Behavioral Sciences, 2009). This analysis of how political institutions affect the economic system has been further developed over the years, due to the technical evolution of the analytical tools used in the field of economics, which allowed for a deeper analysis of the issues studied and the questions posed by political economists (Chari V. V., 2000).

Such an approach can be applied not only at a national level (governmental institutions etc.) but also at an urban level (urban political economy) where economic and political developments shape the local public policies, while at the same time examining the role of local politicians and what affects their decision-making processes (Helsley R. W., 2008).

Moreover, the tools and assumptions used in political economy can be used in a broader context to study international relations in trade and finance and their connection with the political and economic systems, forming an International Political Economy (IPE) approach (The SAGE Glossary of the Social and Behavioral Sciences, 2009). This is a relatively

new field that was developed throughout the 80's and 90's when economic globalization mandated a collective effort for common or similar policies among countries in order to benefit from the advantages of the free movement of capital, goods and manpower. Relative subjects of study in IPE are climate change policy and governance, the multinational industrial sector that has developed in communications, energy, transport and finance and the role of government policies in facilitating and improving international trade and competitiveness to achieve economic growth for their countries (Galindo Martin, M. A. and Nissan E., 2010, pp. ix).

Political economy also includes the economic modelling of political institutions and processes developed in the last few years, deriving, to a great extent, from the need of economists for exploring the importance of such models to companies, positioning its approaches closer to the field of economics, rather than that of political sciences (Dewan, T. and Shepsle K. A., 2008).

The different political economy approaches have undergone many changes over time, due to changes in the ideological, political and economic background of today's societies. Nowadays, we can talk of a new political economy, bringing together economic methods and political science theories that were previously separated. As otherwise stated "the New Political Economy reverses the split that occurred between the disciplines of economics and political science at the end of the nineteenth century" (Besley, T., 2007). The four sub-areas in which it has developed are in fact international political economy (IPE), state theory, comparative government-industry relations and public choice. The new political economy reflects the changes made in the global economy and political systems of today. (Gamble, A. 1995).

In the ICT sector, markets are affected by the advancements in technology, but allowing new innovative technologies to become incorporated into a market is highly defined by both the political and economic system in which they are introduced. A political economy approach can help understand how these three are interrelated and the forces they exercise on each other (Mansell, R., 2005). This is also expressed in the analytical framework used in this project, which is presented later in this chapter.

2.1.2   Institutional Approach

The importance of institutions and the role they play in an economy has for many years been studied in the political economy literature, pinpointing their interrelations with politics and the economy (North, D. C.; Weingast, B. R., 2000). Analysing institutions means approaching them through creating models that describe how institutions (in both a political and economic context) or "the rules of the game", as mentioned by Douglass C. North (North, D. C.; Weingast, B. R., 2000) impact the behavioural patterns in an economy. This contributes to not only understanding how a market works and reacts but also to creating policies in a society.

According to D. North, one of the most important contemporary economists that has studied and contributed to institutional analysis in the past century, these "rules of the game" can be divided into two categories; formal and informal (North, D. C., 1990). The first one includes constitutional, property-rights rules and contracts and the second one refers to norms and customs. North also implied that enforcing formal rules successfully in one case doesn't mean enforcing them in another case, due to the existence of informal rules, which might be different from case to case (North, D. C., 1990).

Today, economists tend to make a distinction between traditional institutional economics and new institutional economics, which take into account the latest developments in other economic theories such as the theory on transaction costs (Hodgson, G. M., 2013).

To exemplify, several institutions play a very important role in the research for this paper and the approach it follows. In the ecosystem we are examining several are the national and European institutions that define and change the rules in the Telecom market. In the Appendices at the end of the project, there can be found interviews with several of them including one with the Portuguese Regulator for Communications, ANACOM (Autoridade Nacional de Comunicações) in Appendix A. As a national regulator their responsibilities are regulation, supervision and the representation of the communications sector.

The first one, regulation, ensures equal access to networks for all operators and transparency in the market, so that competition will work under healthy conditions and facilitate new investments in the networks. Supervision allows the regulator to monitor that the laws and regulations are followed by the operators to establish universal service and safeguard consumers. The representation of the communications sector establishes the

cooperation with other national bodies as well as international regulators in order to coordinate efforts for a better communications sector in the country and in the EU[8].

But national legislators and regulators cannot stand and act alone in a unified Europe. Other institutions exist to ensure this unification, such as the European Commission, which is one of the most important institutions of the EU and whose purpose is defined with four different functions; the proposition of new laws for the EU, the management of the EU's budget both for the long and the short (annual) term, and ensuring the proper spending of EU funds all over Europe, the enforcement of European law and finally the representation of the EU in the global society[9].

According to the institutional theory presented above, these two institutions can be classified as formal institutions. But the European Union is a mixture of different cultures and economies with different norms and customs, which represent the informal institutions. This fact could explain to a great extent the difficulties of creating a single market in Telecommunications as rules and laws are not easily and successfully applied in all cases.

2.1.3 The Analytical Framework

The approach followed in this project is based on the basic concepts expressed by the above two approaches. The European Telecom market is explored as an organism, a living system constantly evolving, affected by the rapidly evolving technological developments in the Telecom sector as well as the regulations, the rules imposed by the political system affecting both the technologies and the market itself. The interdependence between these three is obvious and expressed throughout this project and visualized in the following figure, also presented in the introduction.

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[8] http://www.anacom.pt/render.jsp?categoryId=5409#.VPsf8fnF9UV
[9] http://europa.eu/about-eu/institutions-bodies/european-commission/index_en.htm
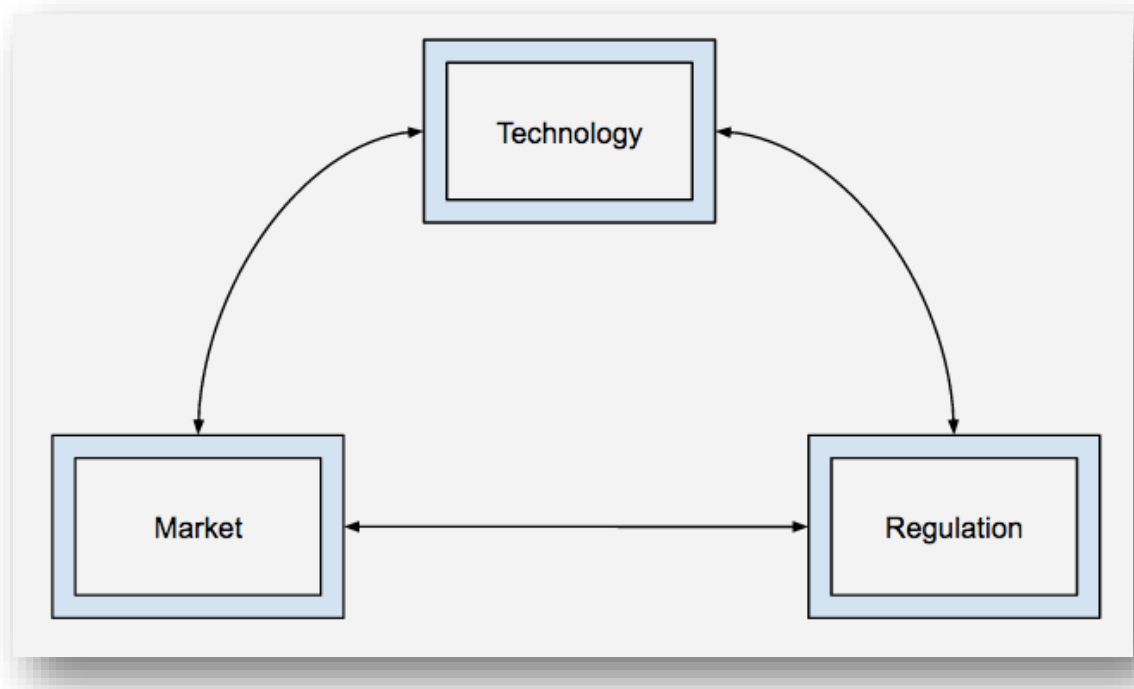
Figure 3: The three pillars and the interrelations to be examined

This interdependence is clearly present in the Telecom market, as in many industries of an economy.

Technology-Market: Telecom networks are evolving constantly and technological developments push for newer faster and more reliable networks, offering all types of services, from voice, texting and video communication, to entertainment, content and e-commerce. The connection required for offering these services has pushed innovation in the networks, achieving high speeds and quality services through technologies such as VoLTE or 5G networks. Large investments are required by ISPs/Telecom operators and the costs are high but the pace at which technology and the market are evolving mandate such a development.

At the LTE World Summit in Amsterdam in 2013 companies like Telenor and Telia Sonera said that nowadays with technologies like LTE and VoLTE deployed, LTE roaming is growing fast globally, with ten million megabytes being consumed from roaming customers only in Europe in 2012 but stressed on the fact that the challenging part about roaming is not so much the technical aspect but the roaming agreements that could take up to six months to conclude and as a result creating a single digital market in Europe would take years[10].

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[10] http://Telecoms.com/155772/roaming-comes-to-forefront-of-lte-carrier-community/

At the same time, everyday more and more new services are created and more and more people are using the networks for this purpose. Innovation is necessary not only at network level but also at the application level where the available resources have to be efficiently used for better service provision. Over-the-top technologies, such as VoIP, have not only introduced new ways to communicate but have created new business models and revenue streams bringing new players and causing fundamental changes to this market. At the same time it fuels back the need for innovation in networks and applications in order to keep up the pace of development.

Technology-Regulation: No technology in a market is freely applied without supervision through rules and regulations by the political system of a country, and in the case of Europe, that of the European Union as well. Political institutions are there to examine and decide what the best options are for the citizens of each country as well as the international implications of the application of a certain technology on the collaboration of states, for example at a European level. This means that in a world where compatibility and interconnection are the basis of every exchange, whether a business agreement or the facilitation of communication, the rules of the political system must take into account all aspects of a candidate technology.

This project examines thoroughly the plan of the EU to create a single market of Telecommunications across Europe, where operators can compete over national borders in the rest of Europe. In order for this to happen, there needs to be a facilitating legislative framework that allows such a market to exist. The goal of political institutions such as the ones of the EU, is always the benefit of European citizens, but at the same time ensuring the protection of their rights.

Such regulation can influence the direction that the technological advancements take, depending on the political decisions made. For example, one of the main subjects of research in this work is the regulatory framework for net neutrality throughout Europe. If a net neutrality law is in place, the legislators must take into account the new technologies being developed and decide which ones can be adopted, which ones violate net neutrality principles and which ones need special rule exceptions from the law. For example, technologies like VoLTE use priority codes for different types of traffic, meaning that in order for them to be applied, they need to be classified as specialized services otherwise they cannot be adopted

as they violate net neutrality and another technology must be developed for the same purpose.

Market-Regulation: As discussed before the political system and institutions influence to a great extent the developments in a market. The Telecom market for instance, is a heavily regulated industry, but as we move towards new types of communication that use the internet as the means to circulate traffic, traditional Telecoms services are being substituted but also complemented with new technologies, new players enter the market and Telecom operators change their business models and strategies to keep up with the latest developments.

The emergence of OTTs as players with little power but significant contribution to the transition to an all-IP era of communications and services calls for more regulation in the market and especially when it comes to net neutrality.

Another subject studied in this project is the termination of roaming fees in the European Union, another measure that is being pushed as part of the creation of competition and the single market of Telecommunications, which causes significant losses for several European operators and calls for a change in strategies on how to compete with the rest (for example, bundled packages that include roaming in other European countries in the subscription).

The above described framework will be used in this work to explain the Telecom market from the Telecoms perspective and with a focus on the voice and SMS sectors, as all three parts of this equation are equally significant for the future of Telecommunications.

In the rest of this chapter the two theoretical tools that will be used to analyse the Telecom and OTT players in this market will be presented, namely Multi-sided Platforms and Resource-based View.

2.2 MULTI-SIDED PLATFORMS

Telecoms has for centuries been a platform for communication between people. Traditionally their networks allow the caller to reach the receiver and thus facilitate long-distance connection. Today though, there is a two-sided nature in Telecoms. This is due to the fact that the traditional Telecom operators have evolved their networks into platforms, not just for fixed and mobile communication, but also for content provision and IP services and applications. This new business model makes the concept of multi-sided platforms relevant to this project and thus this framework will be used for further analysis of Telecom operators today.

With the term Multi-Sided Platform (MSP), also known as multi-sided markets, we refer to platforms that allow more than one distinct groups of customers to interact with each other, creating value for the platform provider. The platform thus, is valuable to each group as long as the other groups participate in the platform. The value eventually increases for one group as more users join the same or other groups of customers on the platform, creating what is known as a network effect (Osterwalder, A. and Pinguer, Y., 2010; pp.77). One typical example is that of operating systems that allows the interactions between hardware manufacturers, software developers and users.
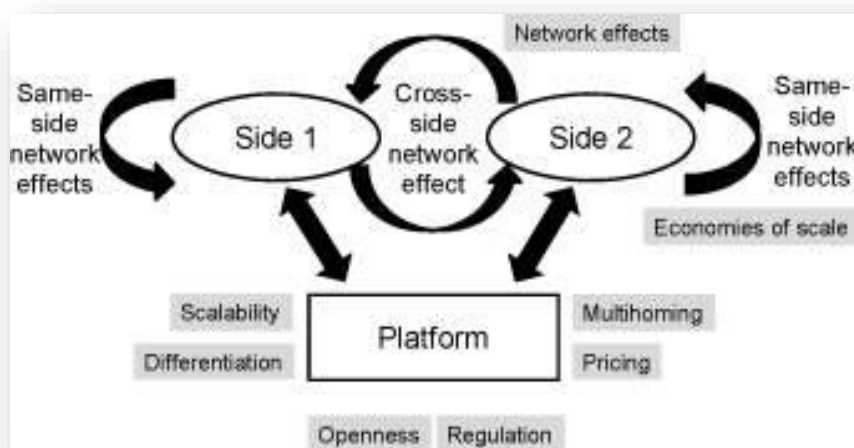
Figure 4: MSP[11]

A common problem in creating value in the cases of MSPs is that in order for one group to be motivated to provide services to another group on the platform, the other group must

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[11] http://www.strategy-keys.com/business-model---winning-the-multi-sided-platform.html

grow in size, attracting this sort of "investment". But in order for the group to grow, there needs to be a service provided by the other group that is attractive enough to join the platform.

In this case it is the platform's responsibility to find a way to attract customers to one group, whose growth will cause the other group to provide its services over the platform. One technique that is often used is offering the platform's services for free (also known as "freemium model") or for a low price to one group of customers. Choosing the group that will be offered such a model is not always an easy task and should be carefully considered and studied beforehand, so that the platform will make sure there will be a sustainable business model that will produce enough revenues (Osterwalder, A. and Pinguer, Y., 2010; pp.78-79).

In general, there is no strict definition of what a MSP is, thus creating the issue of different interpretations of it. Rochet and Tirole (Rochet, J.-C. and Tirole, J., 2006) define them as platforms that enable interactions between users, using different price strategies to attract new customers to the platform, while securing financial viability for the platform. At the same time they analyse the role of network externalities and the different price structures as the base for the theory for multi-sided markets.
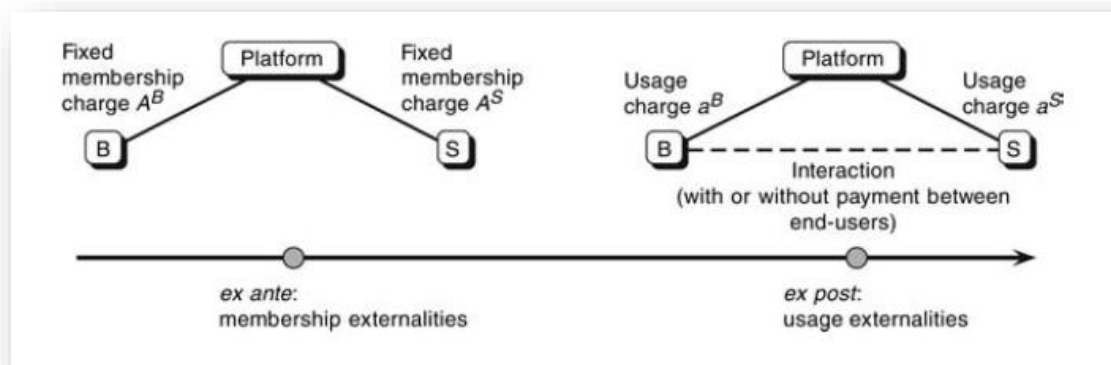
Figure 5: Usage and Membership externalities (Rochet, J.-C. and Tirole, J., 2006)

There are cases where there is a distinction made between usage and membership externalities (Rochet, J.-C. and Tirole, J., 2006) (Rysman, M., 2009). In the first case the network effect is based on the decision of a user to use a network because the benefit is higher compared to another alternative. This way the more users join the network the more the old user benefits from being able to interact with them through the specific platform than the alternative options. In the second case, the network effect from a fixed fee is studied,

which translates to benefit for the user while the network grows, as they acquire the ability to interact with more users on the same network with no additional fees (Rochet, J.-C. and Tirole, J., 2006). Telecoms are a typical example where such externalities exist.

In essence, this definition distinguishes between multi-sided and one-sided markets based on a price structure that balances charges on each side in a way that it attracts the desired amount of customers on the different sides.

Rochet and Tirole (Rochet, J.-C. and Tirole, J., 2004) also list a series of elements that affect the level of prices on a two-sided platform; this includes: demand elasticities on both sides of the platform, the position and power of the product and service providers that use the platform to offer their products and services, the extra gain from internalizing externalities from one side of the platform through lowering or eliminating prices on the other, competition with other platforms, offering bundling services on the platform (Rochet, J.-C. and Tirole, J., 2004).

Consequently, decisions on pricing strategies play a significant role for MSPs and have for many years been studied by economists, since the customers that join one side of the platform might affect the reaction of another group of customers that have joined or want to join another side of it (Rysman, M., 2009).

Demand elasticity and marginal costs are always taken seriously into consideration when forming a pricing strategy for a market. In a multi-sided market though, the demand elasticities and marginal costs of the other side or sides should also be considered when making decisions for the prices offered to one side. MSPs could present prices that fall below the marginal cost on one side, if for example the price elasticity for this group of customers is high, attracting a greater number of them, while that would mean higher prices for another side of the MSP (Rysman, M., 2009).

At the same time competition with other platforms could bring these prices even further down. In addition, price discrimination which is applied based on the heterogeneous nature of a MSP allows more earnings on one side and lower prices on the other, attracting more customers to it. Furthermore, prices that fluctuate throughout the life stages of a product (also referred to as dynamic pricing in the literature), for example prices that start low but are gradually increased as the product gets more popular, can also be applied in MSPs (Rysman, M., 2009).

But pricing is not the only aspect a MSP should deeply take into consideration. It is important to also know how many distinct user groups to pursue, meaning how many sides to serve. At the same time positioning oneself in a market means defining the relationships with competitors. A MSP should thoroughly consider to what level and if at all the platform will be compatible with other competitive MSPs in the market, determining the level of openness of the platform. Apple for example, is a company that has a very low level of openness producing both the hardware and the software for its products, creating a lock-in effect for its customers. The same applies to video games that are specifically developed for each game console (Rysman, M., 2009).

Hagiu and Wright (Hagiu, A. and Wright, J., 2011) on the other hand, provide another slightly different definition through specifying what the various parts of the definition exactly mean. According to them a MSP is *"an organization that creates value **primarily** by **enabling direct** interactions between two (or more) distinct **types** of **affiliated** customers"* (Hagiu, A. and Wright, J., 2011). According to their definition cross-side network effects, or indirect effects, are not a prerequisite for an organization to be called a MSP, contradicting a wide range of the available definitions, but at the same time they signify the importance of such network effects in certain types of MSPs. The use of cross-side network effects as a criterion for MSPs tends to either include too many or exclude too many platforms from being MSPs, while looking at them from other aspects would provide a better and clearer distinction.
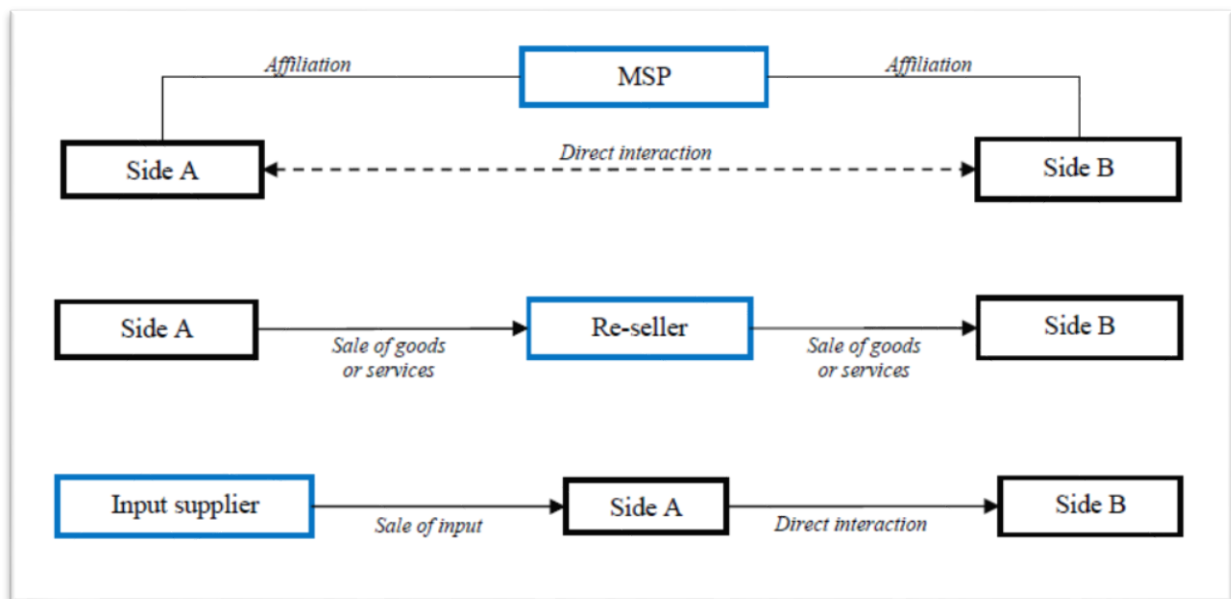
Figure 6: Differences between input suppliers, MSPs and re-sellers. Source: (Hagiu, A. and Wright, J., 2011)

In addition, while most definitions focus on price strategies to distinguish MSPs, Hagiu and Wright (Hagiu, A. and Wright, J., 2011) make this distinction by defining the different ways in which a platform can serve the different customer segments, separating them from intermediaries such as resellers and input suppliers. What distinguishes MSPs according to this definition is that they allow the different customer segments to interact directly with each other while stressing the affiliation between the different groups and setting them apart from resellers and input suppliers. Such a definition provides a strict distinction between the different platforms that according to other definitions might be or not be considered MSPs.

Telecoms have been studied under the prism of multi-sided markets based on definitions such as the one provided in (Rochet, J.-C. and Tirole, J., 2006) but the literature of such analyses is not extended. In (Waverman, L., 2007) the two-sidedness of the Telecom market, in its traditional sense as a means of communication, is explored according to Rochet and Tirole's (Rochet, J.-C. and Tirole, J., 2006) definitions but it is not extended to include the role of Telecoms as a platform for OTT services.

2.3 RESOURCE-BASED VIEW

After using the Multi-Sided Platform approach to examine Telecoms, the authors decided to use Resource-based View to enhance their understanding of how Telecoms and OTTs take advantage of the available resources to create a competitive edge against one another because in the case of the OTTs, since there is almost no lock-in mechanism, it is only the perceived value that makes the users keep using the OTT services and this value is in most cases attributed to the company's own or scarce resources.

And since Resource-Based View is in a nutshell about competitive advantage it can also be used to explain the lack of competitive advantage, so it can be used to explore why Telecoms have lost some of their revenue in SMS and Voice fields.

Resource-based View (RBV) has some aspects that were developed long before it turned into an academic theoretical framework. But the first work that put together this framework was done by a Danish Economist called Birger Wernerfelt in 1984 in a paper that he called *"A Resource-Based View of the Firm"*. In this paper he explained how important it is for a company to take into account their resources when they plan their business strategy.

The main idea behind this model is to use these resources to transform short-term advantages into sustainable competitive advantages (Wernerfelt, B., 1984). When planning a business strategy for a company based on the RBV theory it is important to understand a few key points:

- There are many other theories that help form a business strategy but Resource-Based View is the most commonly cited strategy when a company wants to attain competitive advantage.

- If a company wants to benefit from the transformation of a short-term competitive advantage into a sustained competitive advantage, their resources need to be varied in nature and not perfectly mobile. These resources must also not be easily copied or substituted without great effort. For these resources companies can use patents or industrial secrets.

- The RBV starts by searching for the companies' potential key resources that can give them a competitive advantage and from there creating a strategy to apply them in a synergic way.

- When the resources are valuable, rare, inimitable, and non-substitutable (VRIN), they may enable a company to create a strategy for achieving competitive advantage (Barney, J.,1991).

The last bullet point derives from the work of Jay Barney from the University of Texas (Barney, J., 1991), who in 1991 came up with a model to make it easier for companies to identify the resources that could give them a sustainable competitive advantage. This framework was called VRIN (valuable, rare, inimitable, and non-substitutable) and its usage is nowadays common for companies to shape their strategy.

The implementation of RBV is a 3-step job that can be more easily explained with the following figure.
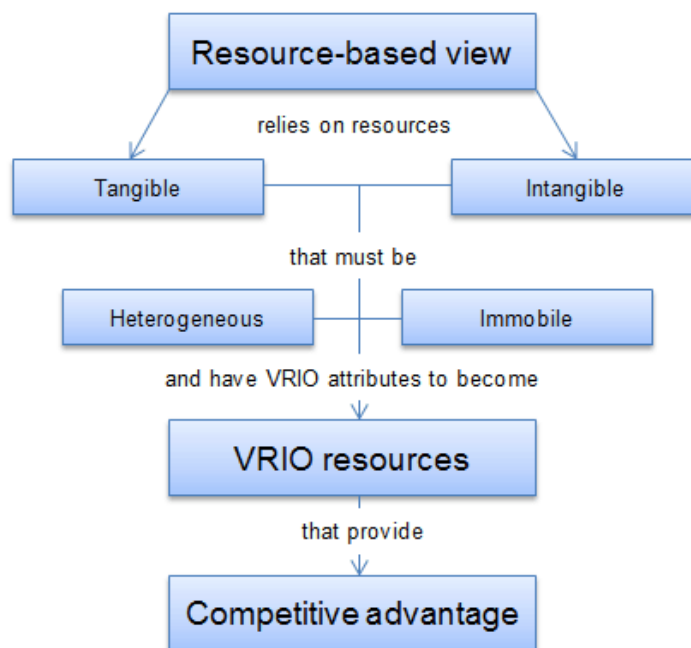
Figure 7: key points of RBV[12]

As the figure describes the three steps that anyone can make to see if a company or product has a competitive advantage are three simple questions:

- Does it rely on tangible or intangible resources?
- Are they Heterogeneous and Immobile?

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[12] http://www.strategicmanagementinsight.com/topics/resource-based-view.html

- Do the company's resources have the VRIN (also known and refered in the figure as VRIO – Valuable, Rare, Inimitable, Organized to capture value) attributes?

If all these three questions can be answered in a positive way, then the company product or institution will have a competitive advantage.

2.3.1 Tangible and Intangible Resources

In Resource-Based View, the resources described before are usually divided into two types and as such can be classified as tangible or intangible (Grant, 1991).

Tangible resources – are constituted of financial reserves and physical resources such as buildings, equipment, patents, shares, raw materials.

Intangible resources - are constituted of brand image, reputation, technology, and human resources, the culture, the training and expertise of employees, and their commitment and loyalty.

The tangible resources are very easy to measure and understand their value but in most cases if a Resource-Based View is just about the tangible resources, the company might be missing the big picture. But in themselves, the intangible resources are often hard to measure but that doesn't make them less important. In fact many times they are what the competitive advantage for a company (Grant, 1991).

2.3.2 Heterogeneous and Immobile Resources

Heterogeneous resources are the skills, capabilities and other resources that companies possess that makes them different from their competitors. These are the capabilities that enable companies to employ different strategies that help them outcompete each other. What RBV assumes is that companies can achieve competitive advantage by using their unique sets of skills and capabilities.

Immobile resources are the second assumption of RBV as from the reality of a company with competitive advantage. In short this means that these resources are not mobile and do not move from company to company, at least in the short-run. And it is due to this immobility, that companies cannot copy the rivals' strategies because they are unable to replicate their competitors' resources. There are many examples from immobile resources like brand and image, culture, knowledge or intellectual property (Grant, 1991).

2.3.3 The VRIN Characteristics

As mentioned previously when a company wants to achieve a sustainable competitive advantage and not only a temporary one, they have to make sure that the VRIN characteristics are met. These characteristics are described as valuable, rare, inimitable, and non-substitutable, and as such the model is referred as VRIN:

- **Valuable** – The resource in question must enable and generate some kind of greater value that either helps the company to outperform its competitors or reducing its own weaknesses. In addition, the investment on this resource has to remain lower than the revenue generated by investing in this resource.

- **Rare** – For a resource to have value by definition the company has to have a limited pool of it. The more limited this resource is the more it will be sold for in the future as such, the price of the resource will reflect expected future above-average profits.

- **Inimitable** – For a resource to be controlled by only one company it has to be hard to copy. This can only be sustained if competitors are not able to duplicate it with the quality that the market threshold demands.

- **Non-substitutable** – Even if the resource is valuable, rare and inimitable it would all be for nothing if it was substitutable with equivalent or even lower costs. As such, if competitors are able to create a substitute, prices would be driven down to the point the asset wouldn't be profitable to sell anymore or at least the profitability from it would be diminished.

(Barney, J.,1991).
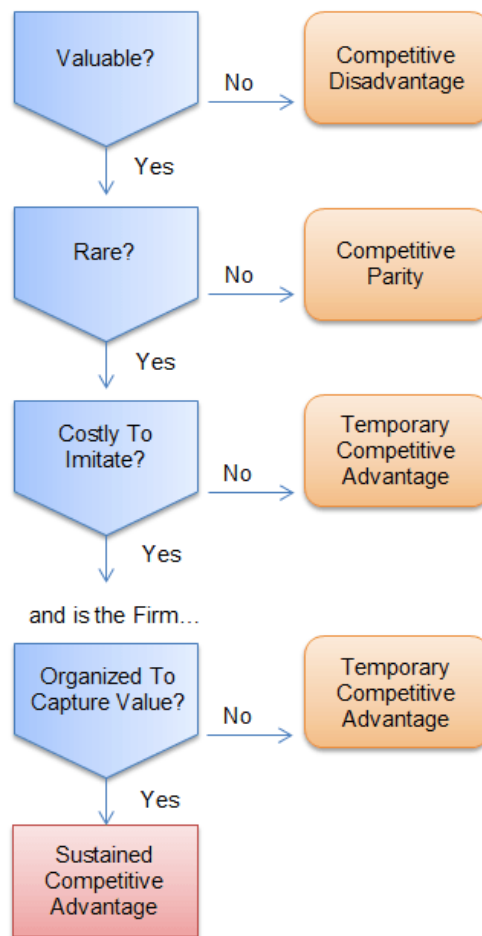
Figure 8: The VRIO (aka VRIN) characteristics [12]

3 METHODOLOGY

This chapter describes the methods used in order to produce the outcomes for this project and answer the questions posed in the problem formulation. This project includes both primary and secondary research, in an attempt to support the analysis, discussion and conclusion in the most complete way possible.

3.1 METHODOLOGY DIAGRAM

The accumulation of knowledge from the methods used was compiled in a comprehensive manner through a dynamic process. The methodology diagram below tries to show how this process developed time-wise and how this was done. As the figure shows there were two distinct parts in the project. First there was the research phase, the methods for which were described before, where there was a very back and forward dynamic. Although it started with desktop research and continued with a market survey and exploratory interviews, it was necessary to go back to secondary research in order to combine the empirical data with the ones available in the literature and made public. During this stage the choice of the theoretical frameworks were also made and shaped.

Then after the research phase was complete, the process entered a more linear approach, where the framework developed for the analysis was implemented and the analysis and conclusion came very naturally.

The different types of research and how they were conducted are described in the rest of this chapter in more detail.
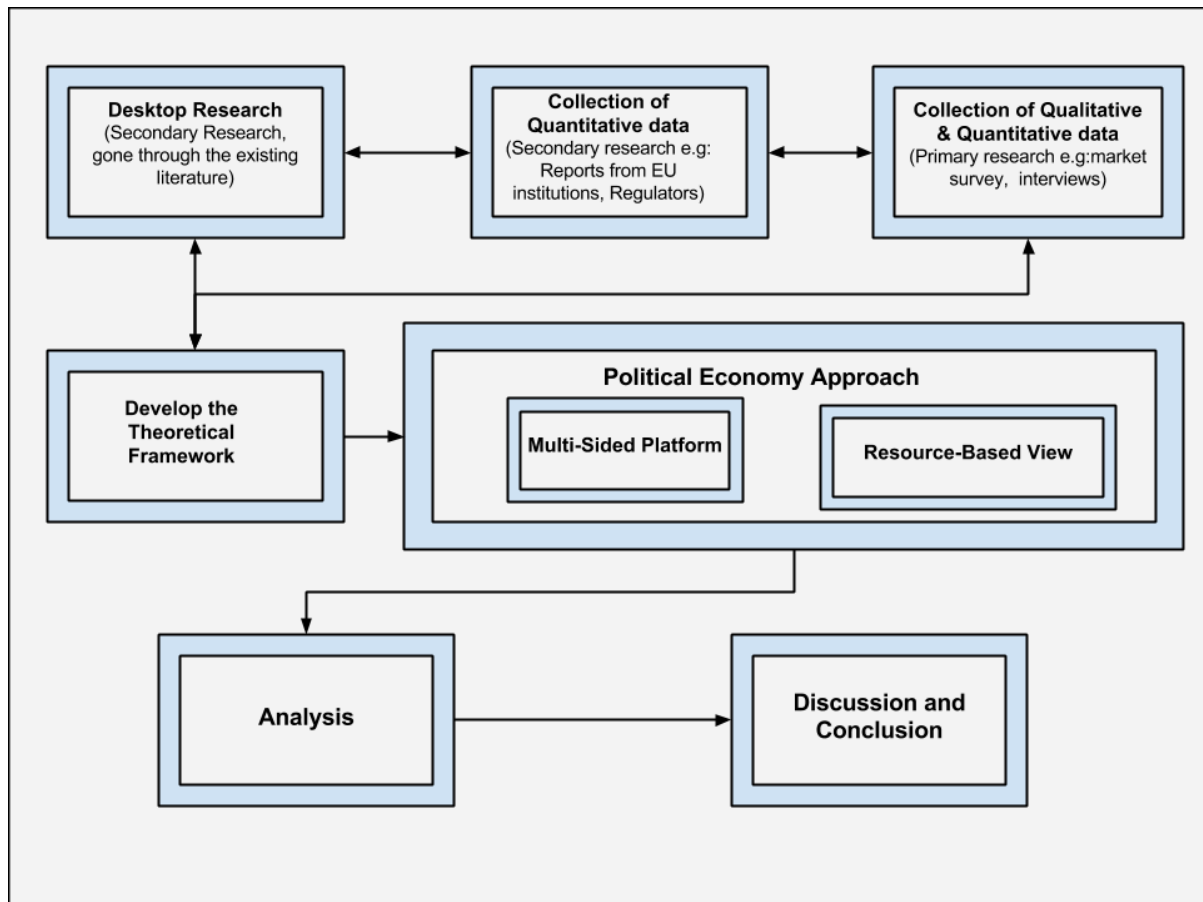
Figure 9: The research methodology timeline

3.2 DESKTOP RESEARCH

Desktop research (secondary research) was conducted in order to acquire knowledge and information about the topic as well as find examples that would help us understand it in depth. Desktop research included the study of all the available material on the subject including academic research, consultancy and Telecom organizations reports, national and EU regulation drafts and announcements from its different institutions, as well as reports from national regulators and independent researchers and organizations.

Initially what was achieved with this is to get a broader knowledge on regulation and the EU plans for the TSM, especially when it came to the subject of international roaming where EU regulation is more clear and progressing. On the subject of net neutrality this stage provided all the background information from the beginning of the discussion in the U.S. until today.

This was important for understanding the market settings and its interrelations with the technology and regulation, hence becoming able to comprehend how each of them can create challenges and change the settings for the interested parties in the Telecom business

ecosystem. Within this research the idea to use two theoretical frameworks, namely Multi-sided Platforms and Resource-Based View, was born and researching further into the subjects for the project, these frameworks became more and more relevant and thus the idea to use them in order to analyse the Telecom-OTT dynamic was verified.

Also involved in the desktop research was the research about the different technological standards and techniques that are used today both from Telecom as well as OTT providers in order to produce quality communications and content delivery. This allowed for a deeper understanding of the subjects of the most important technologies used today like LTE, GSMA and VoIP among others.

This part of the research was very dynamic and brought constant changes to the project and contributes to new issues being raised and studied, based on the knowledge gained from the qualitative and quantitative research exposed after.

3.3 PRIMARY RESEARCH

Primary research was also conducted extensively for the analysis in this project, including both quantitative and qualitative research that derive mainly from two sources that combined will be used to answer the questions posed in the problem definition.

3.3.1 Quantitative Research

For the quantitative research a market survey for both Telecoms and OTTs was conducted by going through company annual reports and other sources available to discover the top players in the market so that later there would be a better look at the characteristics that got them to that position. The market survey concentrated the most important Telecom operators (based on the revenue) and OTTs (based on their user base) in Europe with an overview of the sizes and the revenues involved in the Telecom ecosystem. This allowed a better interpretation of the market settings, through discovering the different players that are competing with Telecom services at the moment and to what extent competition with them might affect the Telecom operators' revenues. Finally it provided a better overview of the market that was later used in the analysis.

3.3.2 Qualitative research

The empirical evidence for the collection of qualitative data gathered for this project collection came from interviewing several leading experts with Telecoms, regulators, associations, consulting companies and even government officials to get a better idea of how

the companies, regulators, associations, politicians and researchers themselves look at the current situation regarding competition and regulatory trends and how they affect business. This research later compiled in a comprehensive way was used to discover the underlying issues, opinions, and motivations. This way it would be easier to uncover trends in the different opinions and explore the problem in depth.

The evidence was used to build two country case studies that take the subject of this thesis to a more narrow context in order to exemplify and make more concrete how the topics under discussion, including net neutrality and the termination of roaming fees, have been or are about to be discussed and faced by Telecom operators in the specific cases, in the light of regulatory decisions and political discussions both at national and EU level.

Some of the interviews conducted had more of a background character, meaning they contributed to understanding the general foundation of the subject in Europe, through the eyes of the different "players" that are a part of the transition to the Single Market of Telecommunications in the EU. Interviews like these include operators and their associations such as OTE, TDC, Telefonica, GSMA and regulators such as ANACOM in Portugal.

But in order to avoid just a general discussion and look at the impact of regulation and the emergence of OTT services in the Telecom market, the rest of the interviews focused on specific cases. One of them is the case of the country of the Netherlands, a country where net neutrality is imposed by law on operators and competition between broadband operators is fierce and reinforced by the emergence of OTTs. Interviews with KPN, the Dutch Ministry of Economic Affairs, Bits of Freedom and PhD researcher Roslyn Layton, played a key role to building a case like this, which was also based on data and papers written on the specific case, one of the first to show how regulation in combination with strong competition are combined in a market. In addition there was an exploratory discussion with Dutch researcher Wolster Lemstra that helped identify which the important topics to address in the Netherlands case were and the right people to talk to about it.

Building such a case provided a good indication of the future regulatory developments and how Telecoms react to the new reality of the European Telecom market. It helped provide insight into the changing business models, from voice and messaging to content and application provision, either through competing or collaborating with OTTs within the regulatory restrictions provided by EU and national regulation. Such changes will try to recuperate revenues lost and intensify the effort to maintain and improve the network

infrastructures and find new ways to fund such investments, a struggle that will highly depend upon the decisions on net neutrality and the operators' ability to compete in a single European market.

3.3.2.1 Interviews

The interviews were a central part of the research done for the project. They shape many of the decisions of which issues to focus on and which ones to let go. They also helped to demystify some misconceptions and helped the authors build solid arguments for the analysis, discussion and conclusion sections.

- ANACOM – The interview with Dr. Carlos Costa was a very good first exploratory interview. Besides knowing how regulators in EU looked at some of the issues, it was also important because it shed some light to where the hotspots are in Europe in terms of Net Neutrality. It also provided a lot of information about BEREC and other regulators which in turn led to make the choice of the case study for roaming.

- OTE – This was the second interview and the first with a Telecom company. This interview helped the authors know the issues which are relevant for Telecoms today regarding net neutrality and roaming. Comparing the view expressed with other interviews from other companies that came later, it was interesting to see how Telecoms saw the same situations.

- Roslyn Layton – The interview with PhD fellow from Aalborg University, due to her extended experience in the Telecom field and the fact she had written a paper about the Netherlands net neutrality case that provided the base for this work's case study, was invaluable for the authors. She also contributed with a lot of other research papers and other kinds of information.

- GSMA – GSMA interview with Public director Mani Manimohan gave an insight of an association that has many and diverse members from the Telecom mobile industry. As such it was a good way to get a sense of how the mobile Telecom industry as a whole sees the issues that were being studied.

- TDC – TDC interview with Senior Advisor Allan Bartoff was the only one that was done in person, and showed how different operators, depending on their size and scale face issues differently from others and how they accept that regulation would always be

inevitable and as long it didn't breach some common sense boundaries, it could be good for the users without endangering the Telecoms future.

- KPN – The interview with Senior Regulatory Counsel Paul Knol played a significant role for the Netherlands case study as it gave the opinion of a Telecom operator about the net neutrality regulation in the Netherlands from the industry's perspective.

- Dutch Ministry of Economic Affairs – The interview with the Policy advisor Jeorem Westerink gave the authors a very clear and concise opinion from the Netherlands government, regarding the current regulation and what the future holds.

- Bits of Freedom – The Bits for freedom interview with the researcher Floris Kreiken gave the authors the final piece of the puzzle because this organization played an important role for this regulation taking shape in the Netherlands, so it was important in order to make a correct assessment of the Netherlands case.

- Telefonica – This was the last interview and was conducted with Regulatory Economics manager Fernando Herrera Gonzalez. It helped the authors get a deeper understanding about all the issues involved in their thesis. It also provided more information about the Spanish market, which was important for the roaming case study about Spain.

3.4 THEORETICAL FRAMEWORKS

To finalize this chapter a brief overview of how the theoretical frameworks were used is given.

This project was based on a political and institutional economy approach. These two were necessary to understand how all the pieces fit together and to make sense of all the information collected. The framework used in this project was based on these approaches so their contribution was fundamental.

Then in order to study Telecom operators today, the framework chosen was multi-sided platforms, as although some authors dispute that Telecoms have multi-sided business models today, or that the two-sidedness is threatened by net neutrality, this analysis shows that besides leveraging OTTs to operate such a model, there are other aspects that prove their role as a platform.

Finally the authors needed another framework to make sense of how OTTs got so much of the Telecoms market share and Resource-based View was used in other to show the resources that provided a competitive advantage against Telecoms and allowed their growth in such a short amount of time.

These two frameworks were from the beginning considered to be used and as research progressed their application was deemed appropriate for the purpose and scope of this work.

4 BACKGROUND

This chapter plays an important role in the project because it lays a great part of the knowledge foundations of the work to come. It is divided into two main parts that provide the reader with the familiarity needed to facilitate the comprehension of the subject that the thesis will entail, before continuing with the analysis.

The first part of this chapter focuses on the inner workings of the European politics and is designed to put in a nutshell the main issues and concerns that are relevant when the authors plan to discuss the topics of net neutrality and roaming charges, as well as their future in a more and more integrated Europe.

Finally there is a significant part of this chapter dedicated to some of the main technologies that helped shape the heritage of interconnection inside the European Union and OTT globally. The understanding of these technologies plays an important role in order to see what is at stake for operators and their network infrastructure and to what extent technology can influence the developments in this sector, surrounded by the applied political and economic frameworks in Europe. Summarizing, this chapter tries to compile a key part of the needed knowledge to understand the fundamentals of the rest of the thesis to come.

4.1 REGULATORY ISSUES

In this chapter there will be an overview of the developments in the regulatory field, primarily in Europe, that affect either positively or negatively the OTT as well as the Telecom providers. Two important topics that are making headlines in the news nowadays and are causing controversy among regulators, OTT companies and Telecom providers, are the issues of net neutrality[13] and the termination of roaming fees within the countries of the EU[14], after both laws were passed by the European Parliament earlier in 2014[15] but not yet approved by the Council. Despite the political will on a European level, member-states decided that roaming fees will remain in the EU until 2018[16].

The reason why net neutrality is important at this point for both OTT and Telecom providers is because any decision made on net neutrality that possibly affects one side in a positive way, might at least in the short term, affect the other side negatively. At this point the lobbying power on both sides will play a significant role especially in Europe where regulatory actions are still to be taken. On the one hand, Telecoms have their own industry lobby group, ETNO (European Telecommunications Network Operators' Association)[17], members of which are all the Telecom giants of Europe and on the other hand OTT companies are based on their growing popularity and media projection on the internet to put pressure in the opposite direction.

For Telecom providers, an additional headache added to this is the EC's decision to end roaming fees in Europe, which has for many years been an important and profitable inflow of cash for Telecom operators.

In both topics, regulatory actions mandate business model and strategy adaptations to abide by the newly made rules and at the same time survive under the new conditions, whatever those may be. And since these adaptations are part of the research questions for this project, having an overview of the situation in Europe is fundamental.

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[13] http://www.europarl.europa.eu/news/en/news-room/content/20140319STO39309/html/Industry-MEPs-vote-to-protect-net-neutrality

[14] http://www.europarl.europa.eu/news/en/news-room/content/20140318STO39202/html/Industry-MEPs-call-it-a-day-on-roaming-charges

[15] http://www.europarl.europa.eu/sides/getDoc.do?type=REPORT&mode=XML&reference=A7-2014-0190&language=EN

[16] http://uk.reuters.com/article/2015/01/27/uk-eu-Telecomunications-roaming-idUKKBN0L02IQ20150127

[17] https://www.etno.eu/home/about-us/etno-governance

4.1.1 Net Neutrality

Berners Lee in 2006 defined net neutrality with this phrase: *"If I pay to connect to the Net with a certain quality of service, and you pay to connect with that or greater quality of service, then we can communicate at that level."*[18] He continued by saying that it is the ISPs' responsibility to make this connection feasible and he stresses that net neutrality does not imply that access to the internet should be free of charge or that there shouldn't be different price ranges in order to get different quality of service if one can afford it.

In more technical terms, net neutrality says that ISPs should not discriminate between data packets and so practices such as blocking or prioritization of traffic depending on what service or application produces it, is against this principle (Choi, J. P. et al. 2014).

Professor Tim Wu (2005) that came up with the term "network neutrality" makes a distinction between network neutrality, open access and broadband discrimination, by defining the last two as the means to achieving network neutrality. He states that in order to have network neutrality, applications over the internet should not be prioritized or favoured in any way, over others (Wu, T. 2005).

The definition that the EU provides is: ""net neutrality" means the principle that all internet traffic is treated equally, without discrimination, restriction or interference, independent of its sender, receiver, type, content, device, service or application"[19].

According to Wu *"The promotion of network neutrality is no different than the challenge of promoting fair evolutionary competition in any privately owned environment, whether a telephone network, operating system, or even a retail store"* (Wu, T. 2005). Regulation on net neutrality means that governments should define whether the owners of the network should prioritize users and be allowed to charge or not for different speed lanes (Marsden, C. T. 2010). The goal of such regulation is to prevent the owners of the network from blocking the best products and applications from reaching the market, on the basis of their own interests (Wu, T. 2005).

Even if people have broadband connections with high speeds, during rush hour, the speed that they have paid for is, many times, not achievable. Providing faster speed lanes for certain services or slowing down others implies a discrimination between types of traffic and

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[18] http://dig.csail.mit.edu/breadcrumbs/node/144
[19] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+AMD+A7-2014-0190+237-244+DOC+PDF+V0//EN

this is where the discussion of net neutrality starts (Marsden, C. T. 2010) (Choi, J. P. et al. 2014).

The net neutrality debate has been ongoing in the United States for more than a decade now, with professors Tim Wu from Columbia Law School, representing the proponents of net neutrality, and Christopher S. Yoo from Vanderbilt University Law School representing the opposite side. The basis for this debate is whether regulation for completely non-discriminatory and neutral networks will harm or benefit competition and innovation over the Internet platform.

Christopher Yoo and the opposing side of net neutrality, on the other hand, suggest that a reasonable amount of prioritization for applications that are time sensitive, such as audio and video, would allow operators to provide customers with more satisfying services. They also suggest that allowing reasonably differentiated network access will boost investments in last-mile networks, not only from incumbents, but also from all parties interested to offer better services to their customers, thus providing better products and services to end-users (Wu, T.; Yoo, C. S, 2007).

Another argument they present is that whether the absence of net neutrality regulations would harm consumers is something that cannot be proven and so waiting to see if such harm is caused and then act would be a better approach. Yoo expresses his concerns on how regulation will impact investments in the network and supports that competition at last-mile level will work better than imposing net neutrality regulations. He also supports that banning different practices because they can potentially be used in a negative way for competition, is not justified as these practices if used in a reasonable way can have a positive effect on the market. (Wu, T.; Yoo, C. S, 2007).

Tim Wu and the proponents of net neutrality on the other hand, suggest that if network operators are allowed to discriminate between traffic, there will be higher barriers of entry for new entrants and innovation on application level will be harmed, while eliminating competition for operators providing similar services. Wu argues on the basis of innovation and how it occurs in a market. He supports that unlike professor Yoo believes, incumbents with significant market power, especially if there is a monopoly in the market, have more incentives to block and thus harm competition if they feel threatened by new disruptive technologies (Wu, T.; Yoo, C. S, 2007).

He stresses his opinion that it's the new players that bring growth to the market and that governments should make sure that incumbents do not abuse their position and create high barriers of entry that leaves new innovative ideas out of the market. He also emphasizes his concerns about the model of competition at the last mile that Yoo proposed, based on the fact that it could work at the expense of applications in the market (Wu, T.; Yoo, C. S, 2007).

This debate provides a basis for the discussion about net neutrality that started several years ago in the United States and indicates the complexity of the issue and the strong arguments on both sides.

Net neutrality is still part of the regulatory discussion because, nowadays, where content streaming and communication services are producing increasingly more and more part of the internet traffic, problems, such as network congestion, arise in the network. For delay-sensitive applications such as streaming or VoIP apps such issues can cause major dissatisfaction to users. For voice and instant messaging apps this is not an issue.

But another reason for it is that content, voice and instant messaging applications on the internet, such as Skype and WhatsApp, can possibly have a negative effect on the Telecom providers' revenues from traditional voice and SMS services as well as from their own competing content services. Lobbying against net neutrality regulations and the free and unregulated provision of OTT services might compensate for these losses.

4.1.1.1 Net Neutrality in Europe: Overview and current situation
The EU has stated that *"The European Commission, with the help of the Body of European Regulators for Electronic Communications (BEREC) is actively committed to preserving the Open Internet and achieving Network Neutrality."*[20]

But in the absence of specific regulation, ISPs are free to engage in traffic prioritization, price segmentation and possible blocking of content (Choi, J. P. et al. 2014). Even though the EU is positive towards net neutrality, in essence, it is up to national governments to take action and create national regulation to protect customers and competition.

"The Open Internet and Net Neutrality in Europe" issued by the EU in April 2011, clarifies the EU's stance on consumer protection, based on the rights and principles defined in the EU Charter of Fundamental Rights, and stresses the need for additional measures to

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[20] https://ec.europa.eu/digital-agenda/en/eu-actions

achieve healthy competition (European Commission, 2011), supported by BEREC and its guidelines on quality of service, differentiation practices and related competition issues, and IP Interconnection [20] (BEREC, 2012).

In 2012 BEREC performed an investigation together with the European Commission regarding traffic management and other practices from operators all over Europe that result in restrictions to the open internet. The following figure indicates these practices reported by European operators making a distinction between mobile and fixed ISPs, while the practices underlined in the figure are the ones most likely to cause restrictions on the open internet. It should be noted that his figure does not show to what extent these practices affect users (BEREC, 2012).

The diversity of measures reported by ISPs
Relative frequency of ISP reporting some level of restriction
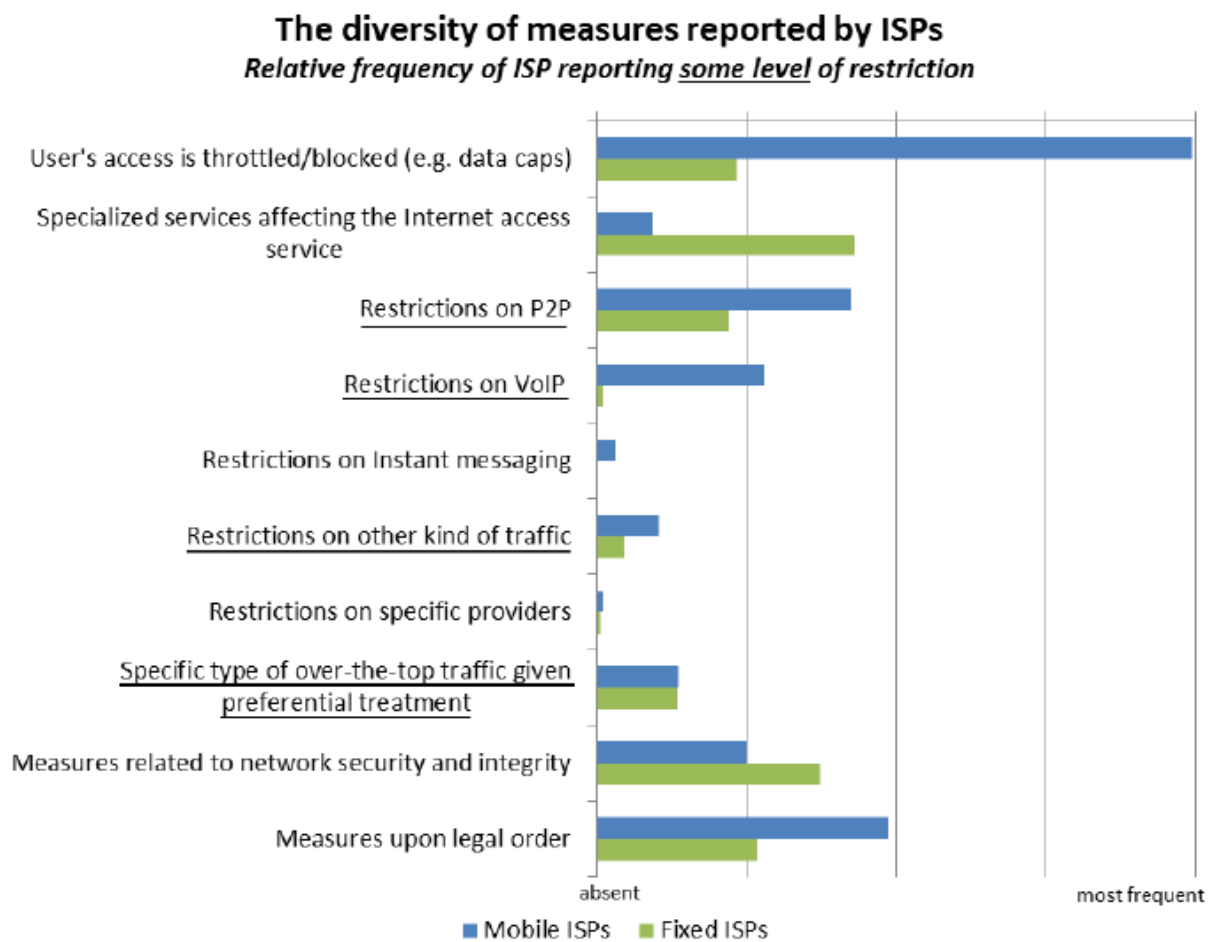
Figure 10: Network management measures reported by ISPs (BEREC, 2012)

Traffic management is not an easy task for ISPs and it puts the EU in a delicate position, when trying to maintain a balance between the ISPs' ability to manage traffic in an effective way and the preservation of an open Internet. The issues they try to tackle are mainly focused on four areas.

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The first one is related to blocking or throttling (slowing down) traffic stemming from different OTT applications and services. The EU condemns such practices as they might negatively affect competition (between similar services offered by the owners of the networks and OTT providers) and innovation (newcomer's fear of being treated unfairly by ISPs), besides the possible deterioration of QoS for users[21].

Another point of focus is user's privacy. Engaging in certain inspection practices can violate basic privacy principles according to the EU. For instance, by acquiring more personal information than necessary for a user and managing their traffic as fit for them, ISPs are violating the data protection law and so the techniques that retrieve such information are not acceptable by the EU.

Lack of transparency is another concern, since the ways traffic is handled are not largely exposed by ISPs. This way users are not properly informed about traffic management or even the QoS of their own subscription. Nevertheless, the EU acknowledges the level of difficulty of managing traffic on a network these days [21].

Finally one of the reasons for firing up the net neutrality discussion has been congestion in the networks. Data-intensive applications and services are posing a challenge for the existing infrastructure. Such excessive exchange of data compromises quality for certain applications and puts on the table the issue of investing in better infrastructure to support faster broadband for all European citizens, a target that the EU hopes to achieve by the year 2020 [21].

Nevertheless, what the EU remains at so far, is only in the form of guidelines "leaving 96% of Europeans without legal protection for their right to access the full open internet" [20] and national regulators are left with the decision-making, enforcing and monitoring processes on net neutrality, especially in regard to OTT services.

In March 2014 the European Parliament voted for a net neutrality law, as part of the agenda for the European Single Market of Electronic Communications, clarifying on the definition of net neutrality and restricting the traffic management that creates fast and slow lanes on the internet and imposes additional fees on the different data-intensive services, meeting the objections by ISPs who claim increased costs from upgrading networks to be able

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[21] https://ec.europa.eu/digital-agenda/en/net-neutrality-challenges

to meet the needs for better broadband, created by those services. It also includes a strict policy on the blocking of services by network operators [19].

But in order for the law to be enforced, it first needs to be approved by the European Council of Ministers. At the time when the proposal was passed in the Parliament, the Council found itself in accordance with the Italian presidency, which proposed a less strict approach to net neutrality, which among other things, supports existence of objectives rather than definitions for "net neutrality" and "specialized services". It also expresses the need for transparency and non-discrimination, while it suggests leaving an open window for management practices such as blocking and throttling and generally, traffic discrimination, based on "court order and legislative obligations; network security and integrity; temporary congestion control; on the request of a user"[22].

The Council decided to extend discussions for the subject to 2015, when there will be new proposals and a fully reviewed version of the electronic communications text on the single digital market in Europe [22], under the presidency of Latvia, which started in January 2015.

In March 2015 the European Commission's Vice President Ansip stated: "On net neutrality, there are three elements we should address: Firstly, we need to make sure that the internet is not splintered apart by different rules. This is why we need common rules for net neutrality. Then, we need an open internet for consumers. No blocking or throttling. And we want an internet that allows European industry to innovate and provide better services for consumers[23]".

Summing up, the EU approach towards net neutrality has so far avoided to provide a strict definition of net neutrality, while it tries to deal with related issues such as traffic discrimination and consumer protection, failing to provide the legal certainty that regulation ensures in the market. The EU approaches on net neutrality leave, at this moment in time, the discussion on the subject far from closed.

In order to look into the regulatory trends currently in Europe, an approach is to look at some specific cases of countries were such regulation is slowly being produced and in most cases triggered by practices, on behalf of the competing companies, that harmed competition.

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[22] http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2015923%202014%20INIT
[23] http://europa.eu/rapid/press-release_SPEECH-15-4659_en.htm

The case of the Netherlands:

The Netherlands were the first country in Europe to enforce a net neutrality law as early as 2011, after major Telecom operators such as KPN announced they would explore using techniques to monitor their customers' traffic, stirring discussions about privacy issues and possible breaches of the Dutch data privacy law[24].

The law, already in enforcement today, was the reason for two fines on two major Telecoms in the Netherlands for violating net neutrality. The first one was given to KPN for their WiFi hotspots at Schiphol airport, which blocked several OTT services and the second one was given to Vodafone for providing its customers with a zero-rated HBO app that allowed their customers to watch the HBO channel without charging for the data to its customers[25].

The Dutch law on net neutrality leaves no open doors for traffic blocking and additional charges to Telecom customers for OTT services. It is stated that "Blocking such new services or charging consumers for internet access would inhibit progress. This is bad for the economy, which is why we are going to legislate for it with the House. We want to ensure open and free access to the Internet."[26]

The net neutrality regulation in the Netherlands was imposed before any discriminating practices being proven or even observed, but was based on the arguments of protection of freedom of speech, privacy and innovation as well as, as a preventive measure against censorship (Layton, R., 2013). Both parliamentarians and the net neutrality lobby in the Netherlands, called Bits of Freedom, reacted with the proposal of this law, which found support by politicians and was successfully passed (Westerink, J., personal communication, March 23, 2015) (Kreiken, F., personal communication, March 31, 2015). But many opposed it saying that the discussion for net neutrality was yet immature in the country and that this was an "imported" problem from the U.S. where competition in the market is low, as opposed to the Netherlands, a country with very high competition in the broadband market (Layton, R. 2013).

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[24] http://www.argentconsulting.nl/2011/05/dutch-isp-kpn-admit-to-deep-packet-inspection/
[25] https://www.acm.nl/en/publications/publication/13765/Fines-imposed-on-Dutch-Telecom-companies-KPN-and-Vodafone-for-violation-of-net-neutrality-regulations/
[26] http://www.government.nl/ministries/ez/documents-and-publications/press-releases/2011/06/29/free-internet-laid-down-in-Telecommunications-act.html

The Dutch case will be analysed in further detail as a case study in the Findings chapter of this project.

The case of France:

In 2014, the French Digital Council (CNNum - Conseil National du Numérique) published a platform neutrality report, which introduces the even more restricting concept of "platform neutrality", which extends to the idea that web platforms such as YouTube, Spotify etc., should not be taking advantage of other stakeholders, such as ISPs, in an abusive manner and should ensure that the users of the platform are all treated equally. The report also emphasizes on Google with a critical view on how it monopolizes the market.

Platform neutrality is based on the following principles:

- Transparency and equity in collecting, processing and retrieving information
- Non-discrimination between forms of expression and shared content
- Non monopolization of Information production means
- Non-discrimination in the economic terms for access to platforms
- Non-discrimination in the technical compatibility or interoperability requirements with platforms[27].

Currently, only the Netherlands and Slovenia have passed net neutrality laws. Nevertheless the lack of regulation has left the door open for practices such as blocking and throttling of OTT services, such as Netflix, that cross the limits of reasonable traffic management, by the network operators, across many countries in Europe, which could deteriorate customer experience for thousands of people.

The situation varies in other parts of the world, such as the US, where one of the largest content OTT providers, Netflix, already pays a "fast lane" fee to Comcast, one of the largest broadband providers in the US[28]. Still, the conflict between supporters and those who are opposed to it in the US, has escalated and regulatory attempts had failed several times.

The national regulator, called FCC or Federal Communications Commission, had been overruled two times in the past by the Federal court, the first time against Comcast and the

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[27] http://www.cnnumerique.fr/wp-content/uploads/2014/06/PlatformNeutrality_VA.pdf
[28] http://corporate.comcast.com/news-information/news-feed/comcast-and-netflix

second against Verizon, in an attempt to create rules that would preserve net neutrality and the openness of the internet and prevent fast and slow lanes[29]. In April 2014, the FCC released new open Internet rules which according to many favours imposing additional charges on OTT services and applications, such as Netflix and Skype, forcing FCC chairman, Tom Wheeler to make announcements on the subject[30].

On February 26, 2015 the FCC in a surprising move, voted for "*strong, sustainable rules to protect the open internet*" that will "*preserve the Internet as a Platform for Innovation, Free Expression and Economic Growth*" (Federal Communications Commission, 2015). The rules make it very clear that no kind of blocking, throttling or paid prioritization that creates fast and slow lanes on the internet are allowed. The chairman of the FCC Tom Wheeler in his statement on the day of the ruling announced "*The American people reasonably expect and deserve an Internet that is fast, fair, and open. Today they get what they deserve: strong, enforceable rules that will ensure the Internet remains open, now and in the future*" (Federal Communications Commissions, 2015).

But in Europe, until the EU regulatory framework proposal is finalized for net neutrality at EU level, and discussions are heating up, with Telecoms opposing for the most part such regulation, supporting that competition in the European market is sufficient and much greater than that in the U.S., as indicated by the number of players in the European market (Layton, R., 2013), hence making blocking or throttling unwise for them to practice as this would mean customer dissatisfaction and consequently negative impact on their business.

On the other hand, politicians and lobbying groups are pushing for net neutrality regulations all over Europe in order to, as the Dutch Ministry of Economic Affairs supports, ensure that there is no room left for such practices (Westerink, J., personal communication, March 23, 2015).

So far though, the EU maintains a positive position on the subject, supporting net neutrality, but the outcome is left to be seen in the near future.

4.1.2 Termination of Roaming Charges in the EU

As developments in the front of net neutrality are ongoing in Europe, the vision of single digital market from the EU's digital agenda tightens the regulatory framework for

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[29] http://www.cadc.uscourts.gov/internet/opinions.nsf/3AF8B4D938CDEEA685257C6000532062/$file/11-1355-1474943.pdf

[30] http://www.fcc.gov/blog/setting-record-straight-fcc-s-open-internet-rules

Telecom operators in an attempt to unify the Telecommunication market among European countries and create cross-border competition.

The EU Telecom policy is based on three major principles stated in (Liikanen, E., 2001). Starting with the liberalization of the Telecom market and the end of national monopolies at the end of the 80s, to the harmonization of the European market and the Open Network Provision that ensured that new entrants can enter the market that was dominated by national monopolies and finally the policies that promote competition in the Telecom market making sure that no operator dominates the market at the expense of competition.

But although, the creation of a unified European continent has, so far, opened the borders for European citizens to travel freely among the countries of the Union, the same freedom does not apply to the same extent to mobile communications, where roaming charges prevent users to use their mobiles when outside their home country's national borders. The absence of substantial competition, on an international level, has allowed operators to impose very high prices for roaming services and create billions-worth revenue streams for their companies[31].

Consequently part of the European digital agenda addressed this problem by gradually reducing roaming charges since 2007 by imposing caps, also known as the "Eurotariff". Gradually these caps were lowered even more, resulting in an 80% reduction in retail prices since 2007 for voice calls, SMS and data. The EU roaming charges are an obstacle to the vision of a unified European single market which led to the adoption of the "Connected Continent Legislative Package" in 2013[32], a package for promoting competition on a European level.

The necessity for regulation in international roaming in Europe has often been discussed since price caps started getting imposed in 2007. This is due to the fact that regulation for international roaming involves operators from different countries and so national regulators find it hard to enforce such rules within their countries. It is also important to consider the fact that mobile infrastructure is deployed and owned by several operators within a country, as opposed to fixed networks where normally infrastructure is owned by one operator and shared with others that want to offer similar services and so regulation is more easily applied in such a market (Falch, M. et al., 2009).

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[31] http://ec.europa.eu/digital-agenda/en/roaming
[32] http://ec.europa.eu/digital-agenda/en/node/67489/#roaming

		From 1 July 2012	From 1 July 2013	From 1 July 2014
Data (per MB)		¢70	¢45	¢20
Voice-calls made (per minute)		¢29	¢24	¢19
Voice-calls received (per minute)		¢8	¢7	¢5
SMS (per SMS)	Text	¢9	¢8	¢6

Figure 11: Roaming tariffs excluding VAT: 2012-2014[33]

This gradual reduction in international roaming prices is aimed at the complete elimination of over-priced roaming charges in Europe, so that mobile users can use their phones in any European country with the same rates as in their home country. On April 3rd 2014 the European Parliament voted in favour of completely eliminating international roaming charges by the end of 2015, a strict decision that favours European citizens but deeply dissatisfies Telecom operators who see the roaming market worth 4.8 billion euros in 2014 disappear (Gentner, A. 2014).

The implications of the legislation for the elimination of these charges for Telecoms are reinforced by the ability of providers other than the users' provider (called Alternative Roaming Providers or ARPs) to offer roaming services to them, which was not possible before 2014. In addition, competition at an international level as well as subscription packages including voice, SMS and data that allow mobile users to roam in other countries at a flat-rate same or similar as charges within the home country (Roaming like Home plans), would mean a significant reduction of income for Telecom operators (Gentner, A. 2014).

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[33] http://ec.europa.eu/digital-agenda/en/roaming-tariffs

The regulation for roaming remains to be approved by the European Council of Ministers and the decision was expected in October 2014 but in November 2014 the Council published a text stating the delay of the decision on roaming based on the fact that the Commission's proposal and the Italian Presidency's text, at the time, presented significant differences on the subject. Therefore it was suggested that the regulation on roaming be revised and deeply explored based on the points that the Presidency raised. The Presidency emphasized on points such as the further examination of the impact of Roam like Home plans, regulation of wholesale prices, clarification of what "fair use" is considered to be, impact on the national prices and several others[34].

European lawmakers are strongly supportive of the elimination of these fees in the immediate future but the resistance from the member states implies a delay in the enforcement of the Roaming Regulation until after 2018[35] and the results are yet to be seen. The difference of opinions is obvious in the European Commission's Vice President's statement in March 2015 that "On roaming, I cannot support the very limited basic allowance of Council's current reply to people's call for the complete abolition of roaming charges. It is a joke. We must definitely go further. We should remember our ultimate aim: the full and swift abolition of roaming surcharges – and not only their reduction[36]"

Following there is a more detailed table of the price caps since their implementation based on the figures defined by the EU. There one can see the gradual decrease, since 2007, in both wholesale and retail prices for roaming within the EU member states. As the legislators observe, before 2007, retail prices for roaming were high compared to the costs for providing the service and so students, business travellers and tourists within the community were paying a lot to use the voice, SMS and data services. But regulating only the retail prices would not be enough as this would make it possible for network operators to leave very thin margins for profit to the wholesale buyers that do not own network infrastructure and offer communication services. As such there was a need for regulation both in wholesale and retail and the EU documents cover both aspects (Official Journal of the European Union, 2007) (Official Journal of the European Union, 2009) (Official Journal of the European Union, 2012).

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[34] http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2015923%202014%20INIT
[35] http://uk.reuters.com/article/2015/03/04/eu-Telecomunications-idUKL5N0W62K220150304
[36] http://europa.eu/rapid/press-release_SPEECH-15-4659_en.htm

Roaming limits in EEA countries (all the prices are in euro without VAT)

Retail caps (applies to subscribers)

Service	Unit	8-30-2007 / 8-29-2008	8-30-2008 / 6-30-2009	7-1-2009 / 6-30-2010	7-1-2010 / 6-30-2011	7-1-2011 / 6-30-2012	7-1-2012 / 6-30-2013	7-1-2013 / 6-30-2014	7-1-2014 / 12-15-2015
Outgoing calls to any EEA number	price of 1 minute	0.49	0.46	0.43	0.39	0.35	0.29	0.24	0.19
	billing interval	Not regulated	Not regulated	per second starting from 31st second					
Incoming calls from any number	price of 1 minute	0.24	0.22	0.19	0.15	0.11	0.08	0.07	0.05
	billing interval	Not regulated	Not regulated	per second starting from 1st second					
Incoming calls redirected to voice mail	price of 1 minute	0.73	0.68	0.62	Free				
Outgoing text message to any EEA number	price of 1 message	Not regulated	Not regulated	0.11			0.09	0.08	0.06
Incoming text message from any number	price of 1 message	Not regulated	Not regulated	Free					
	price of 1 Megabyte	Not regulated	Not regulated	Not regulated	Not regulated		0.7	0.45	0.2
	billing interval	Not regulated					per 1 KB starting from 1st KB		
Data transfer	monthly default cut-o… (ARP)	Not regulated			50				
Right to choose an alternative roaming provider (ARP)		Not regulated							Yes
Default notification text message with roaming prices		Not regulated	Not regulated	Yes					
Free number to call for detailed roaming prices		Not regulated	Not regulated	Yes					
Free '112' access in roaming		Not regulated	Not regulated	Yes					

Legend: Past / Active

Figure 12: EU Retail Price Caps 2007-2015 (Official Journal of the European Union, 2012)

4.1.2.1   The wholesale market in the EU

The international roaming in Europe was always a minor fraction of the European Telecom market but very profitable segment and being called by some the cash cow of Telecom operators (Falch, M.;Tadayoni, R., 2013).

But there are developments evolving with the European single market being close to fruition, the plans are that will be a reality in 2018[37]. And at the moment there are very few mobile operators that can handle most of their clients roaming needs inside of their own network. For all the others, on which we can include operators that don't have any or almost any infrastructure, they have to rely on the networks of the local mobile operators. And this constitutes the wholesale market that is dependent at the moment on access regulation which forces all network providers to sell network capacity at regulated prices.

During the research for this work it was discovered that access regulation is a central worry for the regulatory departments of Telecom companies or at least the incumbents from each country, which was where our focus is most centered on and will be discussed on the coming chapters. But this need gives a high relevance to the subject of wholesale.

There are some alternatives to the wholesale roaming market because there are some operators as mentioned before that can provide roaming services using their own network facilities or by making cross-border alliances (Falch, M.;Tadayoni, R., 2013). But these alternatives never had any real impact on the market because they provided schemes that were not so attractive to the customers. In many cases the users opted for OTT solutions instead of roaming or for simply switching off their phones when abroad.

The European Union saw this regulation (introducing wholesale and retail price caps) as a way to increase transparency and to also make sure that users of mobile telephones, when travelling within the EU, do not pay excessive prices to make and receive calls. This was argued by the EU as a way to achieve a high level of consumer protection, making sure that the competition between mobile operators was present and preserved both incentives for innovation and consumer choice. Now although the success from the first part (increased transparency and protection of the users) was successful, the second part, that is promoting competition and innovation, remains to be seen[38].

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[37] http://www.reuters.com/article/2015/03/04/eu-Telecomunications-idUSL5N0W62K220150304
[38] http://www.europedia.moussis.eu/discus/discus-1343718686-976307-8045.tkl

An interesting example about this was given in an interview with Dr. Fernando Herrera the regulatory economics manager from Telefonica. He mentioned that in terms of innovation, the capped prices (retail and wholesale) in the mobile networks are not incentivizing companies that want to operate in Spain to invest in their own network but in the case of fiber, since there isn't any regulated wholesale market for speeds higher than 30 Mbits, companies that want to go to Spain are pouring in millions and millions of Euros to create a fiber network, because they cannot rely on the networks of others at a discounted price like they can for normal mobile communications (Herrera-Gonzalez, F., personal communication, March 25, 2015).

This point of view is shared by professionals in this industry. Senior Advisor Allan Bartroff from TDC mentioned that TDC is interested in the developments in wholesale and access regulation and that as long the wholesale price caps and retail prices remain balanced there wouldn't be a problem for them to adapt (Bartroff, A., personal communication, March 16, 2015).

The table following includes the detailed wholesale price caps implemented since 2007 based on the directives from the European institutions (Official Journal of the European Union, 2007) (Official Journal of the European Union, 2009) (Official Journal of the European Union, 2012).

		In force from 8-30-2007 / until 8-29-2008	8-30-2008 / 6-30-2009	7-1-2009 / 6-30-2010	7-1-2010 / 6-30-2011	7-1-2011 / 6-30-2012	7-1-2012 / 6-30-2013	7-1-2013 / 6-30-2014	7-1-2014 / 12-15-2015
Outgoing calls to any	price of 1 minute	0.3	0.28	0.26	0.22	0.18	0.14	0.1	0.05
	billing interval	Not regulated		per second starting from 31st second					
Inbound calls		Not regulated		same as termination of a non-roaming call on the visited network, see Termination rates.[a 3]					
Outgoing text message	price of 1 message	Not regulated		0.04		0.03		0.02	
Incoming text message from any number		Not regulated		Free					
Data transfer	price of 1 Megabyte	Not regulated		1	0.8	0.5	0.25	0.15	0.05
	billing interval	Not regulated		per 1 KB starting from 1st KB					
Right to use other operators' networks in		Not regulated		Yes					

Legend: Past / Active

Figure 13: EU Wholesale Price Caps 2007-2015 (Official Journal of the European Union, 2012)

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4.2 TECHNOLOGIES

In order to have a deeper understanding of how Telecom networks work (especially in Europe) as well as OTT services operate on top of networks, it is necessary to look into the different standards, protocols, principles and technologies that are applied in today's networks and make communication possible.

Starting with the OTT services, it is wise to have an overview of how VoIP technologies work on top of the networks offering new services and creating new business model and unexpected competition for providers. In addition it provides the opportunity to investigate the claims by the operators, that OTT data-intensive services put a significant strain on their infrastructure. Especially the VoLTE technology described later in this chapter provides one of the dominant candidate technologies for the replacement of copper wire lines and the transmission on voice exclusively over IP.

In the U.S. this approach is already supported by many carriers as well as the Federal Communications Commission (FCC), creating questions about the amount of traffic that mobile networks can carry in the future from such a move, especially after Net Neutrality laws can limit the possible ways that traffic can be managed by operators[39].

Next there will be a description of the GSM (Global System for Mobile Communications) (2G) standard, developed by ETSI (European Telecommunications Standards Institute), which marked the transition to digital cellular networks and dominated Europe, and a big part of the global market of voice and SMS. Based on the GSM infrastructure, the next generations of standards such as 3G and 4G were later on developed. This standard provided the principles of how cellular networks operate and the same principles were expanded to create faster and more reliable networks today. Therefore it is important to have an overview of how this technology works as it fundamentally describes commercial communications from the beginning of the mobile phones era until today.

Here it is important to additionally describe the way a mobile device maintains connection while moving from one network to another, a process called roaming, which over the years has been a significant, billion-euro, source of revenue for Telecom operators,

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[39] http://spectrum.ieee.org/Telecom/internet/net-neutralitys-technical troubles/?utm_source=techalert&utm_medium=email&utm_campaign=021915

threatened by the EU's decision to completely eliminate roaming charges within the union by 2018[40].

Today we have reached 4th generation (4G) standards, such as LTE-advanced, as the need for mobile broadband keeps growing. Faster data rates and the transition to all-IP networks, in the midst of the latest developments in the Telecom sector in Europe, make this technology extremely relevant to this project and the topics analysed and discussed. Hence, this is an important technology to look into and describe in detail.

4.2.1   End-to-End Principle

In essence the internet was used mainly for military purposes from its creation until the mid-80s, when the TCP/IP protocol was introduced and the commercial use of the internet became a reality[41]. The question of how much intelligence should be put in communication systems was originally posed during that time and so later on the end-to-end principle was formed, stating that every function on a communication system is performed with the help of applications at the end points of the system.

The system itself is not capable of providing such functions independently. This means that there is little function left to be performed by the networks, other than transferring data from one end point to the other. In the years coming, this principle was used to address issues related to the openness of the Internet, as well as to provide the means for the development of new services over the network[42], leading up to the discussion about net neutrality, explained more thoroughly in the next chapters, and to what extent networks should manage traffic without affecting this openness. This of course doesn't mean that network operators are not allowed to use traffic management techniques to ensure the continuous and reliable operation of their networks.

This is the same principle used by VoIP, VoD and messaging services, such as Skype. In these cases, the network is only responsible for carrying the traffic, while the service provider needs to make sure that data packets are delivered in the right order in order to make sure that the service is satisfactorily reliable.

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[40] http://uk.reuters.com/article/2015/01/27/uk-eu-Telecomunications-roaming-idUKKBN0L02IQ20150127
[41] http://www.columbia.edu/~rh120/other/tcpdigest_paper.txt
[42] http://www.ietf.org/rfc/rfc3724.txt

4.2.2   OTT and Best Effort Principle

The Over The Top (OTT) services are apps, webpages and any kind of service that works over the internet. As a way to put this in perspective, they are services that only see the top layer of the OSI model (7 layer), namely the application layer. These services do not account for the network they use, because they are based on the principle explained before the end to end principle.   These services have been disrupting the business plans of Telecoms and creating pressure on the networks, especially in the case of video and torrents. Services like Netflix, Youtube and Bittorrent create increasing traffic and in peak hours they can overload the networks.

The main advantage from these services is that they don't need to build a network to deliver their service and can use the existing infrastructure to do it, but the delivery of these services in terms of quality is sometimes not as good as the managed counterparts[43].

The reason for that is that OTT services are based on a best effort principle which means that they try their best to deliver their services by using several techniques like compression, interleaving, etc. But ultimately, even with using all these techniques, if the quality of the connection is bad, OTT services can be very frustrating to use. So some companies such as Google and Netflix use direct channels on the backbone of the internet to route their traffic to the destined country and in addition they use cache machines for the content with the highest demand, leaving only the last mile as best effort principle. These direct channels are also known as Content Delivery Networks, or CDNs for short, and some companies like Netflix and Google are not only buying specialized services but also building their own CDNs; Netflix Open Connect and Google Global Cache, respectively. In 2013 the Netflix Open Connect already accounted for 13% of CDN traffic [43].

Still sometimes the above are not enough. If the last mile cannot cope with the needed QoS, the services won't arrive with the necessary quality, so Netflix goes even further, paying some ISPs to deliver their services with better quality.

As indicated by the case when Netflix paid Verizon to speed up their traffic in September 2014, the speed for the connection went from 10th place to 1st place in USA[44].

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[43] http://www.disruptivetelephony.com/2012/07/what-is-an-over-the-top-ott-application-or-service-a-brief-explanation.html
[44] http://www.slate.com/blogs/future_tense/2014/10/15/netflix_paying_verizon_for_a_direct_fios_connection_is_making_video_streaming.html
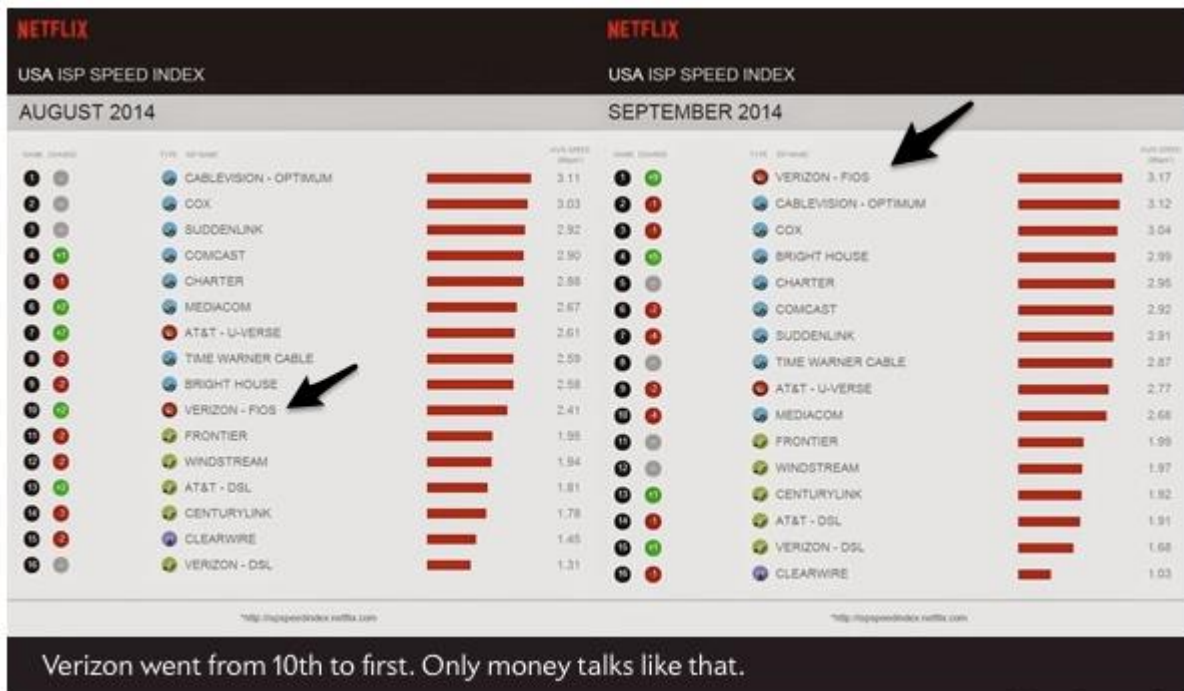
Figure 14: Source[45]

4.2.3 VoIP (Voice over IP)

Voice over IP (VoIP) is not a single technology but a group of technologies that revolve around the idea of delivering voice communications and multimedia sessions over the Internet Protocol (IP). It has been used extensively over the last decade and new VoIP technologies are constantly being evolved and improved in order to accommodate the need for new services and higher data rates. Voice over LTE, for example, is a VoIP technology that has the potential to replace wire-line telephony in the future, marking the transition to an all-IP era. This technology will be briefly described later in this chapter, after the LTE protocol is presented.

This group of technologies allowed the creation of OTT services in the voice area, such as Skype to compete with mobile operators. But it came with a cost in the beginning. The VoIP technology worked very poorly and there were problems such as sketchy voice quality, dropouts in conversation, even dropped or incomplete calls. This forced OTT services to develop techniques like compression algorithms among others, but these solutions only

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improved slightly the quality of the calls. The real solution was in the hands of the network operators, because the OTT companies used VoIP in an unmanaged way since they couldn't control the flow in the networks and the Telecoms later when they started using VoIP they did it in a managed way.

One of the most common problems was the fact that the routers that a call passes along the way, had the option of dropping packets, if necessary, so some packets that are sent will never arrive at their destination. But with a managed network operators could solve this (NEC Unified Solutions, 2006).

Eventually the networks got better and the initial problems ended up being solved. The same happened for OTT services. Network operators saw a big advantage in terms of costs in VoIP technology and many started integrating VoIP in their networks. These technologies brought lower costs and greater flexibility, but also introduced significant risks and vulnerabilities (Walsh, T. J. et al., 2005). These concerns were eventually overcome and VoIP started being a reality for many companies in Europe, especially when we are talking about the backbone of the networks, because VoIP allows very easy interconnection between different networks, one of the reasons for VoIP supremacy when it comes to voice communications is due to its simplicity.

How VoIP works is very simple to explain. The voice is digitized in packets and sent through the web with the destination IP. When it arrives the destination device converts the packets back into sound. Since this is for real time applications the most common protocol that VoIP works with is UDP.

4.2.3.1 VoIP Variants
VoIP Technologies have many applications. These applications are mostly related to the different scenarios where this technology can be applied. With the most significant ones being (T- Systems Enterprise Services GmbH, 2007):

- VoIP backbones in Telecommunications companies
- VoIP in the LAN of a corporate network
- VoIP in a company's wide Private Network
- VoIP on the last mile via QoS-(Quality of Service)
- VoIP over the Internet

Nevertheless, most users aren't aware that VoIP technology is commonly used among Telecom companies. This technology is used to bring several advantages but also has its disadvantages. An overview of the main advantages and disadvantages is important in order to understand the issues behind the usage of this technology. The figure below shows a diagram from VoIP working in a local set up, so companies and institutions start using similar step-ups inside their corporate networks.
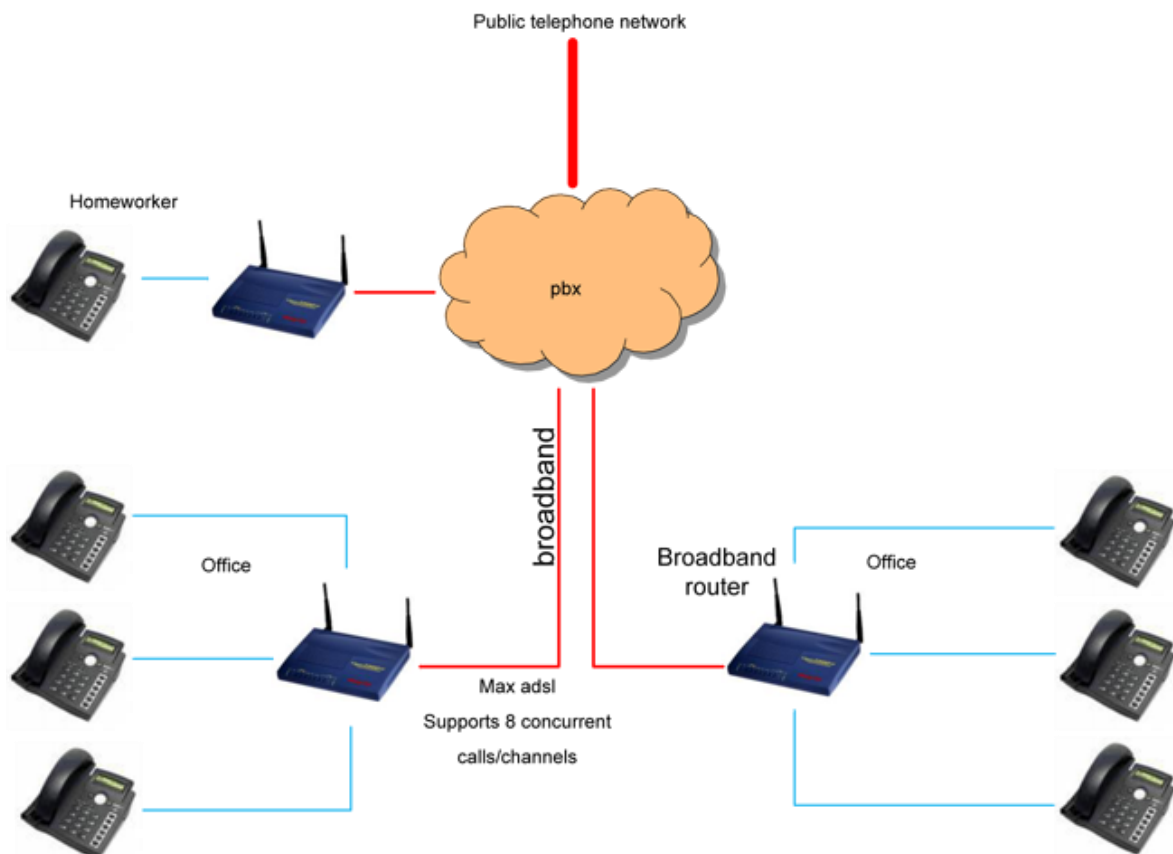
Figure 15: VoIP Diagram[46]

4.2.3.2   Advantages and Disadvantages of VoIP

The main advantages from using the VoIP technology is its flexibility and the lowering of costs both for supporting branch offices and international calls. In addition, it can be deployed anywhere that there is IP connectivity, which makes this technology extremely flexible.

The trade-off for the Telecoms is that there are some potential security risks. The calls can become more easily the target of attacks and consequently good cryptography is important. Companies could minimize this problem by running separate departments for

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[46] http://phoneserviceslocal.com/VoIP-diagram/

voice and data services but this way they wouldn't take the maximum advantage of the VoIP technology.

The second problem is usage peaks and the new data load that the network will have to absorb in the future, meaning that companies have to test if their networks would be able to handle the new load on the network (T- Systems Enterprise Services GmbH, 2007) (Walsh, T. J. et al., 2005).

4.2.4 The GSM Standard – an Overview

The GSM (Global System for Mobile communications) standard was released by the European Telecommunications Standards Institute (ETSI) in the mid-1980s, as a second-generation mobile communication system, in order to primarily provide voice telephony, although a range of complementary services, such as data transmission, were defined along the way[47].

There was a double purpose for this standard. First, it permitted mobile phone users to use their devices outside of national borders, enabling the creation of a pan European service for cellular communications. Second, it revolutionized the way radio communications worked until then, by digitalizing communications allowing circuit-switched connections that reached 9600 bits/s[48].

The GSM standard supported international roaming, speech quality, additional services such as data services, SMS, fax, videotext etc, additional features including caller ID, call forwarding and many others, improved security as well as interconnection with other types of networks such as ISDN. (Kahabka, 1998, p.6)

Initially designed to operate in the 900 MHz frequency band (later adapted to work in the 1800 MHz, 800MHz and 1900 MHz bands) and using modulation techniques such as Gaussian Minimum Shift Keying (GMSK) (similar to Phase Shift Keying (PSK)) with Time Division Multiple Access (TDMA) and signaling over Frequency Division Duplex (FDD) carriers, GSM and its subsequent improvements became the most popular standard among all other wireless technologies on a global scale[49] [50].

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[47] http://www.etsi.org/index.php/technologies-clusters/technologies/mobile/gsm
[48] http://www.etsi.org/index.php/technologies-clusters/technologies/mobile/gsm][http://www.gsmhistory.com/gsm_2g/
[49] http://www.ietf.org/rfc/rfc3724.txt
[50] http://www.rohde-schwarz.com/en/solutions/wireless communications/gsm_gprs_edge_evo_vamos/fundamentals/gsm_fundamentals_106328.html

In the Release 97' of GSM, called GPRS (General Packet Radio Services), users with devices operating with the GSM standard were provided with data services, using packet-switched communication reaching a maximum of 21,4 kbit/s. Later enhanced releases, such as EDGE (Enhanced Data for GSM Evolution), allowed even higher data rates, reaching 59,2 kbit/s[51].

Year	Events
1982	CEPT establishes GSM group in order to develop the standards for a pan-European cellular mobile system.
1985	Adoption of a list of recommendations to be generated by the group.
1986	Field tests were performed in order to test the different radio techniques proposed for the air interface.
1987	TDMA (in combination with FDMA) is chosen as access method. Initial Memorandum of Understanding signed by the telecommunication operators (representing 12 countries). GSM spec drafted.
1988	Validation of the GSM system. The European Telecommunications Standards Institute (ETSI) was founded.
1989	The responsibility of the GSM specifications is passed to the ETSI.
1990	Appearance of phase I of the GSM specifications. DCS adaptation starts.
1991	Commercial launch of the GSM service in Europe.
1992	Actual launch of commercial service, and enlargement of countries that signed the GSM. GSM changed its name to Global System for Mobile Communication.
1993	Several non-European countries in South America, Asia, and Australia adopted GSM.
1995	Phase II of the GSM specifications. Coverage of rural areas. GSM 1900 was implemented in USA.

Figure 16: GSM History. (Das, 2010 , p.194)

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[51] http://phoneserviceslocal.com/VoIP-diagram/

4.2.4.1 GSM Network Architecture

GSM systems, just as every communication system, are divided into different entities, each one considered a subsystem, that are managed separately and communicate with each other through standardized interfaces defined by 3GPP in the 3GPP™ TS 45.-series specifications.
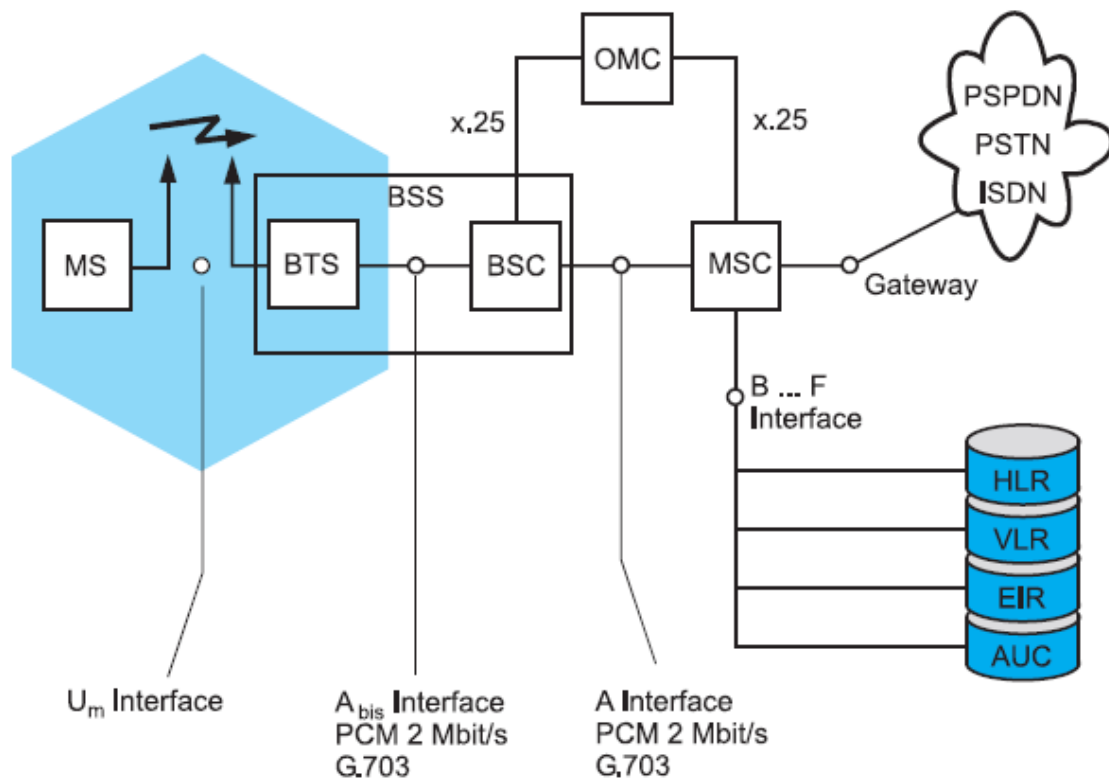
Figure 17: GSM Architecture . (Kahabka, 1998, p.7)

The three fundamental subsystems of the GSM network included the Mobile Station (MS), the Base Station Subsystem (BSS) and the Network Subsystem (NSS). (Kahabka, 1998, p.7)

4.2.4.1.1 The Mobile Station

The MS is comprised of two parts: one is the physical mobile device the user has to access the network, also called mobile equipment (ME) and two the SIM card (Subscriber Identity Module).

The unique, removable SIM card (unique because it contains IMSI - International Mobile Subscriber Identity, a unique identification number) is provided by the network operator in order for the subscriber to gain access to the network and so the users have the

ability to switch to any operator they want simply by changing the SIM card. (Kahabka, 1998, p.8) (Das, 2010, p.194-196)

The BSS is comprised of the Base Transceiver Station (BTS) and the Base Station Controller (BSC).

The BTS is responsible for the RF transmission and reception to and from the MSs in the network. Other purposes it has is the channel coding and decoding as well as the encryption and decryption processes.

The BSC provides radio management functions for the BTSs (can manage up to 40 BTSs depending on the manufacturer) that are connected to it. It is responsible for tasks such as handover decisions, determining the transmitter power for the BTS, authentication, traffic measurement functions and many others.

The BSS, in total, as shown in figure 2, is the intermediary between the MSs and the Mobile Service Switching Center or MSC and provides the connection between them. (Kahabka, 1998, p.8-9) (Das, 2010, p.196)

Five are the main entities in the NSS. The Mobile Switching Center (MSC), the Home Location Register (HLR), the Visitor Location Register (VLR), the Authentication Register (AuR) and the Equipment Identity Register (EIR).

The MSC is the core of this subsystem, in the sense that it provides all the functions needed for the network's subscribers. Tasks such as registration, authentication, handovers, location updating, call routing for roaming users are some of the responsibilities of the MSC. It is also the entity that connects the mobile network to the fixed network (PSTN or ISDN), acting as a gateway to other networks (GMSC).

The HLR is the database containing information about the network's subscribers of possibly more than one MSCs, such as service profiles, location information, IMSI numbers and their current VLR address, in order to be able to route calls to the MSs when necessary.

When the mobile subscriber is roaming in an area other than its home area (meaning that the subscriber is located in an area served by an MSC and whose HLR is located in a

different area), then the VLR database is responsible for storing the necessary information of this subscriber temporarily.

In addition, in order to ensure that communication is performed securely in the network, the AuC, a database unit dedicated to storing a secret key belonging to each specific SIM card, is used for performing authentication and encryption functions over the channel.

Finally the last part of the NSS, is the EIR, a database storing a unique hardware identification number given to each MS, called International Mobile Equipment Identity or IMEI, a number used to ensure security, verifying the validity of the equipment.

Here, it is also important to notice that in order to ensure the GSM network's sufficient operation levels, operators use what is called, an OMC (Operation and Maintenance Center) for managing the MSC, BTS and BSC entities of the network. The OMC can sometimes be responsible for controlling a whole PLMN (Public Land Mobile Network). (Kahabka, 1998, p.9-10) (Das, 2010, p.197-198)

4.2.4.2 *GSM Interfaces*

To allow the communication between the different entities of the GSM Network there are several interfaces being used:

- *The air interface Um:* The frequency bands allocated to GSM by the ITU (International Telecommunication Union) are GSM900 (890-915MHz for the uplink, 935-960 MHz in the downlink), GSM1800 (1710-1785 MHz for the uplink, 1805-1880 MHz for the downlink), GSM1900 (1850-1910 MHz in the uplink, 1850-1910 MHz in the downlink). Time and frequency division multiple access (TDMA/FDMA) are used at the same time for the allocation of the bandwidth to as many users as possible.

- *The Abis interface:* This is the interface used within the BSS for the communication of the BTS and BSC entities using two types of channels, one for traffic and one for signaling between the two.

- *The A interface:* The A interface is used for the communication of the MSC with the BSC.

- *The MSC-based interfaces:* Here there are the B, C, D, E, F and G interfaces used for the connection between the MSC with the different registers, the MSC with another MSC as well as registers to other registers.

(Kahabka, 1998, p.11-34)

4.2.4.3 Roaming in GSM

One of the most basic features included in the GSM standard is the roaming feature. Roaming allows the subscriber of a GSM network to make and receive calls in all GSM networks, besides the home network. In order for this to happen operators must create an agreement that allows the subscribers to roam in their networks without changing their phone number. (Kahabka, 1998, p.40)

In a GSM service area, where several operators might offer GSM services, each operator owns and operates their own PLMN. Within this GSM PLMN, normally in connection with a wire-line network, the operator offers the subscriber voice and data services, while maintaining interconnection with PSTN/ISDN networks and providing the ability to roam through the different GSM networks. (Das, 2010, p.201)

When a subscriber needs to roam in another operator's network, the different GSM PLMNs need to be able to exchange data but at the same time the subscriber must be able to access the services according to his/her subscription. Roaming is performed through the communication between the MSCs, HLRs and VLRs of the home network and the network the subscriber visits. The MSC is responsible for switching the subscriber over to the visited network's MSC.

In order for the subscriber to have the same subscription in the visited network as well, the HLR in the home PLMN that has the subscription information data permanently stored, needs to send this data, through the network's MSC, over to the visited PLMN's MSC and VLR. This way the subscribers can use the services they are entitled to in the visited network as well. If there is a roaming agreement between the home and visited network's operators, then the MSC/VLR stores this data for as long as the subscriber is roaming in their PLMN, even if the subscriber turns off the MS (this applies for a certain period of time). The visited network's MSC then, serves the roaming subscriber in the same way it serves its home network subscribers.

At this point it is important to understand the concept of international roaming as this is one of the regulatory issues that this project explores within the Telecommunication field, which implies that any subscriber can use their mobile phone abroad. The difference between national and international roaming does not lie on technological issues, as long as the standards used are the same. This means that the technicalities are the same, when a subscriber leaves the home network to roam in another operator's network. In the case of

international roaming, the visited network lies in a different country than the subscriber's home network.

With international roaming, operators among different countries form agreements in order to set inter-operators tariffs (ITOs), meaning wholesale charges that the home network pays the visited network in order for its subscribers to use the visited network. (European Consumers' Organisation, 2005)

4.2.4.4   A call in the GSM Network
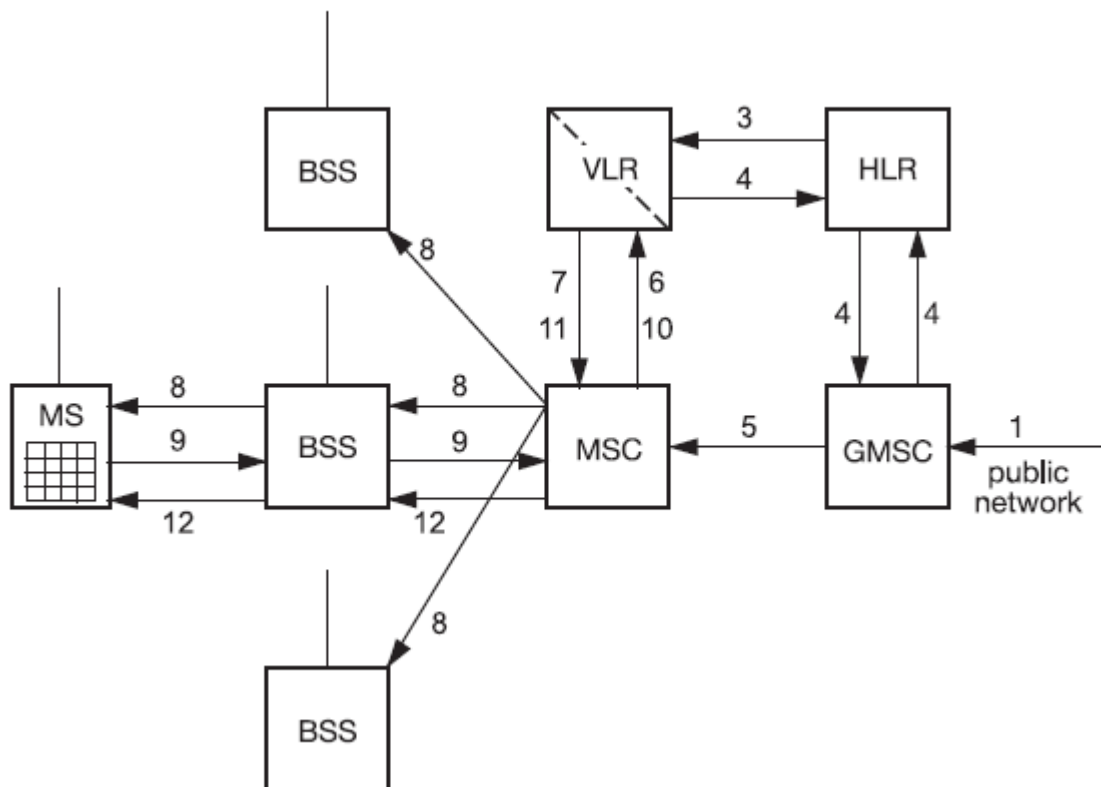
Figure 18: A call in the GSM network (Kahabka, 1998, p.35)

The figure above presents how a call can be performed from one network (for example a fixed line network) to a GSM network and the entities involved. The call originating in the fixed network goes through the GMSC, which will in turn find the HLR where the called number belongs to. When the HLR validates that the number exists and belongs to its network, it contacts the VLR of the network the MS is in at the moment, in order for the VLR to provide the exact location, which is then sent back to the GMSC and for defining which MSC will serve the call. The VLR verifies that the MS can be reached in the network in order for the call to be possible. The MS in return responds and the VLR informs the MSC that the call ready for execution. (Kahabka, 1998, p.35-36)

4.2.5 Long Term Evolution (LTE)

3GPP Long Term Evolution (LTE), is one of the newest standards in the mobile network technology tree that produced the GSM/ EDGE (Enhanced Data for GSM Evolution). It was created to keep the compatibility with GSM (Global System for Mobile Communications) and HSPA (High Speed Packet Access). It was a project of the 3rd Generation Partnership Project (3GPP), operating under a name trademarked by one of the associations within the partnership, the European Telecommunications Standards Institute [52].

4.2.5.1   Overview

When 3GPP started to develop LTE, they had some main objectives they wanted to achieve with this new technology, in order for LTE networks to bridge the functional data exchange gap between very high data rate fixed wireless Local Area Networks (LAN) and very high mobility of the cellular networks.

The main objectives were:

- Increased downlink and uplink peak data rates. - to support situations of unexpected high demand.

- Scalable bandwidth - to make sure that the QoS for the users is always good.

- Improved spectral efficiency - to save energy and reduce the noise on the channels.

- All IP network - to be able to be easily integrated with the internet.

- A standard's based interface that can support a multitude of user types. - So it can allow almost infinite innovation.

4.2.5.2   The LTE Standard

Standardization organizations play a major role in the Telecommunications industry to guarantee interoperability between vendors and allow for a common ground where all players can voice their opinion regarding the direction the industry should follow. So 3GPP created LTE with some driving factors in mind which were:

- Efficient spectrum utilization

- Flexible spectrum allocation

- Reduced cost for the operator

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[52] https://sites.google.com/site/lteencyclopedia/home

- Improved system capacity and coverage

- Higher data rate with reduced latency

This standardization process was very successful as can be indicated by the fact of LTE has become the fastest developing mobile system technology. Which also results in a continuous development of other complementary technologies always aiming for constant LTE improvements. 3GPP called this improvements as releases[53].

And since standardization's ultimate objective is to create a standard to trim the bush of innovation and lead it in the desired way, the map of LTE usage is pretty exemplary of whether the objective in this regard is being achieved.

2010   20 commercial LTE networks across 14 countries worldwide

2013   230 commercial LTE networks across 88 countries worldwide

November 2013
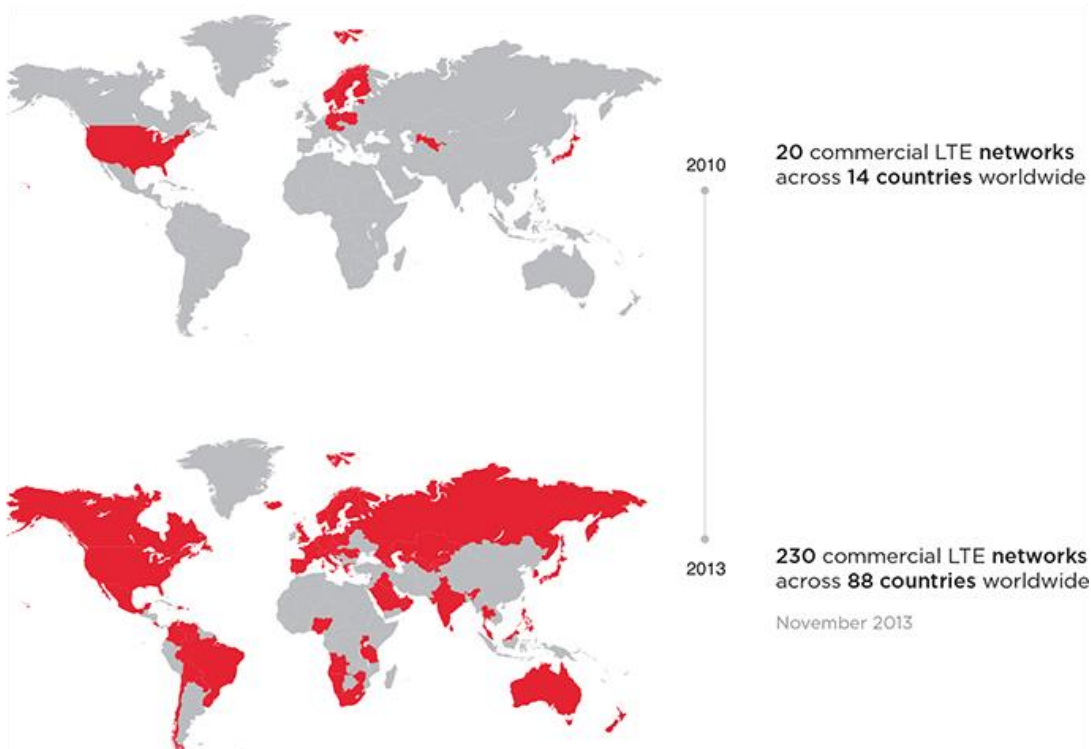
Figure 19: LTE map[54]

4.2.5.3   LTE Architecture

To understand the LTE architecture it is important to understand the Evolved Packet System (EPS) network elements because they're crucial for LTE to work. EPS provides the user with IP connectivity to a PDN (packet data network) allowing them to access the Internet, as well as to run services, such as Voice over IP (VoIP), making sure that the quality of signal is always present even with a possible constant user mobility.

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[53] http://www.rohde-schwarz.com/en/applications/lte-advanced-3gpp-rel.11-technology-introduction-application-note_56280-42753.html

[54] https://gsmaintelligence.com/images/analysis/entries/2013-11-26-lte-map.png

To route the IP traffic from the Internet to the clients' phones, the EPS uses the concept of EPS bearers. A bearer is an IP packet flow with a defined quality of service (QoS) between the gateway and the UE. The E-UTRAN (Evolved Universal Terrestrial Radio Access) and EPC (Evolved Packet Core) together set up and release bearers as required by applications. An EPS bearer is a QoS stream used for providing the user with connectivity for different services same time.

Before trying to understand the figure below it is also important to know that while the quality of the signal is very important, so is the aspect of security and privacy for the user and the protection against fraudulent use is on top of the agenda of the LTE designers. (Alcatel-Lucent, 2009)
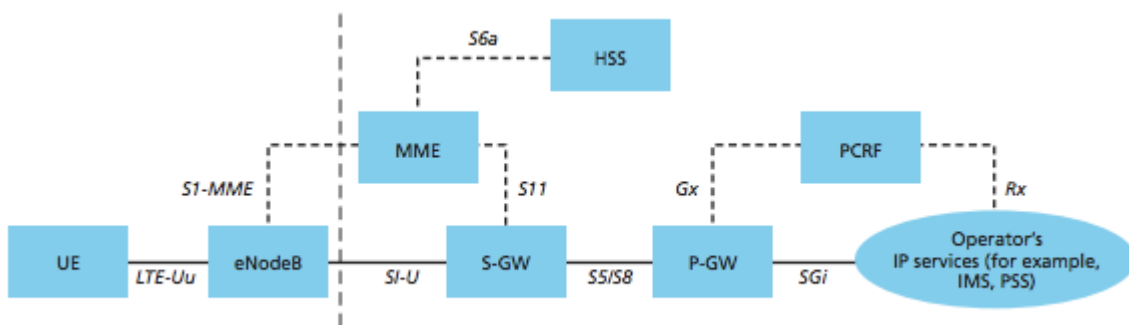
Figure 20: The EPS network elements (Alcatel-Lucent, 2009)

Figure 4 shows the complete overall network architecture of the EPS. This includes all the network elements and their standardized interfaces.

At a high level, the network is comprised of the core network and the access network, usually referred to as E-UTRAN.

On the left of the figure, is the access network, which is composed mainly of one node, the NodeB (eNodeB) and connects to the equipment of the users. On the opposite side of the figure is the CN (Core Network) which consists of many logical nodes. All of these network elements are interconnected by means of interfaces that are standardized in order to allow multi-vendor interoperability. This allows network operators to work together when the network they have isn't enough for the level of use that their users demand.

The Architecture of the core network isn't static at all. In fact, network operators may choose, in their physical implementations, to split or merge these logical network elements depending on commercial considerations. (Alcatel-Lucent, 2009)

In the Figure 5 one can see the functional split between the EPC and E-UTRAN. More details from both the Core network, also known as EPC (Evolved Packet Core) and the access network (E-UTRAN) can be found below.
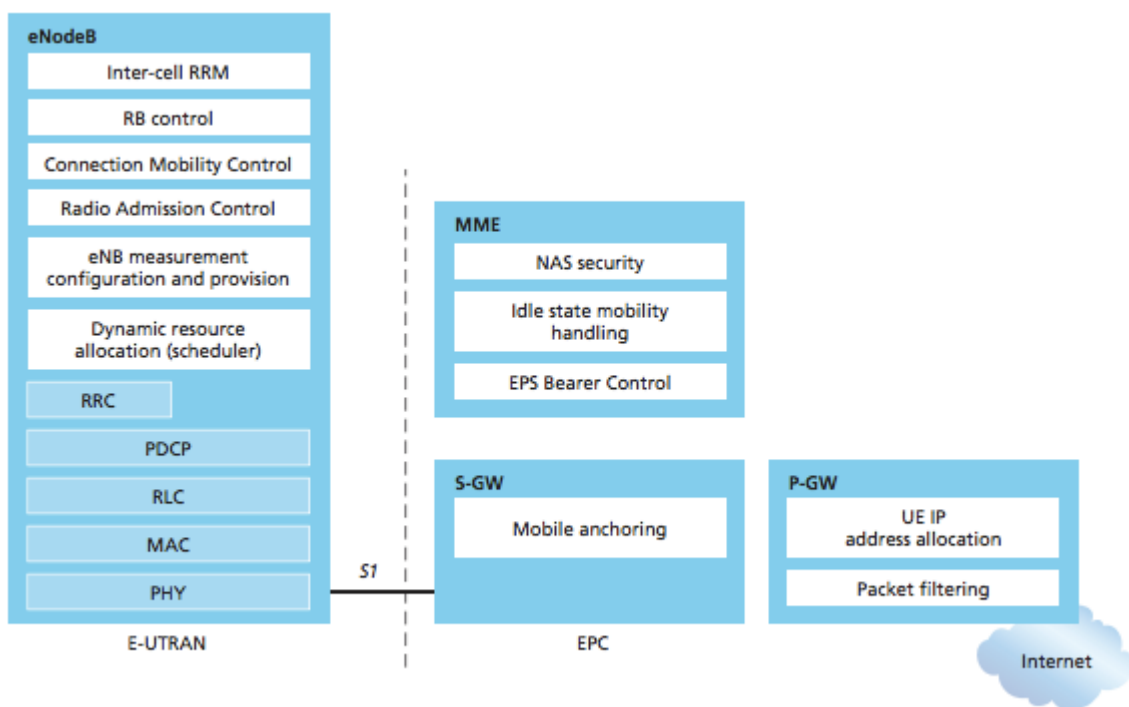
Figure 21: Functional split between E-UTRAN and EPC (Alcatel-Lucent, 2009)

4.2.5.3.1   The core Network

The core network or EPC has three main logical nodes and several others such as the Home Subscriber Server (HSS) and the Policy Control and Charging Rules Function (PCRF). The Main logical nodes are:

- PDN Gateway (P-GW) - The PDN Gateway has the responsibility of IP address allocation for the users, as well as enforcing the QoS necessary, according to rules from the PCRF. The P-GW also enforces the guaranteed bit rate (GBR) bearers and serves as the mobility anchor for the users to interwork with non-3GPP technologies such as CDMA2000 and WiMAX® networks.

- Serving Gateway (S-GW) - The Serving Gateway, also serves as a mobility anchor, but unlike the P-GW, it is between LTE antennas, that can also be called eNodeBs. All the

packets pass through this gateway and it can also be used to retain the information about the bearers, when the devices are in the idle state. The way it does this, is by temporarily buffering downlink data, while the MME, which will be discussed later on, initiates paging of the user device to re-establish the bearers. The S-GW also has as a task to perform some administrative functions in the visited network, such as collecting information for charging.

- Mobility Management Entity (MME) - The Mobility Management Entity (MME) is the control node that processes information between the devices from the users and the core network. The protocols used in the connection between the devices from the users and the core network are known as the Non Access Stratum (NAS) protocols.

As explained before there are other nodes but these three are the most prominent ones. (Alcatel-Lucent, 2009)

4.2.5.3.2 The Access Network

The access network of the LTE standard, also called E-UTRAN, is, in a nutshell, a network of eNodeBs, as illustrated in Figure 6. As opposed to other technologies, like broadcasting in analogue TV or DTV, there is no controller in E-UTRAN; hence the E-UTRAN architecture is said to be completely flat. (Alcatel-Lucent, 2009)
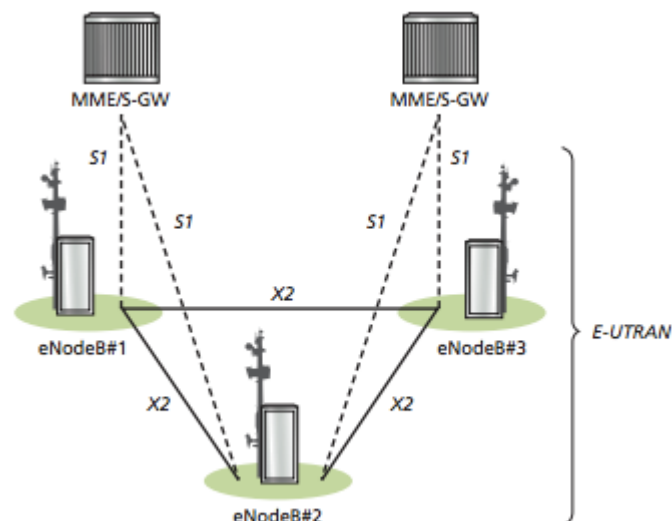
Figure 22: Overall E-UTRAN architecture (Alcatel-Lucent, 2009)

As can be seen in figure 6 the nodes are normally interconnected with an interface called "X2" and to the core network (EPC) with an interface called S1 interface — more

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specifically, to the MME by means of the S1-MME interface and to the S-GW by means of the S1-U interface.

The lack of centralization comes with some cost. As the user device moves in the network, all the information related to the user must be from node to node, together with all stored (buffered) data that the user has in the network. Therefore it is very important to avoid data loss during handover of the users from one node to the other. (Alcatel-Lucent, 2009)

4.2.5.3.3   LTE Roaming Architecture

LTE, like GSM, also took great interest in the roaming aspect. The European single market and the travelling trend in general, has always been an aspect that interested 3GPP, so the architecture to achieve that is also presented in this document.

Roaming is described as the process when users, because of their location, are allowed to connect to a public land mobile network (PLMN) operated by an operator, other than the one to which they are directly subscribed to. It is a powerful feature for mobile networks, and LTE/SAE is no exception.

A roaming user is connected to the Access network MME and S-GW of the visited LTE network. LTE gives the option for the operator to choose which P-GW will be in usage, as shown in Figure 5. This way the user can access the home operator's services even while in a visited network. (Alcatel-Lucent, 2009)
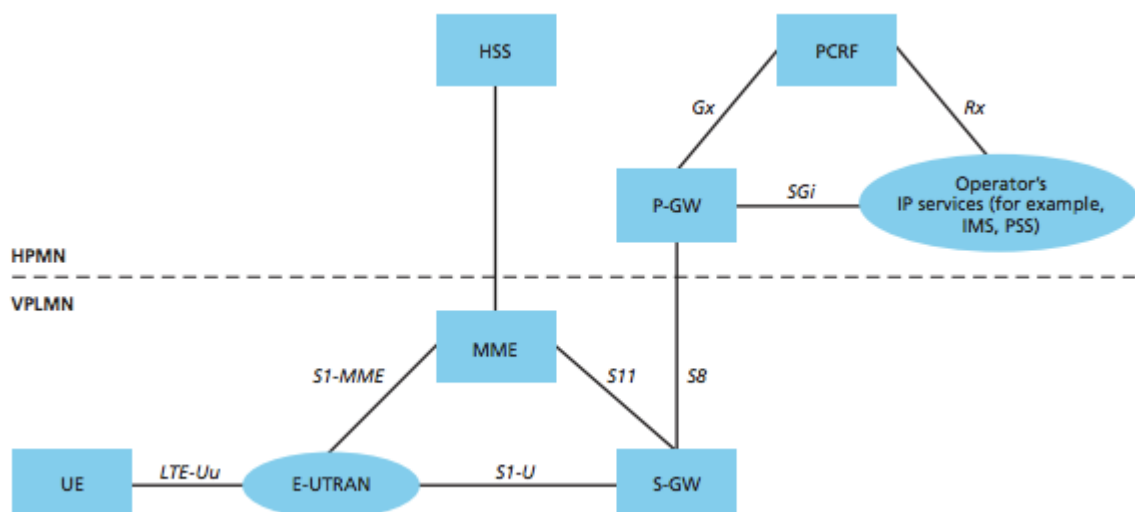
Figure 23: Roaming architecture for 3GPP accesses with P-GW in home network (Alcatel-Lucent, 2009)

4.2.5.3.4   Internetworking with other Networks

The LTE network also had the goal to work with other technologies, like Global System for Mobile Communications (GSM) already explained in this chapter, but also with others like UMTS, CDMA2000 and WiMAX.

So interworking received a lot of focus from the standardizing committee. The architecture for interworking with 2G and 3G GPRS/UMTS networks is shown in Figure 6 below. (Alcatel-Lucent, 2009)
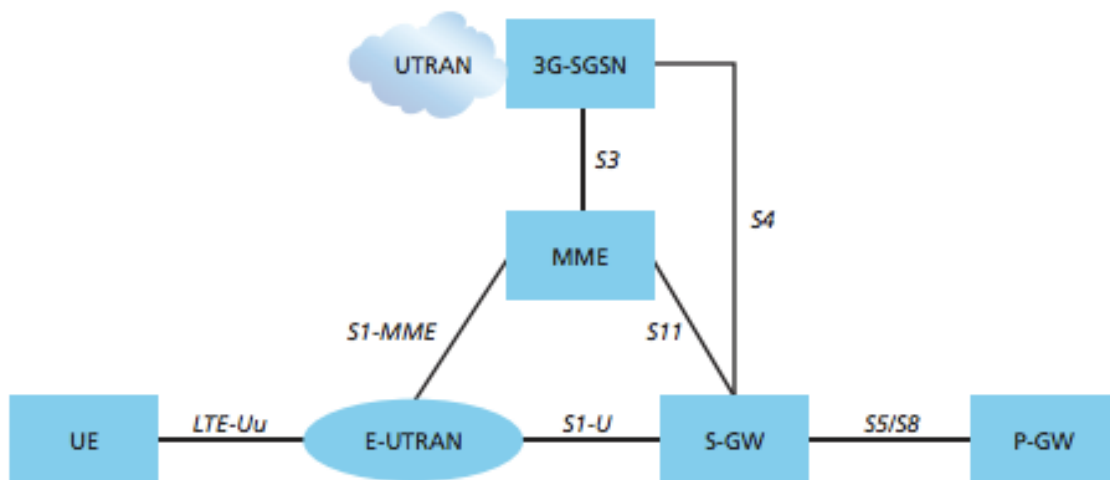
Figure 24: Architecture for 3G UMTS interworking (Alcatel-Lucent, 2009)

Just like in the case of moving from a node to another, in this case S-GW also acts as the mobility anchor for interworking with other 3GPP technologies, while the P-GW has the job to be an anchor that allows seamless mobility to non-3GPP networks such as CDMA2000 or WiMAX.

(Alcatel-Lucent, 2009)

4.2.5.3.5   Protocol Architecture

When discussing the protocol architecture of E-UTRAN, it is important to divide it into two planes, the user plane and the control plane.

User Plane

From the point of view of the user, there are four different sets of protocols that are used. The Port Gateway (P-GW) is the only one that the UE goes up to the IP level. As explained before, in the absence of any centralized controller node, data buffering during handover due

to user mobility in the E-UTRAN, must be performed in the antenna (eNodeB) itself. The PDCP layer has the responsibility of protecting the data during the handover. Every time that the date is transferred from one antenna to another, the RLC and MAC layers start fresh. (Alcatel-Lucent, 2009)
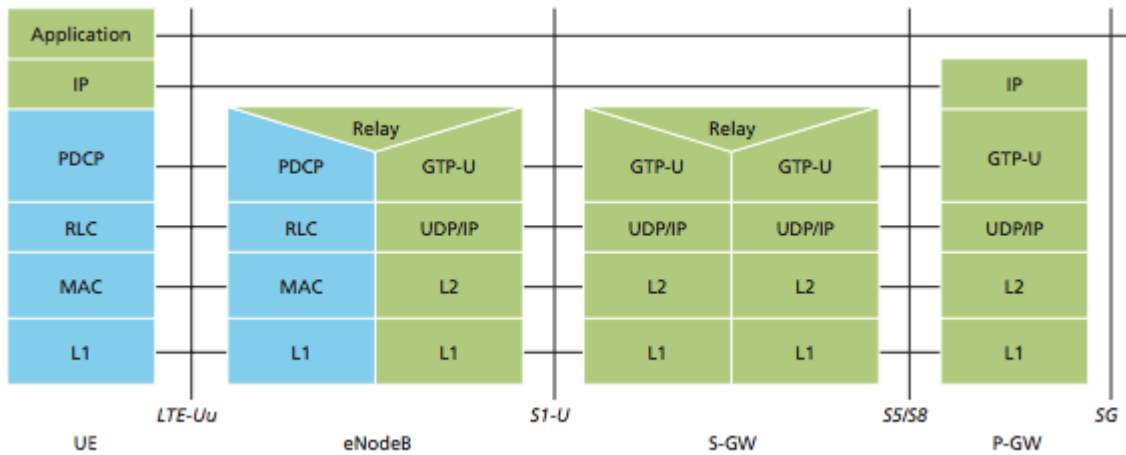
Figure 25: The E-UTRAN user plane protocol stack (Alcatel-Lucent, 2009)

Control Plane

The Control Plane protocol stack has the task of helping the communication UEs and the Mobility Management Entity (MME). This protocol interrelation is represented in the in Figure 8. The blue area are the access Stratum (AS) protocols.
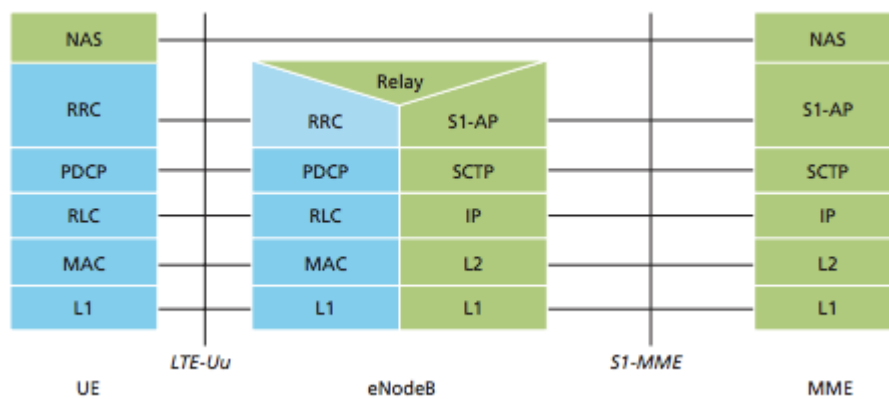
Figure 26: Control plane protocol stack (Alcatel-Lucent, 2009)

4.2.5.3.6   LTE Advanced vs LTE

The main difference from LTE advanced from its older counterpart is that it achieves higher speeds, up to three times faster than LTE. For some people LTE Advanced is a 4G technology, for others it is super 3G and some commercial users might call it 5G although its speed is only what should be called 4G[55].

The theoretical speeds from Mobile Standards aren't always followed by the carriers but the download speeds should be as follows:

- Basic GSM (2G) – 14.4Kbps

- GPRS (2G) - 48Kbps

- EDGE (2G) - 236Kbps

- UMTS (3G / IMT-2000) - 384Kbps [64Kbps upstream]

- HSPA (3G / IMT-2000) - 14.4Mbps [5.8Mbps upload]

- HSPA+ (3G / IMT-2000) - 84Mbps [22Mbps upload]

- WiMAX 802.16e (3G / IMT-2000) - 128Mbps [56Mbps upload]

- LTE (3G / IMT-2000) - 100Mbps [50Mbps upload]

- WiMAX2 802.16m (4G / IMT-Advanced) - 1Gbps

- LTE-Advanced (4G / IMT-Advanced) - 1Gbps

- 5G - 10Gbps

This list allows us to understand the evolution of the standards and the speeds that the different technologies theoretically allow their users to reach[56].

In terms of technology the main evolution from LTE to LTE advanced was Carrier Aggregation (CA), enhanced use of multi-antenna techniques and support for Relay Nodes (RN) the detailed description of which are out of scope for this project[57].

LTE has very high potential and is being deployed worldwide nowadays, providing high performance and speeds. That does not mean that there are no technical challenges as with any technology. Ajay Joseph, CTO of wholesale services provider iBasis, a KPN company, noted, at the LTE World Summit in Amsterdam in 2013, that the use of LTE exclusively as the technology for wireless connectivity is impossible as the radio spectrum is limited and

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[55] http://www.techhive.com/article/2083981/faq-how-is-lte-advanced-different-from-regular-lte.html
[56] http://www.ispreview.co.uk/broadband_mobile.php
[57] http://www.3gpp.org/technologies/keywords-acronyms/97-lte-advanced

complementary technologies like WiFi need to be used to offload traffic from the LTE network[58].

4.2.5.4   Voice over LTE (VoLTE)

When we are referring to VoIP technologies we refer to any technology that uses the IP protocol to pass on voice data from one end to the other, regardless of the type of network being used, fixed or wireless. Up until LTE was introduced by 3GPP, both fixed and mobile networks offered voice services based on a Circuit Switched (CS) system, supplemented by a Packet Switched (PS) system for data services. This changed when LTE came along. LTE and the EPC (together called All-IP Evolved Packet System) do not inherently support CS functions, which means that they can be called an All-IP technology. This implied that traditional CS telephony has to be migrated to a PS system in order to provide voice telephony services, called Voice over LTE or VoLTE, (Husain S. S. et al. 2012).

With a speed of 64,000 bits per second, the audio signal's quality in landline networks could not be reached by previous mobile 2G or 3G technologies' CS telephony services, since digital compression degraded the voice signal in an attempt to manage the radio spectrum efficiently. Migrating voice to IP wouldn't be a good option since the previous generations of mobile networks' capacity was not reliable enough to transfer quality audio signals, especially when taking into account the sensitivity of voice services.

VoLTE came to change that. Its capacity, achieved through better use of the radio spectrum and many new techniques, is adequate to turn the audio signal into packets that are transmitted over a 4G network treating it just as it does with data. Traditional telephony uses an audio bandwidth of 300-3,400 Hz, while VoLTE can offer a service called HD voice using a 50-70,000 Hz audio bandwidth, exceeding that of traditional telephony networks[59].

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[58] http://Telecoms.com/155772/roaming-comes-to-forefront-of-lte-carrier-community/
[59] http://spectrum.ieee.org/Telecom/internet/net-neutralitys-technical-troubles/?utm_source=techalert&utm_medium=email&utm_campaign=021915
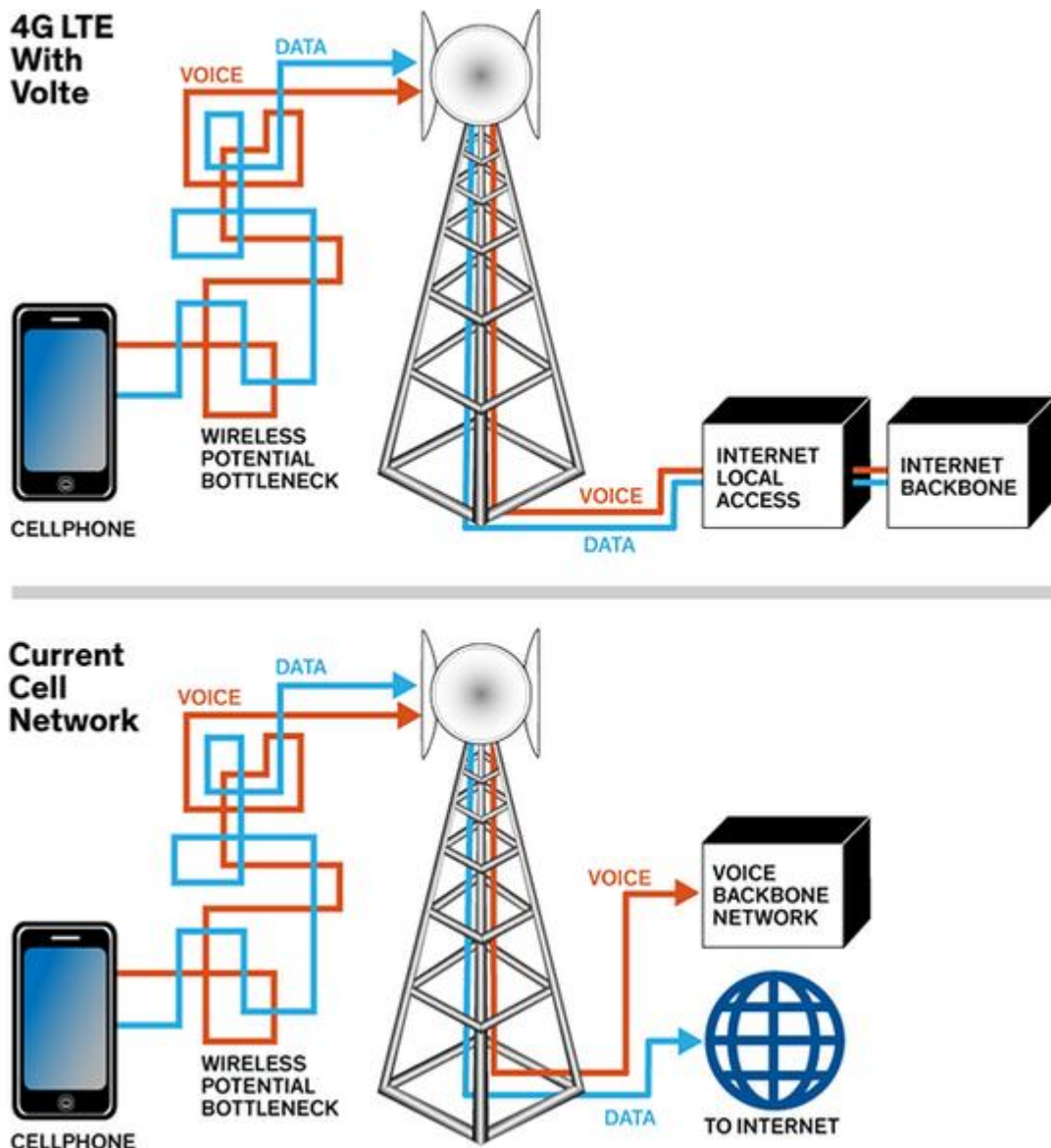
Figure 27: VoLTE vs. Current Cell Network voice and data backbone connection.[60]

With a capacity for voice and data of up to three times more than the 3G UMTS network, VoLTE allows for high-quality IP communications that were previously not attainable, especially on mobile networks. But capacity even on an LTE network is not unlimited so in order to manage the IP traffic on the VoLTE network, the protocol marks each packet with a code that indicates how time-sensitive the data in the packet is. This means that applications such as real-time gaming, conferencing and video-call services have higher priority codes than streaming video services, for example that are not as time-sensitive. The next table shows the priority codes built in the VoLTE protocol.

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[60] http://spectrum.ieee.org/Telecom/internet/net-neutralitys-technical-troubles/?utm_source=techalert&utm_medium=email&utm_campaign=021915

QCI	Resource Type	Priority	Packet Delay Budget	Packet Error Loss Rate	Example Services
1	GBR	2	100 ms	10^{-2}	Conversational Voice
2		4	150 ms	10^{-3}	Conversational Video (live streaming)
3		3	50 ms	10^{-3}	Real-Time Gaming
4		5	300 ms	10^{-6}	Non-Conversational Video (buffered streaming)
5	Non-GBR	1	100 ms	10^{-6}	IMS Signaling
6		6	300 ms	10^{-6}	• Video (Buffered Streaming) • TCP-based (e.g., web, e-mail, chat, FTP, point-to-point file sharing, progressive video, etc.)
7		7	100 ms	10^{-3}	• Voice • Video (Live Streaming) • Interactive Gaming
8		8	300 ms	10^{-6}	• Video (Buffered Streaming) • TCP-based (e.g., web, e-mail, chat, FTP, point-to-point file sharing, progressive video, etc.)
9		9			

Figure 28: VoLTE priority codes[61]

VoLTE presents increased potential for the replacement of wire-line telephony as it allows wireless networks to carry a significantly higher amount of traffic than their predecessors, due to techniques like the above mentioned priority coding. On the other hand, this opens up net neutrality related discussions that could in fact create a problem for technologies that use techniques like these, as discussed in several of the interviews for this project that will be analysed later. PhD fellow Roslyn Layton also brought the example of 5G networks which also use such prioritization and if not classified as exceptions, might create conflicts with net neutrality regulations, if and when applied (Layton, R., personal communication, March 13, 2015).

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[61] http://spectrum.ieee.org/Telecom/internet/net-neutralitys-technical-troubles/?utm_source=techalert&utm_medium=email&utm_campaign=021915

5 FINDINGS

5.1 MARKET SURVEY

The market survey, as explained before, will give more details about the European Market for Telecoms and OTTs. In the case of Telecoms there will be an overview of the Top-10 largest European Telecom companies and the same process is followed for the OTTs. In case of OTTs though, there will be a listing of the TOP-10 for voice and SMS, as this is the market of focus for this project.

The metrics used in the Telecom case will be the number of users and revenue. In the case of Telecoms they will be ranked according to their revenue and in the case of OTTs on the number of users. The choice of these metrics for ranking is due to the fact that in the case of OTTs the fixed costs are normally very low and so they compete for number of users, expecting to turn them into revenue one day. Telecoms on the other hand, due to costs for installing and maintaining the network infrastructure, find it necessary to create the needed revenue streams to keep the machine alive and profitable.

To finalize the market survey chapter, the authors will take a look into the partnerships that are shaping the relations between the Telecoms and OTTs today.

5.1.1 Telecom Market

The Telecom market in the European Union has a very wide variety of different players, some of them covering only one market, others covering several ones. Nevertheless, this wide variety pales in comparison with the number of their OTT counterparts that will be discussed further in the chapter.

For the purpose of this thesis, it was deemed necessary to look into the ten most important operators from the European Union because it is them that in the case of the creation of a single market will most likely thrive in the new common market settings. This doesn't mean the other players will be left out of the game before it begins, but the ones discussed will have the size and scale, which in return means the resources demanded, to make a European-wide strategy for communications.

And the very high barriers of entrance in this market, besides the necessity of acquiring the license to operate a communications network, is discouraging for new players.

Table 1: Telecom companies operating in Europe (ranking based on revenue)

Company	Country	Revenue	Users
Deutsche Telekom	Germany	62.7 Thousand Millions (2014)[62]	197 Million (2014)[63]
Vodafone	United Kingdom	60.88 Thousand Millions (2014)[64]	449 Million (2014)[65]
Telefónica	Spain	50.37 Thousand Millions (2014)[66]	341 Million (2014)[67]
Orange	France	39.4 Thousand Millions (2014)[68]	244 Million (2014)[69]
BT	United Kingdom	25.53 Thousand Millions (2014)[70]	No data
Telecom Italia	Italy	21.57 Thousand Millions (2014)[71]	118 million (2014)[72]
Telenor	Norway	12.31 Thousand Millions (2013)[73]	186 Million (2014)[74]
SFR	France	11.43 Thousand Millions (2014)	22.94 millions (2014)[75]
TeliaSonera	Sweden	10.77 Thousand Millions (2014)[76]	72.8 million (2014)[77]
KPN	Netherlands	8.08 Thousand Millions (2014)	33 million (mobile, 2014)[78]

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[62] http://www.annualreport.telekom.com/site0215/en/files/pdfs/telekom_ar14_complete.pdf

[63] http://www.annualreport.telekom.com/site0215/en/files/pdfs/telekom_ar14_key_facts.pdf

[64] http://www.vodafone.com/content/annualreport/annual_report14/downloads/full_annual_report_2014.pdf

[65] http://www.vodafone.com/content/dam/vodafone/investors/factsheet/factsheet_sept_2014_updated.pdf

[66] http://www.telefonica.com/en/shareholders
investors/pdf/20150227_Consolidated_Financial_Statements_Telefonica_2014.pdf

[67] http://www.telefonica.com/en/about_telefonica/html/in_brief/magnitudes.shtml

[68] http://ra2014.orange.com/en/#slideHeader/

[69] http://www.orange-business.com/en/facts-figures

[70] http://www.btplc.com/Sharesandperformance/Annualreportandreview/pdf/2014_BT_Annual_Report.pdf

[71] http://www.Telecomitalia.com/tit/en/archivio/media/comunicati-stampa/Telecom-
italia/corporate/economico-finanziario/2015/preliminary-results-31december2014-approved.html

[72] http://www.Telecomitalia.com/tit/en/company-profile/2014/Telecom-italia-at-a-glance.html

[73] http://www.telenor.com/wp-content/uploads/2014/04/Telenor-Group-Annual-Report-2013.pdf

[74] http://www.telenor.com/about-us/telenor-at-a-glance/

[75] http://numericable-sfr.com/sites/default/files/Finance/Publications-resultats/pr-results-2014-150305.pdf

[76] http://feed.ne.cision.com/wpyfs/00/00/00/00/00/2C/00/91/wkr0006.pdf

[77] http://www.teliasonera.com/en/about-us/teliasonera-in-brief/

[78] http://corporate.kpn.com/annual-report-2014/downloads.htm

The table shows that the metrics for number of users and revenue are not correlated which makes one conclude that the way the number of users is measured is not always the same. This can be attributed mainly due to two different reasons. First some companies have joint ventures in other markets and don't own 100% of the foreign companies they own a part of but they still include all the users from that foreign company. Second, some markets are much stronger revenue-wise than others, due to the quality of service provided and also the buying power of the population that their users are a part of.

The above list changes every year as Telecom revenues continue their decline ever since they started to decrease in 2009 as reported be ETNO (ETNO, 2015) and is shown in the following figure. On a positive note while this decline was growing more negative until 2013 reaching -4%, in 2014 there was a total decrease of -1.8%. More specifically, in the Telecom sector all over Europe, traditional fixed lines keep decreasing as broadband is gaining ground, with fixed broadband being the only service presenting positive growth the last years. Mobile broadband despite becoming more and more popular is not enough to counteract the falling revenues in mobile but it has managed to improve the negative growth to -1.8% in 2014, compared to the -4.5% observed in 2013 (ETNO, 2015).

The European Telecom sector is left behind, in growth terms, compared to the U.S. and Japan, with the U.S being the only one having a positive growth rate (although steadily declining) in 2013 and 2014, reaching 2.4% and 1.8% respectively. Similarly investments in the European Telecom sector are declining, while in the U.S. and Japan investment is growing. In general the leading sector currently in Europe is mobile, which keeps growing in popularity reaching 794 million subscribers in 2014 (ETNO, 2015).

Telecom service revenues in Europe
(incl. Turkey, excl. Georgia, Russia, Ukraine, EUR bn) *

+ 1.1% - 2.5% - 1.0% - 1.6% - 3.1% - 4.0% - 1.8%

Data & Internet   Mobile services   Fixed telephony
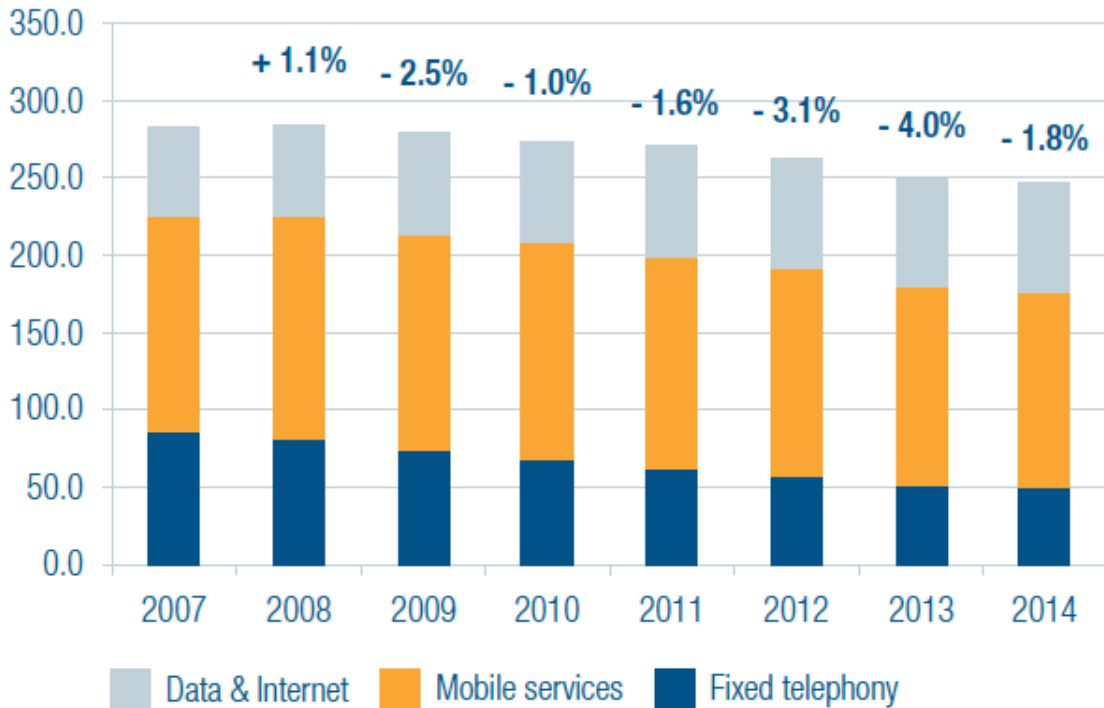
Figure 29: Telecom Revenues in Europe 2008-2014 (ETNO, 2015)

OTT vs. telecom revenue growth (EU-28, %) *

Telecom   OTT
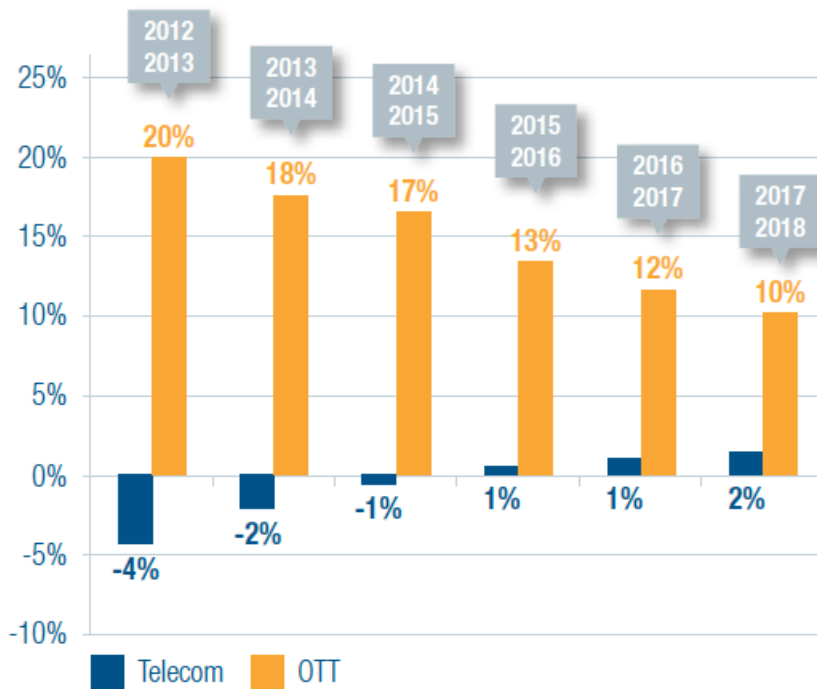
Figure 30: OTT vs. Telecom revenue growth (ETNO, 2015)

91

In the figure above, the growth of the OTT sector is increasing at high rates, although the rate of growth is gradually declining every year and it is expected to keep doing so in the following years. But for Telecoms, although the number of broadband subscriptions is growing, Average Revenue Per User (ARPU) is declining so operators earn less per year. This is due to price competition as well as the substitution of traditional Telecom services with OTT services and regulation related to termination fees and roaming charges (ETNO, 2015).

5.1.2 OTT Market

The OTT market is completely different from the Telecom market. It can literally start in a garage and end up valued at millions of euros. The very low barriers of entrance allow for the possibility of a very fast change of landscape in this market, but for the most part the companies that reach the top tend to stay there. In most cases in such a market, developments lead to a winner-take-all scenario.

As mentioned in the beginning of this market survey OTT's can be divided in three different types (media, cloud services and voice and message) but due to the scope of the project this market survey will be limited to the messaging and voice OTT providers.

Table 2: OTT companies operating in Europe (ranking based on number of users)

Company	Country	Number of Users	Revenue
Facebook	Menlo Park, (USA)	1320 million[79]	3543 million $ (Q1-2015)[80]
WhatsApp	San Francisco-(USA)	600 million[81]	15 million $ (Q2-2014)[81] (Facebook)
Viber	Las Vegas (USA)/Cyprus	400 million[82]	Rakuten
Google+ & Hangout	Mountain View (USA)	359 million (1.15 B Registered)[83]	Google
Skype	Luxemburg	300 million[84]	Microsoft
Twitter	San Francisco, (USA)	284 million[85]	479 million $ (Q4-2014)[86]
Line	Japan	205 million[87]	JPY 28.1 Billion (Q1-2015)[87]
Instagram	San Francisco, (USA)	200 million[88]	Facebook
Tumblr	NYC (USA)	199 million[89]	Yahoo
Snapchat	Venice, (USA)	100 million[90]	Non-disclosed

The size of the revenues of many of these companies is hard to discover due to the fact that many of them are owned by larger corporations, such as Google or Microsoft, and the revenues are not reported separately, but as part of the revenues for the corporation in

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[79] http://www.dailymail.co.uk/sciencetech/article-2703440/Theres-no-escape-Facebook-set-record-stock-high-results-beats-expectations-1-32-BILLION-users-30-mobile.html
[80] http://investor.fb.com/results.cfm
[81] http://www.forbes.com/sites/parmyolson/2014/08/25/whatsapp-hits-600-million-active-users-founder-says/
[82] http://www.viber.com/about
[83] https://econsultancy.com/blog/64319-google-just-35-of-users-are-active/
[84] http://www.skype.com/en/about/
[85] https://about.twitter.com/company
[86] https://investor.twitterinc.com/releasedetail.cfm?releaseid=894844
[87] http://linecorp.com/en/pr/news/en/2015/988
[88] http://instagram.com/about/us/
[89] http://expandedramblings.com/index.php/tumblr-user-stats-fact/
[90] http://mashable.com/2014/08/26/snapchat-10-billion-valuation/

total. What is indeed interesting to look at regarding OTT providers is the number of the users they have, as this is a good measure that indicates how quickly this trend grows globally and how popular such OTT services have become. The above numbers mentioned in the table are the total number of users for these providers globally but all of these OTT companies operate in Europe as well, with great success and they are mentioned by different Telecom providers as one of the reasons for the decline in voice and SMS figures of Telecom operators.

Regarding the issue of substitution of traditional Telecom services by OTT services, in an interview with the Greek Telecom Operator OTE and their Markets Regulatory Strategy Division analyst Mr. George Karageorgos it is mentioned that "*some things, like recent decreases in international voice calls or messaging services can be also attributed to the growing number of OTTs like the ones that you mention*" [WhatsApp, Skype] (Karageorgos, G., personal communication, February 3, 2015).

Similar comments were received from KPN's senior regulatory counsel Paul Knol who confirms a significant decline in the number of SMSs and the growing popularity of services such as WhatsApp, which in the Netherlands is overtaking the Telecom operators' SMS services. He also comments on voice traffic noticing its decline in the Netherlands, but it is not easy to distinguish whether this decline is caused by VoIP services or by the substitution of voice services with other types of communication such as messaging services, for example Facebook (Knol, P., personal communication, March 20, 2015).

What is undisputed is the fact that all these services are growing fast in terms of the number of users, SMS sent and voice minutes used. Much of this doesn't lead directly to revenue so some of these companies make money with alternative ways such as direct ads, games and other sources. This is reflected in the following figures from ETNO's annual report for 2014.
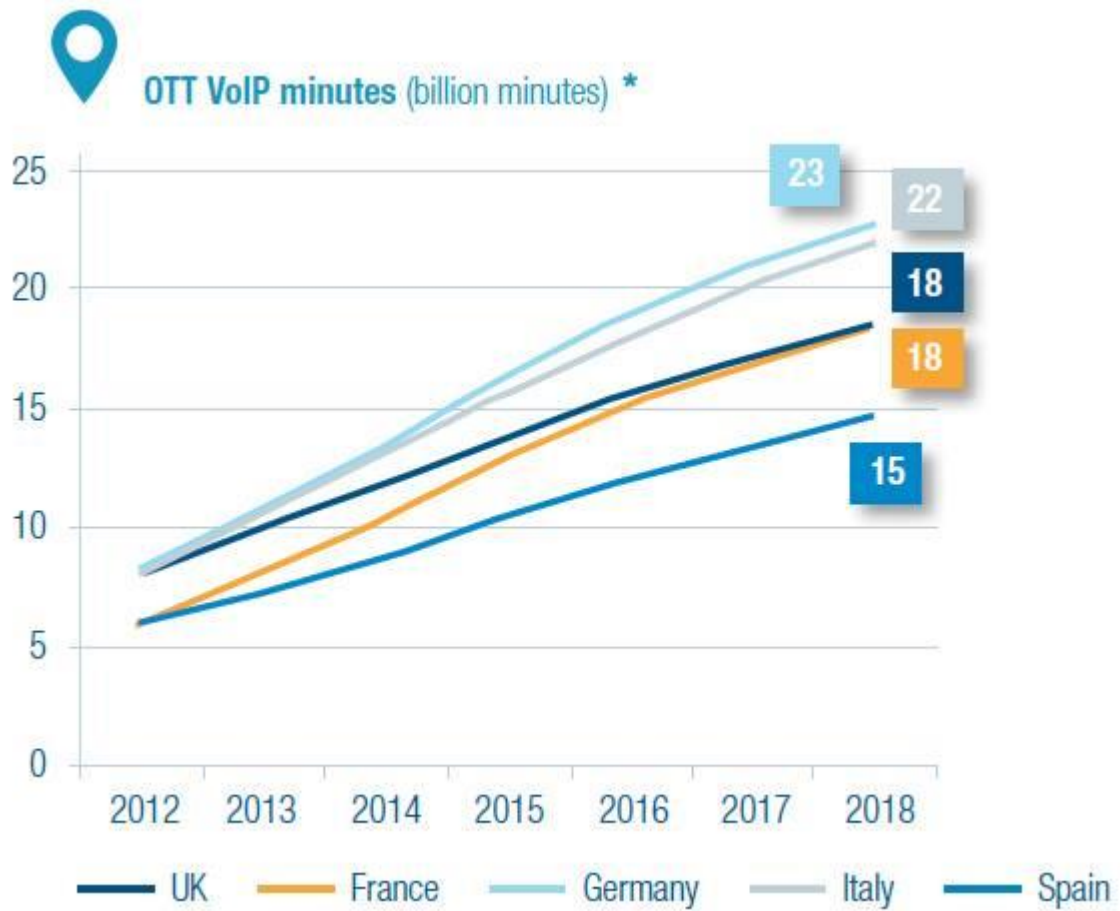
Figure 31: OTT VoIP minutes (in billions) (ETNO, 2015)

In the above figure it is clear that the usage of OTT VoIP services in the biggest markets of Europe, with Germany leading the way, hasn't stopped growing since 2012 and the trend is predicted to continue at the same rate in the future.
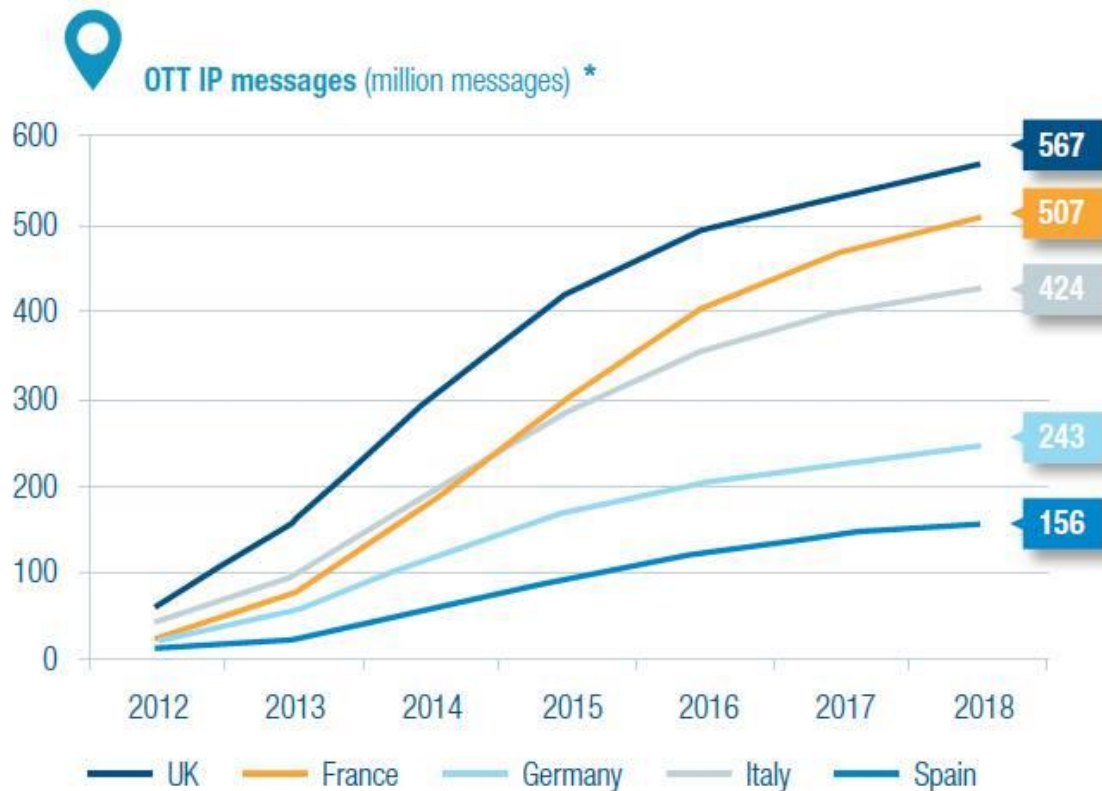
Figure 32: OTT IP messages (in millions) (ETNO, 2015)

The same applies to OTT messages where the trend is similar but the rate of growth seems to be decreasing. In the OTT voice and SMS market there are many small players around the world, but this is a market clearly dominated by Facebook having three different services in the top10. In terms of volume of OTT messages, the leader seems to be the UK in this case, followed closely by France and Italy.

The Telecom-OTT dynamic is a very important relationship for the Telecom market. This market survey is used to show the sizes on both sides that mark a new era in the field of communications where Telecom giants are facing direct competition from companies that started from being small startups and very few resources to having millions of users around the world. This development is an indication of how innovation can bring about important changes even in such a large market as the Telecom market.

5.1.3 OTT & Telecom Partnerships

When we talk about OTT and Telecom partnerships in many cases we are talking about the video and sound sector because these type of services are the ones generally heavier on the network. Because of this reason it is easier for network providers to explain the reason why they need to form special partnerships with content providers so that their users have good access the content that the OTT companies want to provide.

But on the business strategy side, media is equally important to the voice and SMS OTT companies because, although the former cost more resources on the networks, the latter target one of the Telecoms' main sources of income, the SMS and voice communication. According to London-based research and analytics firm Ovum, Telecom operators all over the world are losing hundreds of thousand million dollars because of services like Skype, Viber, WhatsApp and others. Between 2012 and 2018 they predict that Telecoms will lose approximately 386 thousand million dollars, although predictions are often miscalculated. It is important to denote the size of the numbers that the Telecom companies are potentially dealing with[91].

To fight this reality and get some of the lost revenues back, Telecoms are partnering together with OTTs and there are many examples of such partnerships all over the world. In this chapter a few of them will be mentioned. One company that has been putting a lot of effort in forming partnerships with Telecoms is Spotify. Several Telecom companies in Europe are giving their users the option to add a Spotify to their subscription. Deutsche Telekom for example offers the option to have online and offline versions of Spotify. These kind of partnerships are a simple way for Telecoms to capitalize on the OTT market[92].

Other companies in Europe, including Telia (Telia Sweden, Telia Denmark, Sonera in Finland, and NetCom and Chess in Norway), Virgin Media (the UK), KPN (Netherlands and Belgium), Orange (Switzerland) and Telefónica (Movistar) and Yoigo in Spain also have high profile Telecom partnerships with Spotify[93].

These partnerships are more common in the media sector. Besides Spotify, other companies like Netflix also formed some partnerships with Telecoms to further expand their

[91] http://fortune.com/2014/06/23/Telecom-companies-count-386-billion-in-lost-revenue-to-skype-whatsapp-others/

[92] http://www.telekom.com/media/company/151940

[93] http://www.hypebot.com/hypebot/2013/03/spotify-latest-mobile-partner-spains-telefonica-.html

business strategies. On the SMS and voice world, although less common, it is also possible to find some partnerships.

Skype for example in 2010 made a partnership with Verizon allowing the users of Verizon to make unlimited free calls to Skype users worldwide and Skype Out at the usual rates. This helped force AT&T to allow Skype to be used in their 3G networks[94]. It is very hard for small OTT companies to partner with large Telecom providers. When they grow and gain critical mass it gets easier to draw the Telecom providers' attention but sometimes these partnerships can be the enablers of growth for OTT companies.

In addition, there are some companies that are trying to make a business out of building bridges between Telecoms and OTTs; Asia Info is one of them. With their Veris o2p platform they plan to help both OTT and Telecoms to partner up and in their words "OTTs also represent a tremendous opportunity for operators to unlock more value from their assets" and in exchange "Operators possess what many OTT players need: established customer and billing relationships, comprehensive customer behavioural data and advanced, reliable business and operations support systems"[95].

Although there are many forces trying to converge, there is a major obstacle regarding OTT and Telecom partnerships, the radical interpretation of what net neutrality means.

As mentioned in an interview with the Netherlands-based organization Bits of Freedom and their researcher Floris Kreiken, in terms of regulation, the idea of the OTT and Telecom partnerships is a little controversial because in many cases it involves zero-rating and that is against what some defenders of net neutrality define as net neutrality (Kreiken, F., personal communication, March 31, 2015). The issue of partnerships and zero-rating is very central in the net neutrality debate all over Europe and will be analysed further in chapter 6.

On the other side of the spectrum, authors like Christopher S. Yoo would rather see the internet being organized in a different way and he mentions the vertical integration which in his opinion could solve some of the network problems by charging users correctly according to their traffic (Yoo, C. S., 2005; pp.13-16).

The developments in the Telecom market could not evolve uncontrollably in a time when the Telecom scenery is forcing Telecom operators to change their business models and strategies and this is where the role of regulatory developments, whether at EU level or

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[94] http://www.Telecomasia.net/content/verizon-partners-skype-mobile-voip
[95] http://www.asiainfo.com/ProductsSolutions/VerisO2P/Introduction.aspx

national, come into play. Coinciding with the attempt for a creation of a Telecoms Single Market in the EU, the ongoing net neutrality discussion and roaming charges rules imposed are at the epicenter of attention. In order to get a deeper understanding into these two issues, the next two subchapters are dedicated to two case studies regarding net neutrality in the Netherlands and the other on the roaming market in Spain, that will help consolidate the knowledge and data gathered from the research for this project.

5.2 CASE STUDIES

Case studies are a great way of describing complex problems and help understand them. There are multiple definitions and opinions of what constitutes a case study. But one of the most widely accepted one was given in 1990 from Bromley in his paper about "Academic contributions to psychological counselling" where he describes a case study as a "systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest" (Bromley, D. B.,1990) . Another popular author in this field is Yin, who defines the case study research method as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context" (Yin, R. K., 1984).

During this paper and together with the help of several interviews conducted, it is indicated that the cases of net neutrality abuses are rare in today's Europe, even without specific legislation in this regard in most countries. In an interview with the Portuguese Telecom Regulator ANACOM and principal consultant Dr. Carlos Costa the example of net neutrality cases being extremely rare was given, like an endangered species that no one sees but somehow is there (Costa, C., personal communication, February 3, 2015).

Nevertheless the strong position in which Telecom operators and ISPs are in, meaning their control over the communication networks, as infrastructure owners, and taking into consideration their market power and the fact that until a few years ago they consisted national monopolies in many European countries, the net neutrality debate is of increasing significance for European Telecommunications, especially now that they are competing directly with OTT providers in several areas, creating a conflict of interest, and regulators have an important role to play.

Our choice for the net neutrality case was the Netherlands, as at the moment, in Europe, it seems to be the hot spot of contention for the pro and anti-net neutrality sides. In this case study the data collected from the different interviews such as net neutrality lobbying organizations, Telecoms, net neutrality experts and government officials will be put together to describe the process that created the law in the Netherlands, the law in itself, the infringements of the law that were registered so far, as well as some of the implications of the existence of a law like that in the Netherlands. For this case study there were four interviews conducted with the parties that played a significant role in the Netherlands for the law to be passed. The parties interviewed were the Dutch Ministry of Economic Affairs, KPN, the digital rights organization that lobbied for the law from the beginning of the net neutrality

discussion in the Netherlands called Bits of Freedom and finally a PhD candidate on the subject and consultant Roslyn Layton.

The second case study is related to the termination of roaming fees in Europe, which was recently pushed back to 2018 by the European Commission, because at this point this was still an undertaking that the EU wasn't ready for. For the roaming market the case chosen is the Spanish market and the reason was that going through the data and material gathered from the interviews and the literature, the authors came up with the realization that in the south of Europe, where tourism is more prominent, the termination of roaming fees could have a bigger impact on the revenues of Telecoms. The Spanish tourism industry is one of the leading industries in the world in this sector in the world receiving more than 60 million tourists every year and having a total revenue higher than 60 thousand million euros (UNWTO, 2014).

This case study will also include the impact of the substitution from roaming by OTT services and the wholesale market and try to give some light to access regulation that seems an area that incumbent Telecoms from each market are very interested in, based on the interviews with regulatory departments in companies like TDC in Denmark, Telefonica in Spain and OTE in Greece.

5.2.1   Net Neutrality - The Netherlands case study

5.2.1.1   Introduction

The Netherlands is a relatively small country, where there is high competition both in networks and Telecom services and where almost every home can choose to have access to the Internet between two different networks, either DSL or the cable provider (Knol, P., personal communication, March 20, 2015). In addition there are four different mobile networks consumers can choose from, as well as tens of virtual providers that share the infrastructure with them, paying wholesale fees (Layton, R., 2013)[96].

The net neutrality discussion started more than a decade ago in the U.S. and was "imported" shortly after in the E.U. and national governments, a few years after Tim Wu named net neutrality and raised the issues about the open internet (Wu, T. 2005). The

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[96] http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm

discussion in the Netherlands started not long before the law was passed in June 2011 by the Lower House of the Dutch Parliament.

The discussion in the Parliament was also supported by Bits of Freedom, a digital rights organization in the Netherlands[97] that advocated in favour of net neutrality since 2009, on the basis of the idea of a free and open internet where ISPs are not allowed to discriminate between traffic and content no matter where it originates from and ends at and where consumers are equally free to choose between all services available over the internet (Layton, R., 2013)[98]. As additionally stated by Floris Kreiken, a BoF researcher, they support that net neutrality allows for innovation from new entrants and smaller players in the market, which cannot be guaranteed by competition law (Layton, R., 2013), and that ISPs should compete on price and broadband speed (Kreiken, F., personal communication, March 31, 2015).

KPN announces use of DPI and surcharges on SMS OTT services

The Dutch net neutrality law came shortly after the debate had started and it was brought to the forefront of the political discussions by an announcement made by KPN's CEO on April 21st 2011. KPN's revenues were rapidly declining (Layton, R., 2013), especially in mobile, due to OTT services such as WhatsApp (Knol, P., personal communication, March 20, 2015) and KPN was considering using Deep Packet Inspection and exploring imposing additional charges for the use of such services, although according to KPN, there was no actual plan within the company to implement this (Knol, P., personal communication, March 20, 2015). The plan was approved by the Dutch Telecom Regulator, called OPTA at the time, as long as customers would be aware of these additional charges (Layton, R., 2013) (Layton, R., personal communication, March 13, 2015). This announcement, sparkled an even more intense debate on net neutrality.

The announcement caused the immediate reactions of politicians and net neutrality lobbying organizations like BoF that supported that KPN would start blocking and throttling traffic at the expense of consumer freedom of choice and innovation on the open internet, while the use of DPI was perceived as a violation of consumers' privacy rights (Layton, R., 2013).

The Net Neutrality decision

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[97] https://www.bof.nl
[98] https://www.bof.nl/live/wp-content/uploads/2010/01/netwerkneutraliteit-def.pdf

At that specific point in time the Telecommunications Act was being revised in order to include the newest European Directives on Telecommunications and so the group of parliamentarians that supported net neutrality, together with BoF, having already created a draft of the net neutrality law, and together with the occasion of the KPN announcement, found support in the Parliament and had the opportunity to include the net neutrality law in the Telecoms Act within a few weeks (Layton, R., 2013) (Knol, P., personal communication, March 20, 2015). On June 5th 2011 the Lower House of the Dutch Parliament passed the net neutrality law, which was later approved by the Upper House and put into effect on January 1st 2013.

5.2.1.2 Net Neutrality Law; Necessity or circumstance?

The two opposing sides on net neutrality in the Netherlands presented various and different arguments on why a net neutrality law was or wasn't necessary at that point in time.

The necessity of the law in the Netherlands cannot be proven based on hard facts and on the limited or almost non-existent studies on the subject before the law was passed. The Dutch broadband and Telecom market was a highly competitive well-functioning market with no recorded violations of consumers' privacy or blocking and throttling (Layton, R., 2013) (Knol, P., personal communication, March 20, 2015).

The move towards such regulation was considered by many circumstantial (due to KPN's announcement and the revision of the Telecom Act) (Knol, P., personal communication, March 20, 2015) and not entirely justifiable, based on the conditions in the Dutch market (Layton, R., personal communication, March 13, 2015). Even in the U.S. where there is much less competition, there were two or three cases of such practices that many support were still too few to create a need for net neutrality regulation (Layton, R., personal communication, March 13, 2015). In addition, there was no regulatory impact assessment in the Netherlands before the law was passed, a methodology that is used to explore what the implications of such regulation are in order to justify the decision to take such measures (Layton, R., personal communication, March 13, 2015).

In both interviews with PhD fellow Roslyn Layton and KPN it was also supported that blocking or throttling certain services would not be a clever approach on behalf of Telecoms in the Netherlands because in a competitive market like this a dissatisfied customer from the services of an ISP would switch to another competitor's services if they experienced slow

service and applications on their current subscription (Layton, R., personal communication, March 13, 2015) (Knol, P., personal communication, March 20, 2015).

Another issue named by both KPN and Roslyn Layton is the extensive regulation on Telecom companies while OTT companies like Google, whose mode of operation and the way they treat traffic has similar characteristics as those of Telecoms, are slightly or not at all regulated (Knol, P., personal communication, March 20, 2015) (Layton, R., personal communication, March 13, 2015). The argument was extended to the fact that in essence, there already are fast and slow lanes, when it comes to CDNs (Content Delivery Networks) and services that need special treatment to function, such as credit card services (Layton, R., personal communication, March 13, 2015).

The issue of extensive regulation on Telecoms is not only a Dutch issue. It is a general trend that cause the Telecom world and many others to talk about over-regulated Telecom companies while OTTs are free to manage data, pay few taxes and operate freely on the networks (Layton, R., personal communication, March 13, 2015) (Knol, P., personal communication, March 20, 2015). Nevertheless the solution could lie in, not necessarily imposing more regulation on OTTs, but on removing regulation from Telecoms (Herrera-Gonzalez, F., 2014) (Layton, R., personal communication, March 13, 2015) and make sure that the regulations applied are at least technology neutral and at a higher level (Knol, P., personal communication, March 20, 2015) so that problems won't be created with the networks themselves (Manimohan, M., personal communication, March 16, 2015).

In the subject of innovation in the market and net neutrality regulation in the Netherlands, KPN supports that partnerships with OTT companies, such as the one between Spotify and KPN, are merely promotional services that don't create higher barriers in the market (Knol, P., personal communication, March 20, 2015).

In addition another argument was that technological innovations, such as the creation of smartphones such as Apple's iphone, happened without the presence of any regulation, which in turn supports that innovation is not necessarily harmed by the absence of regulation (Layton, R., personal communication, March 13, 2015).

The necessity of such a law cannot, in any way, be proven, as stated by all the interviewees with both proponents and opponents of net neutrality in this project. Whether the situation would have been different if the law hadn't been enforced, cannot be verified

or discarded (Layton, R., personal communication, March 13, 2015) (Westerink, J., personal communication, March 23, 2015) (Kreiken, F., personal communication, March 31, 2015).

In the interviews conducted with both the Dutch Ministry of Economic Affairs and BoF it was stated that the law was used as a preventive measure for practices that harm consumers, competition and innovation in the market and that KPN's announcement was a very good opportunity to block any such attempts from ISPs in the future, but it is highlighted that the discussion was ongoing before the KPN incident (Westerink, J., personal communication, March 23, 2015) (Kreiken, F., personal communication, March 31, 2015).

For the proponents of net neutrality in the Netherlands, this was a matter of freedom of speech and choice as well as a matter of privacy of consumers and an important step to ensure innovation on the open internet and keeping barriers of entry for new players low. They supported that a net neutrality law would protect the open internet, banning discrimination and pricing practices that limit consumers' choice. The plans announced by KPN was the perfect example of how this could be done by an ISP and it was immediately used to create and pass the law.

At the same time proponents of net neutrality stressed the necessity of a law like this arguing that competition and the already existing laws are not enough to ensure that new and innovative ideas emerge without being hindered by large ISPs with significant market power and that consumers are protected from companies (Layton, R., 2013) (Westerink, J., personal communication, March 23, 2015). According to the Ministry the matter of the fact was that ISPs had plans for charging their customers more based on the service they were using and this is unacceptable according to the concept of the open internet, therefore making sure that this doesn't happen was the main purpose of this law (Westerink, J., personal communication, March 23, 2015).

More specifically the Ministry elaborated on how price discrimination practices such as negative and positive price discrimination and zero-rating can harm consumers and new entrants in the market. Regarding the argument that charging more for certain OTT services would cost ISPs customers is indeed accepted as a plausible rationale of why ISPs would not practice this type of price discrimination, but on the other side, positive price discrimination, which is referred by many Telecom companies as just a commercial practice that is used for promotional purposes, is viewed as a practice with negative impact on innovation as well as for consumers (Westerink, J., personal communication, March 23, 2015).

With positive price discrimination and more directly zero-rating, companies offer certain services, either theirs or their partners' services, for free in order to make their bundles more attractive. The consequence of that according to the Dutch Ministry of Economic Affairs and BoF is that no smaller, new and potentially innovative companies would be able to compete under the same terms, while consumers would be steered in the direction of specific services and would not be free to choose between all available ones (Kreiken, F., personal communication, March 31, 2015) (Westerink, J., personal communication, March 23, 2015).

At the same time, it strengthens the position of ISPs with significant power in a market, while other smaller players that cannot afford to offer such services for free are at a disadvantage. It is also supported that the ban of zero-rating helps with forcing ISPs to compete in bandwidth and speed and lowering prices for consumers, without strengthening monopolies and creating higher barriers of entry in the market, which would have a negative effect not only in the national but also in the European Market and the vision for a Digital Single Market in Europe.

According to the Ministry it is indeed true that Telecoms are subject to heavy regulation but this is justified based on their position and the responsibilities they have as network operators but it is also mentioned that it is necessary to look into the regulation of OTTs but it is clear that they don't fall under the same category as Telecoms and so the same exact rules cannot be applied to them, which is also something that BoF noticed, although they also notice that "amounts" of regulation between Telecoms and OTTs cannot be compared but the regulatory safeguards that Telecoms are subject to have to be there (Westerink, J., personal communication, March 23, 2015) (Kreiken, F., personal communication, March 31, 2015).

For the proponents of net neutrality in the Netherlands, this law is protecting consumers, innovation, competition and the ability of new start-ups to emerge in the market. This is also reflected in the law itself as it is presented in the next subchapter.

5.2.1.3 The Dutch Net Neutrality law

5.2.1.3.1 The Contents of the Dutch net neutrality law provisions

The digital rights organization Bits of freedom provide on their website an unofficial translation of the Dutch net neutrality provisions which are quoted next:

*"**Proposal for net neutrality provision – Article 7.4a Telecommunications Act (unofficial translation)**

1. Providers of public electronic communication networks which deliver internet access services and providers of internet access services do not hinder or slow down applications and services on the internet, unless and to the extent that the measure in question with which applications or services are being hindered or slowed down is necessary:
a. to minimize the effects of congestion, whereby equal types of traffic should be treated equally;
b. to preserve the integrity and security of the network and service of the provider in question or the terminal of the end-user;
c. to restrict the transmission to an end-user of unsolicited communication as referred to in Article 11.7, first paragraph, provided that the end-user has given its prior consent;
d. to give effect to a legislative provision or court order.

2. If an infraction on the integrity or security of the network or the service or the terminal of an end-user, referred to in the first paragraph sub b, is being caused by traffic coming from the terminal of an end-user, the provider, prior to the taking of the measure which hinders or slows down the traffic, notifies the end-user in question, in order to allow the end-user to terminate the infraction. Where this, as a result of the required urgency, is not possible prior to the taking of the measure, the provider provides a notification of the measure as soon as possible. Where this concerns an end-user of a different provider, the first sentence does not apply.

3. Providers of internet access services do not make the price of the rates for internet access services dependent on the services and applications which are offered or used via these services.

4. Further regulations with regard to the provisions in the first to the third paragraph may be provided by way of an administrative order. A draft order provided under this paragraph will not be adopted before it is submitted to both chambers of the Parliament.

5. In order to prevent the degradation of service and the hindering or slowing down of traffic over public electronic communication networks, minimum requirements regarding the quality of service of public electronic communication services may be imposed on undertakings providing public communications networks."

In essence the above rules define that in general, providers of internet access services, whether they operate the network or not, are not allowed to block or slow down traffic with the exception of cases of; congestion in the network, where types of traffic are treated equally, measures for maintaining the integrity and security of the network, the services and the end-users terminals, unsolicited communication, court orders and blocking for ideological reasons based on the request of a subscriber (Layton, R., 2013).

5.2.1.3.2 Infringements of the law

In January 2015, the Dutch Consumer Authority (ACM), that the Dutch Telecom Regulator previously named OPTA merged with, publicly announced that there were two fines imposed for net neutrality violations, one on KPN and one on Vodafone[99].

KPN and WiFi hotspots:

KPN had partnered with Schiphol airport in Amsterdam to offer WiFi services in the airport area. Initially these services were paid by the customer that wants to acquire access to the internet. In 2008-2009 Schiphol airport asked KPN to create a "Free Basic Internet" service and the airport itself would pay for the traffic of these free customers and so certain types of traffic such as BitTorrent, VoIP etc were not being provided with this type of free access. Although this happened years before the net neutrality regulation was passed, under the current law this type of discriminatory access is now forbidden and so when a VoIP company complained to ACM, KPN received a fine of 250 000 Euros for net neutrality violation.

Vodafone and HBO go App:

Vodafone launched a promotional service that allowed its customers to use the HBO go app for free for three months, which according to net neutrality law constitutes positive discrimination which is a violation of the law and limits freedom of choice for consumers and harms innovation according to net neutrality proponents. A fine of 200 000 Euros was imposed on Vodafone for the provision of this service.

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[99] https://edri.org/netherlands-two-telcos-fined-for-net-neutrality-violations/

These two cases will be further analysed in the next subchapter as part of the implications of the Net Neutrality law in the Netherlands, but it should be noted at this point that both companies called for more clarifications on the law, waiting for more guidelines in order to make the appropriate adjustments to their policies.

5.2.1.4   Implications of the law

The Dutch net neutrality rules have stirred discussion all over Europe. The Dutch politicians and net neutrality lobbies are pushing for their rules to be copied into the European laws and any upcoming European net neutrality regulatory framework (Westerink, J., personal communication, March 23, 2015) (Kreiken, F., personal communication, March 31, 2015). Regarding blocking and throttling it is clear that it would not be accepted in the European law. But the Dutch government is trying to find support for a ban on price discrimination, whether positive or negative, just as it is a part of the Dutch law although there is not sufficient support yet from the European Council.

What is currently being discussed is intervening on such practices being used by operators based on the scale of their company. This means that if an operator has enough market power to affect consumers' choice through such practices as price discrimination then the regulator would intervene. But the Dutch law is implicitly applying the ban to all companies and that is what they support in the European front as well (Westerink, J., personal communication, March 23, 2015).

At the same time proponents of net neutrality are supporting that a pan-European net neutrality law is necessary in order to achieve competition in Europe and have a single digital market. In the absence of a net neutrality law all over Europe the bigger players and national monopolies will keep dominating the market, hindering competition and practicing techniques that only strengthen their position. The Dutch bring themselves as a successful example of how net neutrality works, as the market in the country is very competitive, while the law prevents the negative effects of the absence of regulation for net neutrality, without this proving that these effects would necessarily take place if the law did not exist (Kreiken, F., personal communication, March 31, 2015).

But the biggest challenge of having such a law is to make sure that the law is clear and precise. Even today operators are complaining about the absence of clear rules regarding

when a practice is a violation of net neutrality or not. At the same time it is not clear to what extent this law applies to the government itself and how it uses its citizens' data raising similar privacy issues (Layton, R., personal communication, March 13, 2015). The law is still new and while the Dutch Ministry of Economic Affairs supports that it is very clear what is or isn't allowed (Westerink, J., personal communication, March 23, 2015), Floris Kreiken, the net neutrality researcher from BoF, stated that sometimes there might be need for clarifications that will come up in the near future (Kreiken, F., personal communication, March 31, 2015).

In an interview with the Telecom provider KPN there was an example provided that indicated how the law can be unclear in some cases (Knol, P., personal communication, March 20, 2015). The example is referring to an app provided to KPN customers called MyKPN, whose only purpose is to allow customers to change their monthly subscription in case for example that the customer has run out of data and would like to add more. For KPN it is unclear whether this app is a service over the internet or a managed or specialized service. If it is the former, then the app cannot be zero-rated and so the customer that wants more data cannot go online and buy them because the data limit of the subscription is exceeded and so the app is rendered useless. But under the definition provided in the legislation that describes what a service over the internet is, it is unclear, according to KPN, under which category this app falls.

KPN recently also received a fine for violating net neutrality with its free WiFi service at Schiphol airport in Amsterdam which was characterized as an internal mistake as they omitted to change the service after the net neutrality law was enforced (Knol, P., personal communication, March 20, 2015). PhD fellow Roslyn Layton referred to cases like these as part of the implications of regulation calling it *"a regulatory nightmare"* (Layton, R., personal communication, March 13, 2015)*.* Layton mentions that companies are concerned about breaking the rules and regulators need to justify the necessity of the law, especially as they are trying to push the same strict rules in the EU so it is only natural that at this stage there is uncertainty regarding what is a violation and what isn't, which also led to the fines imposed on Vodafone and KPN (Layton, R., personal communication, March 13, 2015).

One other possible implication from the net neutrality law in the Netherlands is that it is not easy to define whether a slow or bad service offered over the internet is an operator's practice that violates net neutrality or a matter of interoperability. For example, mobile phones might work better in some frequencies than others, meaning that in case of bad

reception the user will have a poor experience when accessing the internet and users can blame this on the network. Proving whether such a case is a net neutrality violation or a matter of device operation can be a difficult task and doing so would mean that the regulator would need to invest more and hire more people in order to perform such checks, which would not be easy to do, especially since the Telecom regulator in the Netherlands is no more independent authority but is now part of the consumer authority ACM (Layton, R., personal communication, March 13, 2015).

Another similar example, mentioned by KPN's Paul Knol, is the problems that can arise with applications over the internet. It is not easy to define whether an application is not working due to the operator blocking it or slowing it down or due to an interoperability issue with the network. Not everything on the internet and the networks is fully interoperable, adjustments need to be made but nowadays application developers might blame such an issue on operators by calling it a net neutrality violation. This implies that there is this danger that the interoperability discussion of applications and networks could turn into a part of the net neutrality discussion, when that might not be the case and that is another challenge that operators are facing in the Netherlands due to the law (Knol, P., personal communication, March 20, 2015).

Another question raised by PhD fellow Roslyn Layton, after the net neutrality law came to force in the Netherlands, is to what extent this law helped more Dutch OTTs emerge and compete with larger international companies. Even though the Dutch net neutrality law was enforced not only to protect consumers but also to create competition with equal chances for smaller players, the traffic from companies like Netflix has increased significantly since then. Netflix today takes up almost 20% of the traffic, while the competition from Dutch or other similar companies is not as high in the Netherlands. This makes many wonder whether this law has or hasn't given smaller players the chance to compete or if it allows for companies like Netflix, with their large revenues and ability to lower prices, to grow even more (Layton, R., personal communication, March 13, 2015).

At the same time there is the discussion on future communication and network technologies using traffic prioritization to offer faster, more effective and more reliable services and whether they are affected or not by the new net neutrality rules. Technologies like VoLTE that have potential for replacing wireline telephony networks and use priority codes to do so are according to the Dutch Ministry of Economic Affairs specialized services

and thus are not affected by the net neutrality law as this law only regulates the open internet (Westerink, J., personal communication, March 23, 2015) (Kreiken, F., personal communication, March 31, 2015). The same will apply to other technologies such as remote health monitoring and self-driving cars in the future (Westerink, J., personal communication, March 23, 2015).

It is left to be seen what will happen in the future with next generation networks, especially in mobile, where network management is essential and treating every bit the same would not allow for efficiency and higher speeds. In an interview with Paul Knol from KPN the importance of network management is being stressed as a necessity in Telecommunications (Knol, P., personal communication, March 20, 2015). The newest standards such as 5G, for example, are using more and more prioritizations to overcome the challenges of heavy traffic on the networks and net neutrality regulation should be clear to what extent such management is allowed (Layton, R., personal communication, March 13, 2015).

The net neutrality law in the Netherlands is forcing operators to change their pricing models as well as reconstruct their bundles according to the new rules (Knol, P., personal communication, March 20, 2015) (Layton, R., personal communication, March 13, 2015). Some of these changes are also meant to counteract the impact of OTTs on operators' revenues. Companies like KPN face significant decline in SMS and voice international calls as well as a drop in voice traffic, which could be partially attributed to VoIP services or instant messaging applications.

Together with the strict regulation on net neutrality operators in the Netherlands feel over-regulated and that they should be able to compete under the same rules as their OTT competitors that are subject to very little regulation but the government and proponents of net neutrality signify that operators cannot be treated the same as OTTs due to their position as gate-keepers and so the safeguards need to be there and competition should be pursued on different levels (data volume, speed etc.) (Westerink, J., personal communication, March 23, 2015). Regulation on OTTs is a different issue that is currently being looked into but it cannot be compared and put under the same category as Telecom operators as the nature of these businesses is different (Westerink, J., personal communication, March 23, 2015).

With only a couple of years into enforcement the net neutrality law in the Netherlands is likely to undergo changes and clarifications in the future, while the gap between the political and the Telecom world seems to grow even more. Europe looks at the Netherlands

as example to decide on its own rules for net neutrality and so the results of this law in the Netherlands will largely affect net neutrality frameworks all over Europe in the near future.

5.2.2 Elimination of Roaming Charges in Europe – Spain Case Study

5.2.2.1 The European Union agenda for Roaming

As described before, the previous European Commission, just like the current one, have a strong plan for creating a Digital Single Market in the EU. This plan has as an end goal to end roaming charges and make all European Telecom operators compete for European customers and not only from one country alone. This plan also includes the unification on other aspects such as net neutrality, spectrum distribution and access regulation.

Just as the net neutrality case study in the Netherlands that precedes this one, the goal with this case study is to show the effects of the implementation of the measures necessary to achieve a competitive Digital Single Market for Telecoms in Europe through exemplifying and studying specific country cases. For the case of roaming, Spain was chosen as markets with a large tourism industry like Spain, are highly prone to suffer most revenue losses with the price caps and the reduction of prices for communications. Although this is true there is also an argument that suggests that roaming revenues would one way or another decline due to the competition of substitute services like Skype, WhatsApp and Vine.

In 2011 the European Commission Vice President at the time, Neelie Kroes, "pleaded for an end to mobile roaming fees within the European Union."[100] The ex-commissioner Neelie Kroes had a very noble principle to reduce the "mobile roaming fees within Europe [which] would be great news for the millions of Spanish residents who regularly travel for work and pleasure. In 2011, Spain's mobile phone companies notched up roaming revenue of over €700 million, according to the national Telecommunications agency the CMT." [100]

In her opinion this sector is an exception to the European standard of a common market and as such during her speech she mentions "There is no other sector of our incomplete European single market where the barriers are so unneeded, and yet so high". Kroes also said "pan-European operators helping consumers take advantage of a borderless market" as well as "increased investment in quality networks and content". [100]

The EU Council realizing that the market might not be ready for the end of roaming decided to postpone the introduction of these measures. In recent years the revenue of

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[100] http://www.thelocal.es/20130531/we-need-to-scrap-mobile-roaming-fees

Telecoms has been declining, although due to efficiency gains, the profitability did not fall as much. It is in this tough environment that we will study the Spanish market so that it will be easier to perform the analysis and draw conclusions.

Spain is a leading country in terms of tourism and home to one of the largest European Telecom Operators, Telefonica, one among the few that can take more advantage of the newest Telecom framework in Europe, in the occasion of a complete EU Digital Single Market.

5.2.2.2 Implementation of Price caps and its impact

In our interview with the Greek operator OTE's Markets Regulatory Strategy Division analyst, Mr. George Karageorgos he admitted that abandoning roaming fees altogether will possibly impact the company's revenues. He also replied that OTE would benefit from the single European market because OTE is a part of the bigger European Telecoms group Deutsche Telecom (Karageorgos, G., personal communication, February 3, 2015). To this he added that "*such a consolidation would be beneficiary to the European Telecoms market. But there might be reasons other than the EU Telecom regulatory framework, which has been there for almost twenty years now, that are behind this fragmentation; issues that are wider and go beyond Telecoms itself, for example e-business and e-commerce on taxation, invoicing etc. where there is still a lot to be done at the EU level*" (Karageorgos, G., personal communication, February 3, 2015).

This is interesting for the Spanish case because Greece is another country in the EU where tourism is also a very important sector and as such the challenges that OTE as the incumbent Telecom company faces in Greece are possibly similar to the ones Telefonica faces in Spain. The same applies for both OTE's and Telefonica's competitors.

In an interview with TDC and senior advisor Allan Bartroff there was a somewhat opposite opinion being expressed stating that for TDC the European Single Market wouldn't change their strategy and plans for the future. In this interview it was also expressed that roaming wasn't a big stake of TDC's revenues and losing part of it would not be ideal but it wouldn't have such a significant impact on TDC's business strategy (Bartroff, A., personal communication, March 16, 2015).

In terms of compliance with the already stepped up price caps it seems that things are moving well in a report from BEREC from September of 2014 where they report "The

information gathered by BEREC continues to show a good level of compliance with the Roaming Regulation in all EU Member States. At the retail level, all consumers have access to a Euro-Voice-, Euro-data- and a Euro-SMS-tariff. At the wholesale level, the voice, SMS and data roaming charges set between operators are in line with the declining regulated average caps. Some countries reported average prices slightly above the price caps" (BEREC, 2014).

This indicates that for the biggest part, in Europe the price caps imposed by the EU are respected and this has resulted for most countries in an increase of roaming calls when users are outside of the borders of their Telecom SIM card and also in international calls inside the EU.

The two graphs below from the BEREC report in September 2014 use the number of calls from 2008 as a value to measure, considering it as the value 100 and then comparing if it increased or decreased and how much. In both cases for most countries the number of calls grew and in some cases two or three or even four times more.
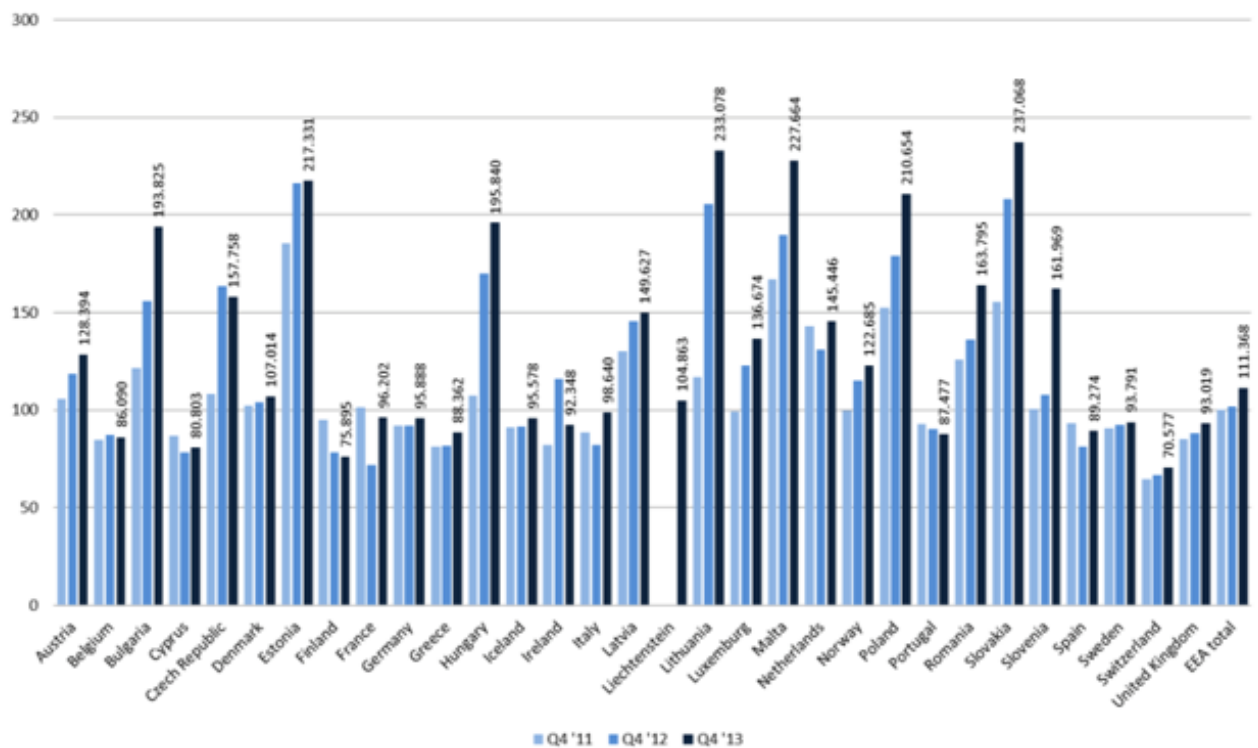
Liechtenstein based on Q4 2012 = 100

Figure 33: Volumes of calls made inside the EEA- 2013 Q4 (BEREC, 2014)

Austria 103.569 Belgium 108.385 Bulgaria 403.465 Cyprus 95.525 Czech Republic 153.734 Denmark 112.639 Estonia 215.623 Finland 77.474 France 126.308 Germany 93.790 Greece 115.896 Hungary 249.502 Iceland 109.979 Ireland 123.729 Italy 101.048 Latvia 262.323 Liechtenstein 101.964 Lithuania 406.138 Luxemburg 122.431 Malta 296.138 Netherlands 140.665 Norway 125.462 Poland 399.914 Portugal 169.061 Romania 391.384 Slovakia 333.151 Slovenia 195.435 Spain 82.863 Sweden 105.629 Switzerland 73.640 United Kingdom 114.881 EEA total 145.803

■Q4 '11   ■Q4 '12   ■Q4 '13

Liechtenstein based on Q4 2012 = 100

Figure 34: Volumes of calls received inside the EEA-2013 Q4 (BEREC, 2014)

5.2.2.3   Spanish market settings

The Spanish market has been hit in the recent years by the worst recession since the great depression from the 1930s. A recession spreading all over the western world. And in Europe it hit mostly the countries that had a higher reliance on services and products that are more elastic, such as tourism. In 2012 the revenue in the Spanish mobile phone market declined by 15.9% and the reason why the drop wasn't higher was because it was compensated with the offer of other services (CMT, 2014).

The Telecom market was a market that saw highs and lows since its inception, first with fixed lines until the creation of IP and later with mobile phones until data would also dominate that market. But voice wasn't the only market affected by this new fast changing environment. Instant messaging has also seen a fast substitution by free apps like WhatsApp and Line. Revenues in this segment also dropped very fast.

But of course it was not only bad news for Telecoms in terms of revenue. One segment that is growing very fast is mobile broadband and its growth can be attributed to some extent to the same apps and online services that are taking away revenue from voice and SMS.

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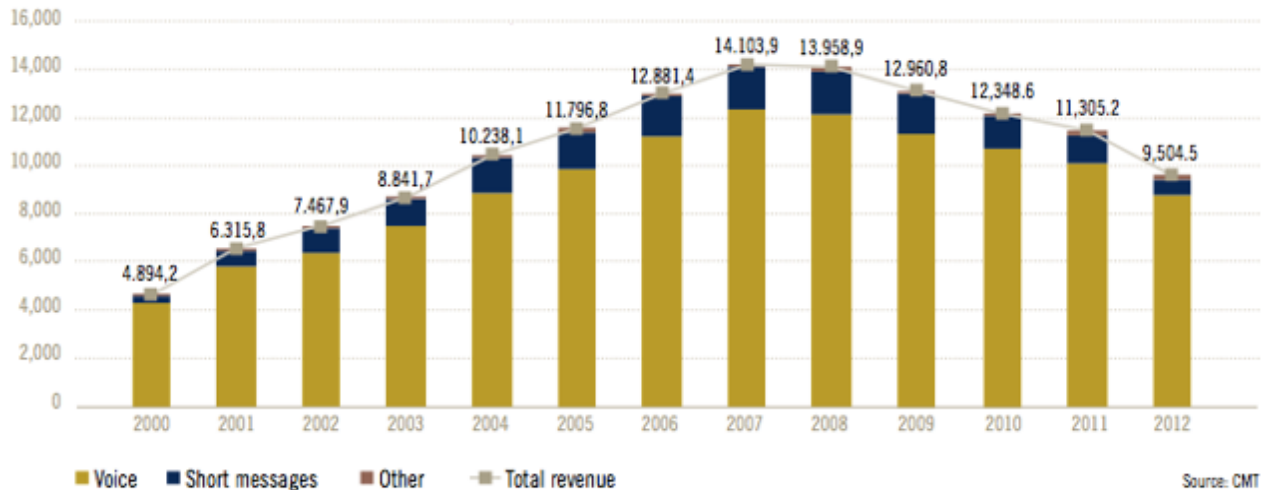
Figure 35: Evolution of revenue from final services (millions of euros) (CMT, 2014)

In the above graph of the evolution of revenue of mobile services in Spain it can be observed that in 2012 the revenue was at a level lower than in 2004 which pre-dates the crisis of 2008.

5.2.2.4 Spanish Telecom Operators

Spain is an interesting market especially due to its competition conditions. The Spanish market counts four main operators with various levels of networks deployed and twenty three MVNOs (Mobile Virtual Network Operators) some of which are owned by the four main competitors.
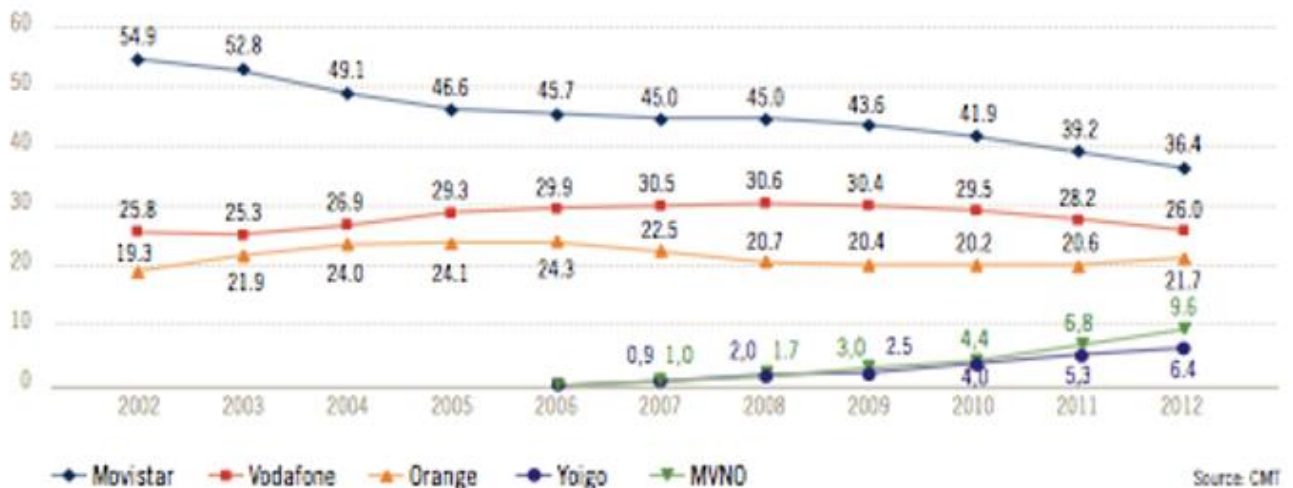
Figure 36: Evolution of market share by active lines (%) (CMT, 2014)

Looking at the evolution of the market share it can be observed that only Orange, Yoigo and MVNOs gained market share in a year that the market itself shrunk more than 15%. Although the market shrank significantly in 2012 and has been doing so since 2007, the total number of users only dropped for the first time in 2012. It is also interesting to notice that MVNOs are growing faster in terms of market share and as a big component of international calls. This is because these companies are clearly investing in this segment of the market. Immigrants, students on Erasmus programs and other similar programs are attracted to the offers by MVNOs so they can make calls home at much cheaper prices.
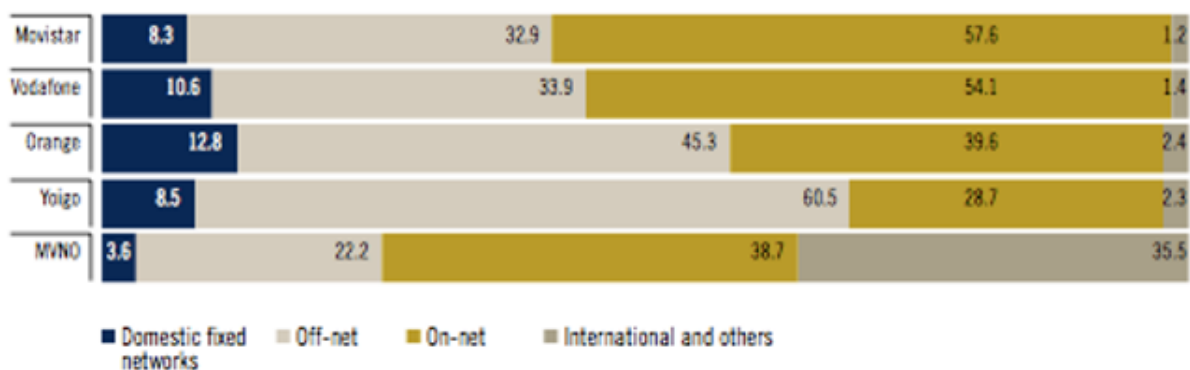
Figure 37: Distribution of traffic by destination (%) (CMT, 2014)

5.2.2.5 Number of users in the Spanish market.

In terms of number of users 2012 was the first year in the history of mobile Telecommunications that the number of users dropped and this was mainly due to a fall in terms of number of users in the segment of pre-paid packages. The post-paid segment, once very unpopular, is now gaining popularity especially due to packages which include SMS, voice and data.
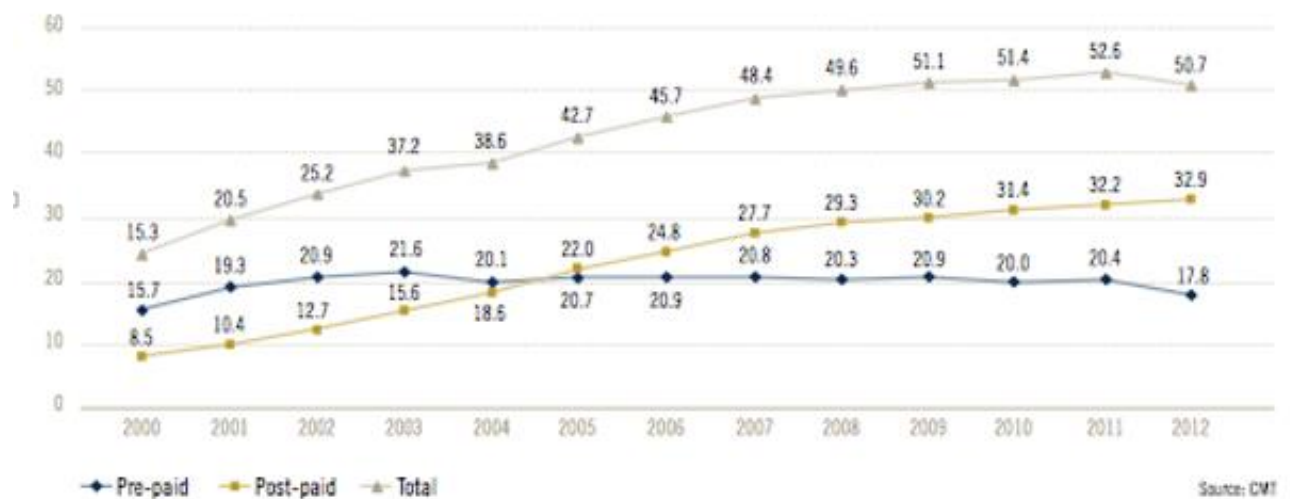
Figure 38: Evolution of mobile users in millions (CMT, 2014)

5.2.2.6   Spanish Roaming Market

Regarding the roaming market, the revenues have been falling quarter after quarter due to the price caps. Both in terms of wholesale (in red in the following figure) and in retail (in blue in the following figure). When in the summer of 2007 roaming was accounting for more than 400 millions, in 2011 for the same period it did not even reach 250 millions.
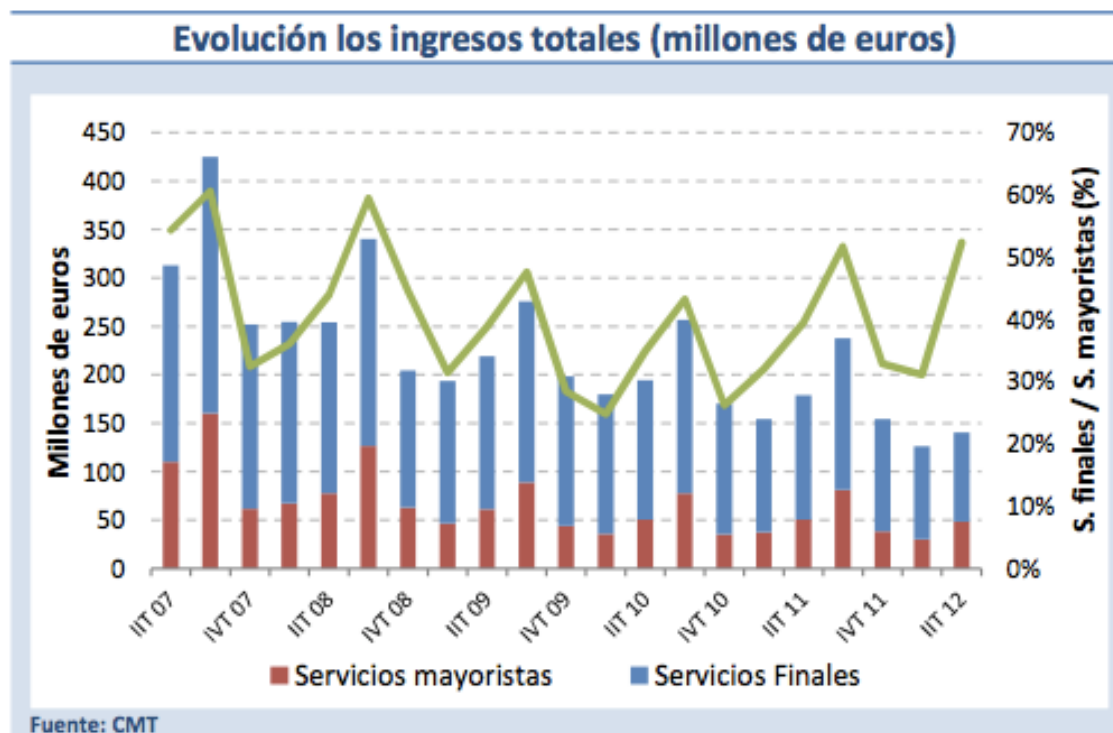
Figure 39: Evolution of total revenues of roaming (millions of Euros) (CMT, 2013)

Using this graph and comparing with the information from the total revenue of the market we can calculate the size of the roaming market in the period from 2007 to 2011.

year	Roaming Revenue (Mil. €)	Total Revenue (Mil. €)	Percentage of Revenue
2007	1230	14103.9	8.72%
2008	980	13958.9	7.02%
2009	860	12960.8	6.64%
2010	760	12348.6	6.15%
2011	710	11305.2	6.28%

Based on these calculations we can conclude that until 2010 the revenue in the roaming market declined faster than the rest of the market but in 2011 the roaming market actually gained some "share" back in the total revenue from Telecoms. Next there will be a closer look at the market of focus for the project, namely the SMS and voice market both in terms of Spanish and roaming markets.

5.2.2.7 Evolution of SMS market

The total number of SMSs was in 2012 already at half of what it was in 2008. And this number is expected to keep on reducing very fast because of the already mentioned substitution of other services like WhatsApp, Vine and Skype.
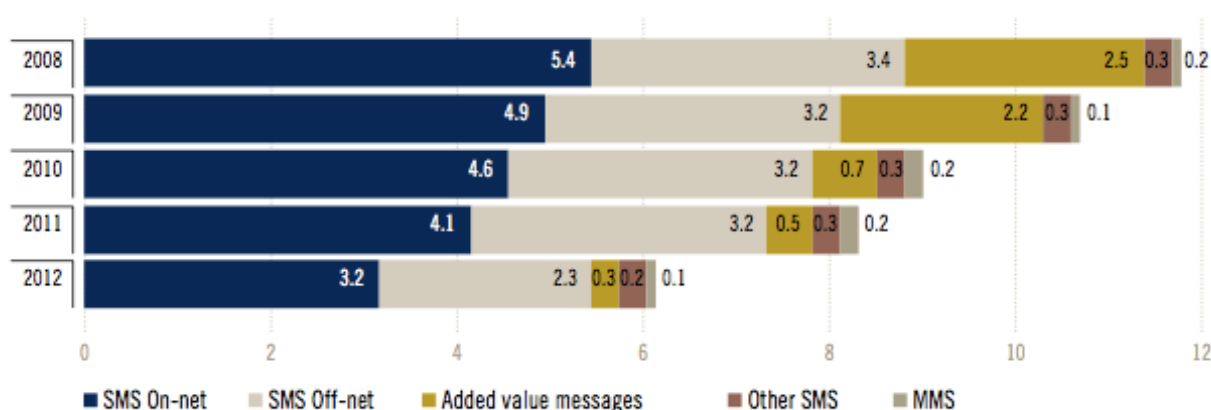
Figure 40: Evolution of message traffic in billions (CMT, 2014)

The number of SMSs sent in 2012 is almost half of the one sent in 2008, and this is observed in all types of messages. All of them suffered huge losses and an important revenue that Telecoms have been relying on for many years to be highly profitable is rapidly going extinct. In a world more and more connected the substitution is very clear in this graph and the trend is that it will keep on declining in this segment (CMT, 2014).

5.2.2.8 Evolution of Voice Market

Just like in the case of the SMS market, voice has also suffered a very fast reduction of revenue in the last years, although the reduction was less significant than that in the SMS market. It was still at around 30% over a 5 year time span, which is a very negative development, especially since this was the biggest segment of Telecoms revenue at that point (CMT, 2014).
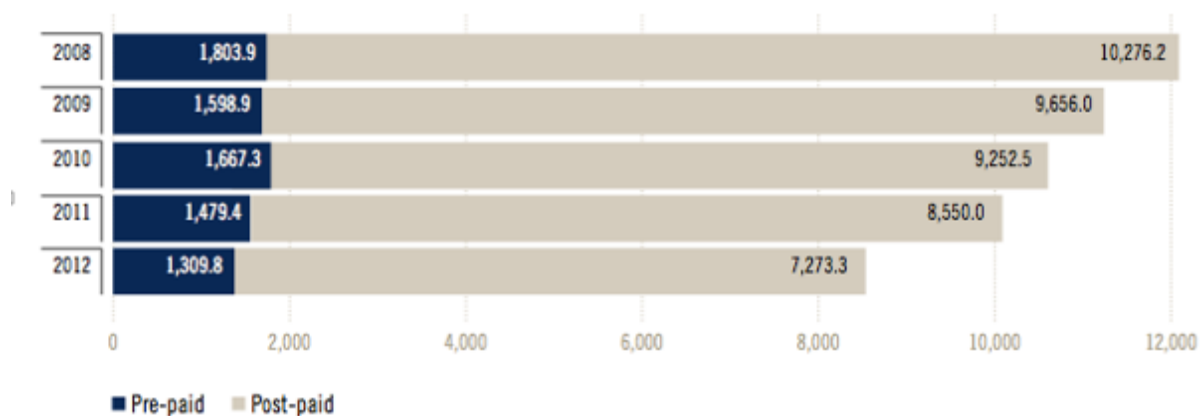
Figure 41: Evolution of revenue from voice traffic in millions of euros (CMT, 2014)

5.2.2.9 Roaming Voice and SMS market

Here we can see that in terms of roaming, voice accounts to the vast majority of traffic and SMS and data have a very small share of the Telecoms retail revenue when roaming. But as it will be commented further in the data case this is not because of a reduction in the usage but because of the implementation of price caps.
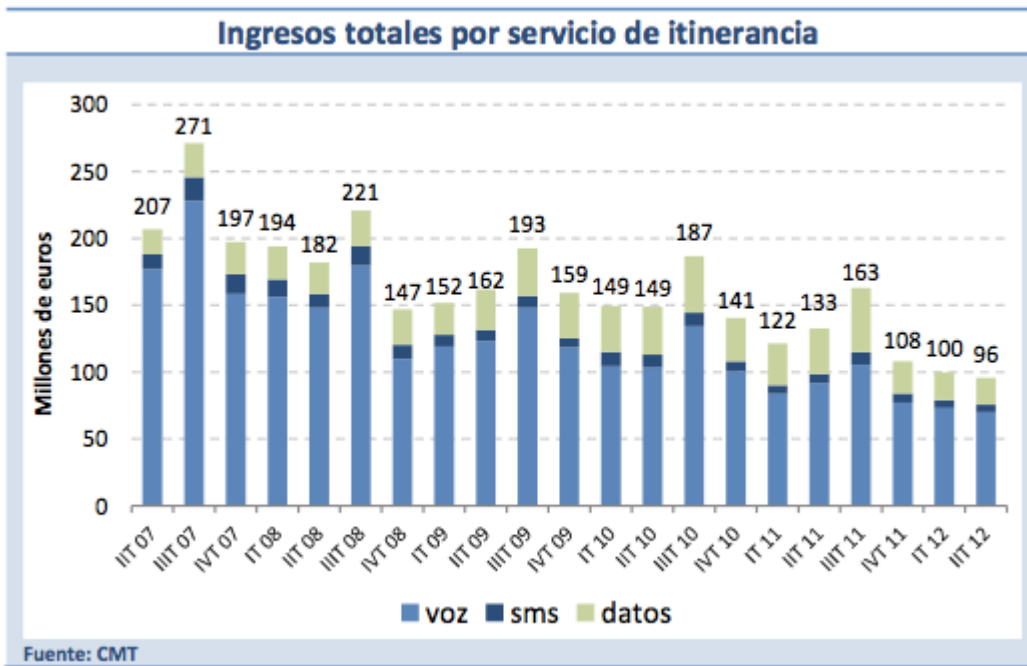
Figure 42: Total revenues for roaming service (CMT, 2013)

The introduction of price caps inferred the reduction of revenue in terms of voice and SMS but in terms of data it actually had the opposite effect, at least until 2011. In 2012 it also started dropping too. More in mobile broadband will be discussed further ahead (CMT, 2013).

5.2.2.10   Mobile broadband market

The mobile broadband market seems to be a very important growing market for Telecoms already. This market is seeing increasing growth and is allowing Telecoms to regain part of revenue lost in other segments, and in Spain this is also the case. This is the market that is offering the best opportunities for the future of Telecoms in Europe with the leading mobile technology being LTE. This trend can also provide an explanation regarding why the SMS market has shrank so much.

The substitution of traditional SMS due to mobile broadband seems to have a bright future ahead. With a growth of 29% from 2011 to 2012 it offers a very strong glimpse of hope for the future of the sector and makes it even clearer that the content is moving to the internet but the value of the networks will always be present to provide users with access to the network (CMT, 2014).
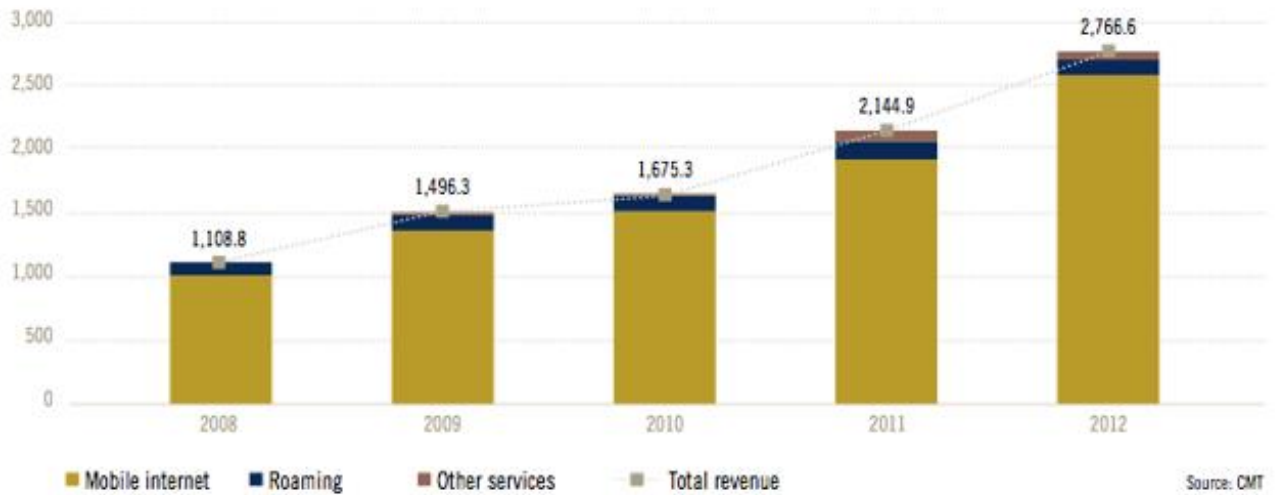
Figure 43: Evolution of revenue from mobile broadband in millions of euros (CMT, 2014)

The growth of broadband revenue has been growing constantly in the Spanish market and this growth is sustained by an increase in the data lines. Operators are able to bundle those data lines with voice lines and that way sustain some revenues on voice.
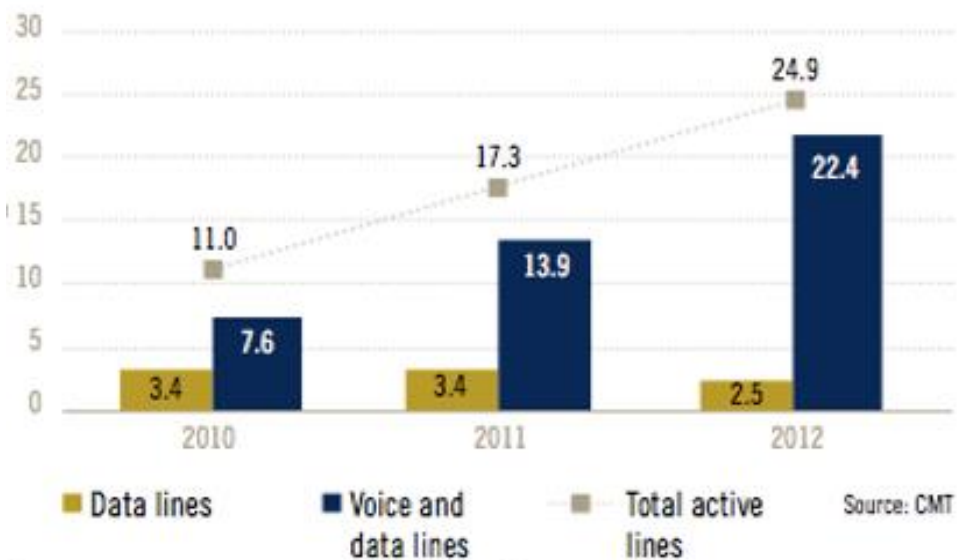
Figure 44: Evolution of active mobile broadband lines in millions of lines (CMT, 2014)

5.2.2.11 Mobile broadband roaming market

Regarding roaming broadband, the price caps that Neelie Kroes and the European Commission have introduced on roaming are having a very positive effect on the data usage when Europeans are roaming.
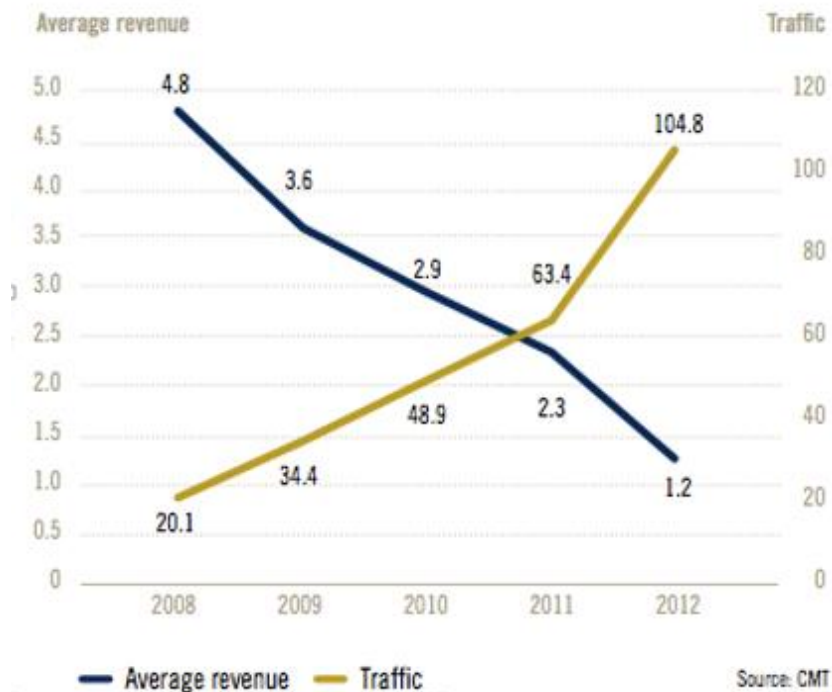
Figure 45: Evolution of average revenue per MB and international roaming traffic volume (Euros/MB and TB) (CMT, 2014)

With mobile broadband users are allowed to use their apps, when outside their country, to circumvent the prices of roaming in SMS and voice, contributing to the decrease in the numbers of the last two.

In terms of revenue base it is possible to calculate the revenue that the broadband roaming generated for Spanish operators from the previous figure. The following calculations are in millions of euros. In order to make these calculations the traffic from the previous figure where it is mentioned in TB will be converted to MB for this table.

Table 4: Total revenue of mobile broadband roaming in Spain from 2008 to 2012

Year	Traffic(MB)	Average Revenue(€/MB)	Total Revenue(M/€)
2008	21.076.377,6	4.8 €	10.12 M/€
2009	36.071.014,4	3.6 €	12.99 M/€
2010	51.275.366,4	2.9 €	14.87 M/€
2011	66.479.718,4	2.3 €	15.29 M/€
2012	109.890.764,8	1.2 €	13.19 M/€

The reduction of price caps did not create an explosion in usage but there was still a noticeable growth. In addition, until 2011, the growth was larger than the reduction of prices, which in turn can be translated as the tendency of operators to charge prices that were higher than they should for the Telecoms maximum profitability.

5.2.2.12 Evolution of the Wholesale market.

In a future Telecoms Single Market, the roaming wholesale market will be crucial for Telecoms, just as it is today. This is also a market that presents a decline due to several factors, such as competition and price caps, but what can be observed is that with the implementation of price caps, roaming did not decline as fast as the rest of the market. This can explain that there was an increase in usage, as suggested from figures 33 and 34 from BEREC.
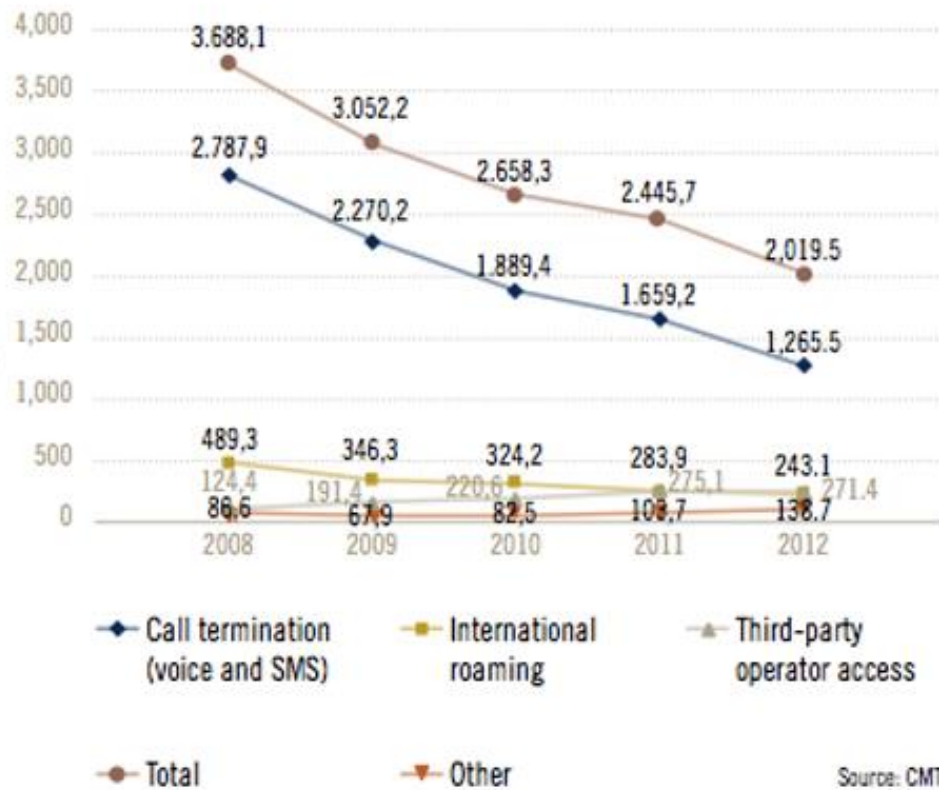
Figure 46: Evolution of wholesale revenue in millions of euros (CMT, 2014)

In terms of wholesale although the revenue is dropping constantly in almost all segments, the usage almost doubled from 2008 to 2012 (CMT, 2014).

In the figure below it can be observed that although the revenue has fallen, as noted before, it is not due to lack of usage, as that has grown in almost all segments. But the two segments that were the main drivers for this growth were mainly third party operators and international call termination (CMT, 2014).
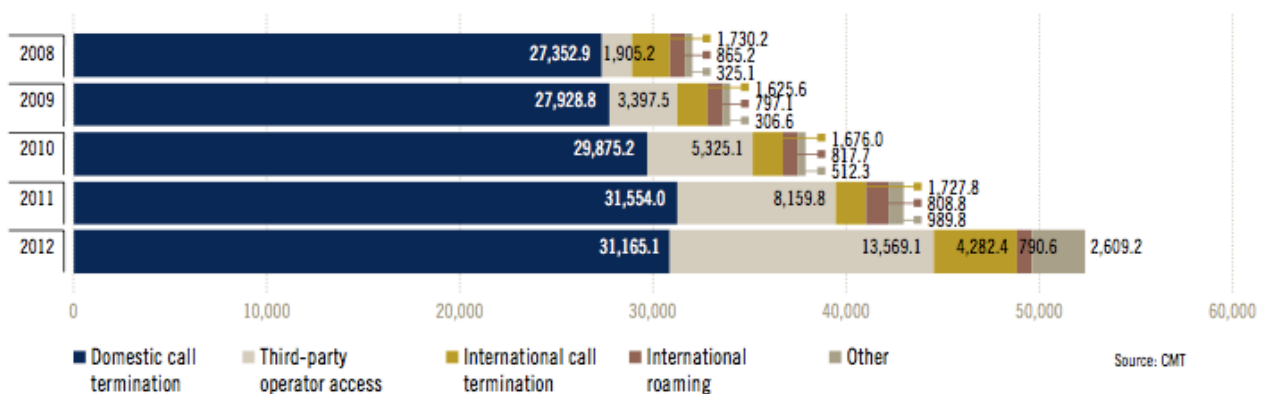
Figure 47: Distribution of wholesale service traffic in millions of minutes(CMT, 2014)

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Roaming prices have been falling in line with the price caps imposed by the EU, which is an indication that the BEREC study announcing that most operators are applying the rules according to the EU regulation is indeed true in the Spanish case (CMT, 2014).
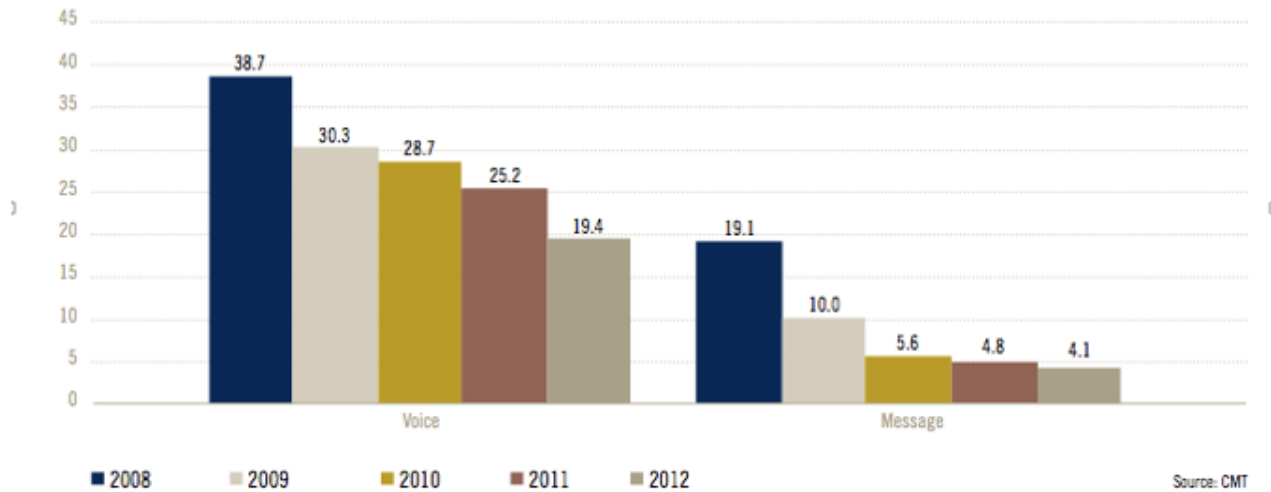
Figure 48: Average revenue by international roaming (cents/minute and cents/message) (CMT, 2014)

When it comes to market share, the wholesale market is a three-way race between the three largest operators. The wholesale market in terms of revenue appears well distributed among them and is virtually similar to their total market shares, the only difference being that in terms of wholesale Yoigo is larger than the MVNOs.
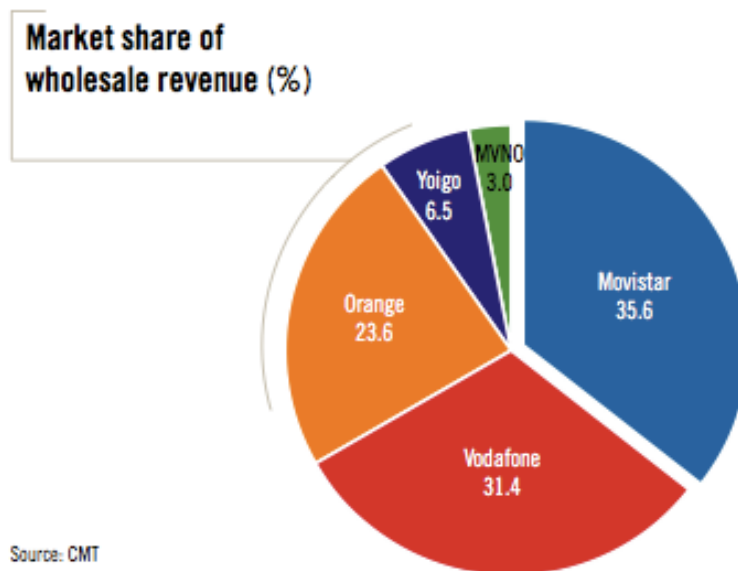
Figure 49: Market share of wholesale revenue (CMT, 2014)

5.2.2.13 Summary of the Spanish case study

In the case of Spain, it can be observed that Telecoms have suffered losses in revenues, which can be mostly attributed to substitution from OTTs. Other factors also played a role, such as the economic crisis that hit Spain very hard leaving more than one quarter of the population without jobs, leading to less buying power for services such as communications, as well as the fact that many companies that were responsible for a great number of these calls went bankrupt.

The only segment of the market that performed and is performing well despite the above hindrances was the mobile broadband sector, with a growth of 30% in a market that was shrinking around 15% every year. As such LTE is a technology that fuels hope that in the near future Telecom revenue can start increasing again.

The roaming market in Europe during this period has grown significantly and so has the number of intra-European calls. Nevertheless, in terms of revenue, the reduction from the implementation of price caps was higher than the increase of usage which lead to a decrease of value in terms of percentage of total revenue. In 2007 the Spanish roaming market represented 8.72% of the total market and in 2011 it descended to 6.28% and next improving slightly from 2010, although still far from the 2007 levels.

The Spanish case study is a good example of how the EU price caps in roaming have operated so far as a lever to gradually lower the roaming charges barrier in the EU and create a unified Telecom market. And although the market is still far from being called a Single Market, the effects of such measures are being studied and monitored as we are approaching towards the end of roaming fees within the EU.

6 ANALYSIS

In this chapter the primary and secondary data gathered from the available literature and several interviews conducted in the Telecom sector in Europe will be analysed in a coherent and detailed manner in order to answer the questions that the authors intend to answer in this work. The way this is done is by using the analytical framework followed throughout the whole work which derives from the principles of the political and institutional economy theories and explores the relationships between the players in the Telecom market with the regulatory frameworks imposed by the European and national institutions and always in relationship with the technology factor, the developments of which influence and are influenced by the market and the regulations that apply to it.
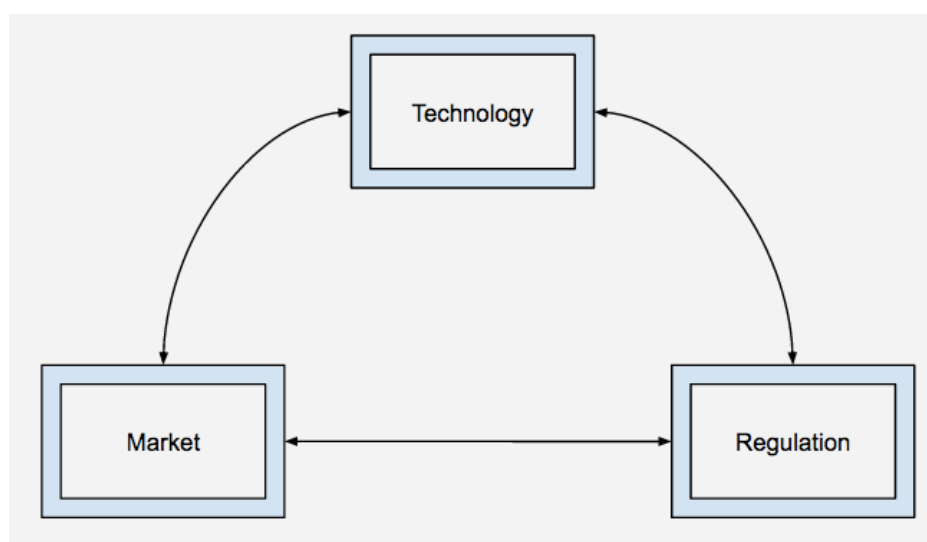
Figure 50: The three pillars of the analytical approach

Keeping in mind the above interdependencies, in this chapter there will initially be a closer look into the two different players in the European Telecom market, namely the large Telecom companies that have dominated the market for so long and secondly the OTT players that emerged only a few years ago to, gradually but at a quick rate, substitute traditional Telecom services creating competition with Telecom operators and disrupting the Telecom market as we know it.

As explained in chapter 2 "Theoretical Frameworks", the frameworks based on which Telecom operators and OTTs will be analysed and compared are those of Multi-sided Platforms and Resource-based View.

After the settings and players in the market have been analyzed, the analysis continues with exploring the data gathered to assess the role and impact of regulation in the European

Telecom market, the current regulatory patterns and trends, while the case studies from the Findings chapter will be extensively used to exemplify and strengthen the points made from the compilation of the data collected.

6.1 THE TELECOM MARKET AND ITS PLAYERS

The traditional Telecom model was for many years that of a single-sided platform that allowed the caller to reach the receiver and normally the former or both pay for the use of the network for the call. But this model changed when the Internet and the IP protocol came along to change and revolutionize the way communications operated forever. When Telecom companies started providing access to the internet it wasn't just the new ways of communicating and doing business that we saw innovation in.

Innovation in technology allowed for faster and more reliable networks, while innovation over the internet created new business models and changed the course of the communications industry as we knew it, by substituting and enhancing traditional Telecommunication services such as voice and SMS, as well as by offering services such as content delivery, that were previously and traditionally not provided over the Telecoms' networks. Telecom operators started provided broadband together with traditional voice services both in wireline communications, through DSL and fiber, and in mobile communications by moving from the GSM protocol as the base of mobile communications to 3G and 4G that allowed fast mobile broadband for users.

But next Telecoms had to react to the changes and the disruption and emergence of competition from this completely new type of OTT businesses that were enabled by broadband, through changing their own business models and pricing structures and strategies to survive and maintain their strong position in the market. Telecoms moved to being a platform for not only voice and SMS services, but also for content providers, users and in some cases service and application providers, embracing the era of an IP world. This multi-sided model is examined in more detail in the following subchapter, while next there will be a side by side analysis of Telecom and OTT players based on their resources using the RBV framework described in the Theoretical Frameworks chapter.

6.1.1 Telecom Operators – The Multi-Sided Platform approach

Being a multi-sided platform implies that the platform has several distinct customer segments with differentiated treatment on each side, while at the same time many types of externalities occur. Another prerequisite for multi-sided platforms is that the profit and its allocation depends on the price structure and not only on the total price, as described in chapter 2.2. The formation of the price structure for the platform is based on demand elasticities for each customer segment, meaning that prices for each group of customers are balanced in such a way that they provide the optimal profit for the platform.

As the Internet becomes the main means of communication for people today, operators shift their focus from a voice- and SMS-oriented model towards a data-driven model and the pricing for it in order to increase revenues that went into a downfall when voice and SMS started declining. Data plans that emphasize on data volume, are most common these days, while flat rate and pay-per-use charges are being abandoned, especially in the case of mobile communications (Krämer, J.; Wiewiorra, L., 2014).

All these new services on the network add value to it and operators need to make sure that they take full advantage of this fact and thus have created and operate a multi-sided business model that allows them to profit not only from end-users and businesses, but also from companies that offer their services using their networks.

The following figure shows how Telecoms nowadays have managed to serve as a platform where end users and businesses meet offering both B2B and B2C services.
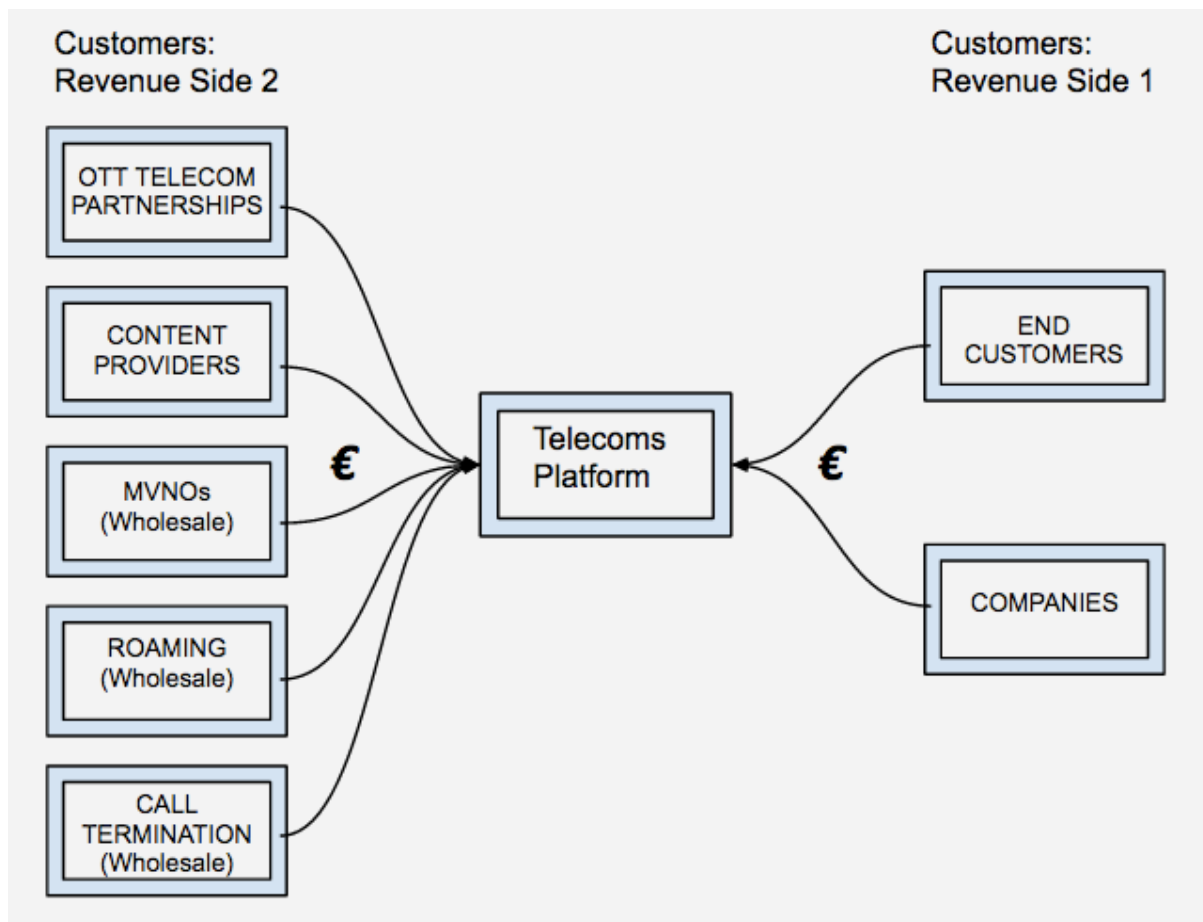
Figure 51: The customer segments of Telecom operators as MSPs

The above figure presents the customers of Telecom operators grouped in two sides, one for the private end-users and the companies that pay operators for access to the internet, as well as voice and SMS services and are mainly download customers and the other one for the customers that use the operators' networks to provide their services to end-users. In this group there are mainly wholesale customers, such MVNOs that do not own network infrastructure and pay network owners to use theirs, content providers that pay operators to connect their servers directly to their network in order to offer better services to their customers, as well as partnerships with certain OTTs in order to offer a common promotional service and share their revenues the more popular the service becomes.

6.1.1.1 Price structure and competition

In most definitions about MSPs the price structure is one of the aspects that separates single-sided from multi-sided markets. How the services on each side are priced from the platform is decided based on the demand elasticity on each side and defines to a great extent the success or failure of the platform. As described in chapter 2.2 in order to maximize profit in total, the owners of the platform need to come up with a pricing scheme that offers lower prices for the more elastic sides of the platform (possibly lower than the profit margins), thus attracting more customers and higher prices for the more inelastic sides, since they are highly dependent on the platform's services. This way multi-sided platforms are able to internalize network externalities and gain additional profit.

In the case of Telecoms in the European Union, we are talking about a regulated market. In this market, regulation, national or European, is not only attempting to prevent monopolies and protect consumers from possible abuse of the operators' strong position but it is also used to reduce the high barriers of entry that the Telecom sector has, so that new players can enter the market and compete with incumbents.

As a result in most European countries, especially after the European Commission recommendation regarding wholesale in 2003[101], there was a proliferation of competitors such as MVNOs. MVNOs appeared because access regulation allowed them to buy data, voice and SMS traffic in bulk from network operators and resell that to end costumers. In order for this business model to thrive and provide competition that lowers prices for consumers, regulation that limits prices for wholesale was also imposed. Wholesale is also regulated for roaming, call termination but not for content providers that wish to directly connect to operators' networks to provider better services to their customers.

In terms of retail companies have more freedom to price their services as they want but they cannot be lower than the wholesale prices because such would be considered price dumping. Still price caps are also applied in cases like roaming within the EU, which has been lowering prices for roaming users since 2007.

Returning to the principles of MSPs, regulation in the Telecom market does not allow operators to freely price each side as they wish, although it is obvious that MVNOs, OTTs and anyone that uses their network is on the inelastic customer segment of Telecoms as the

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[101] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003H0311&from=EN

operators' networks are the only way to provide their services. Consequently regulation exists to minimize the effects from the elastic and inelastic side of the Telecom platforms. Otherwise Telecoms could, theoretically, impose prices that would be prohibitive for anyone to use their network and possibly compete with the operators' services.

End users and businesses are on the more elastic side of the Telecom platform. Lowering prices for this side would attract more customers to the network and gain ground against competitors but as the more inelastic side that buys wholesale cannot be priced as fit best there needs to be a balance between wholesale and retail prices. Still the retail side of end-users and businesses remains more elastic especially as competition from OTTs and MVNOs is intensified more and more. In case where there is also infrastructure-based competition from other operators prices can be affected even more but in any case interconnection between networks is mandatory and so Telecom "platforms" need to maintain openness with their competing platforms.

6.1.1.2 Externalities on the Telecom platform

As previously explained in chapter 2.2, one of the basic elements of MSPs is that they are subject to externalities and taking advantage of them is one of their basic characteristics. Telecom networks even in their traditional form as communication enablers for voice and SMS are subject to network externalities.

In chapter 2.2 there was a distinction between usage and membership externalities and Telecom networks can have both. Users that pay per minute/ per SMS benefit more by communicating with other users within the same network as charges are normally lower for them. The more users join the network, the more the old user benefits from being able to communicate with more people cheaper, a phenomenon also called usage externalities.

But a similar pattern, called membership externalities, exists when the user of a network pays a fixed amount to the operator every month for unlimited usage within the network and benefits whenever a new user joins the network as there is no additional cost for the old user to communicate with the new one.

But nowadays Telecom networks are platforms for all kinds of services. The open internet and the rapid development in broadband technologies have allowed for new innovative OTT services that are extremely popular among users. In order to benefit from this trend, besides the value that the network acquires from the traffic that these apps and

services cause, Telecom operators are partnering with OTT companies to benefit from their popularity and gain access to more users. The example of KPN in the Netherlands partnering with Spotify is a good example of such a collaboration (Layton, R. 2013).

Such partnerships can be used as promotional practices both for Telecom operators and OTT providers, although price discrimination and zero-rating are heavily discussed in the context of net neutrality and the regulation of networks in the EU as discussed extensively throughout this project. Nevertheless these partnerships are a good example of cross-side network effects on Telecom networks. OTTs partnering with Telecom providers attract the users of such services to the Telecom network and incentivizes new ones to join as well.

Telecoms have stopped existing in their traditional form. Operators have changed their mode of operation adjusting to the latest developments and the new competition conditions. Their business model now resembles that of a multi-sided platform and that was the parallel that was drawn in this chapter. In order to look further into their relationship between them and OTT players though, the next chapter looks into the resources of both using RBV in order to investigate which one has or lacks the sustainable competitive advantage that is necessary for the survival in this competitive environment despite the differences in the business nature of these two.

6.1.2 Telecom operators & OTT providers – A Resource-based View approach

Resource-Based View is a tool that provides the framework for explaining how a company's resources define the company's position in a competitive environment and how they lead the way to the performance necessary to survive in such an environment. By analyzing companies based on this framework it is possible to understand why a company is more profitable than another. The way this is done is by identifying the different tangible and intangible resources and capabilities of the firm. This way it is made clear what differentiates one company from the other and the one with the best resources is identified as the one that is more successful.

Telecom operators and OTT providers that compete in the same market (for example voice and messaging) are very different as businesses but they operate and compete in the same market. For many years Telecom operators dominated the Telecom market and were the sole players in the market absorbing all the produced revenues. But that is not the case anymore. While Telecom operators have been seeing negative growth and declining revenues, OTT providers have been growing at a very high rate, creating a trend that Telecom operators, whose infrastructure they use, have been unable to stay unaffected from.

Using the RBV framework for both, this chapter explores where Telecom operators have or lack competitive advantage in relation to OTTs, through looking at the available resources and how each side exploits them efficiently to compete with the other and create a sustainable competitive advantage for the company.

6.1.2.1 *Telecom operators' resources:*

It can be hard to identify the most important tangible and intangible resources for a company. Telecom operators had for years been at an advantage due to the lack of significant competition (the largest European Telecom operators used to be national monopolies). Being owners of the communication networks was enough for them to dominate the market and charge prices that could not be lowered in the absence of competition.

But regulation and innovation on the open internet came to change that proving that the operators' most important resource, the network itself, was not enough to create a sustainable competitive advantage. Looking at declining revenues, operators need to identify all the resources that have the VRIN characteristics and try to gain back part of what regulation and competition in the market have taken away. In the following table there are

the most important resources for Telecom operators nowadays and they are examined under the VRIN characteristics:

Table 5: Telecom Resources

VRIN / Resources	**V**aluable	**R**are	**I**nimitable	**N**on-Substitutable
Physical Network	✓	✓	✗	✓
Brand Name	✓	✓	✓	✗
Installed base	✓	✗	✓	✗
Trust	✓	✓	✗	✗
Capital	✓	✓	✗	✗

The first resource to be examined is the physical network whose owner for years offered Telecom services over. Although undeniably a valuable, rare and non-substitutable resource, the physical networks operation and role in communications were not inimitable. And this is what OTTs innovated in. The created services that over the open internet allowed for communication, mostly for free, bypassing the role of traditional Telecom voice and SMS services of the network as the only way to communicate. This was also facilitated by the fact that broadband technologies evolved and became faster and more reliable and more importantly when mobile communications went from GSM to 3G and 4G technologies like UMTS and LTE, allowing internet access not matter where the user is.

A Telecom operator's brand name is another important resource for them. Although not a tangible resource, like the network, most large Telecom operators in Europe have existed since the beginning of Telecommunications and have a well-known established name and a reputation for being reliable. This resource although valuable, rare and unique can be substituted with competitive brand names offering similar or better services.

For the same reasons Telecom operators normally have a widely installed based due to serving as the only means of Telecommunications for many years, which is another valuable and inimitable resource, although not rare or non-substitutable if competition and lack of vision and adaptability in the company make customers switch their preference for them.

Trust is a resource that Telecom operators have focused on a lot since competitors such as MVNOs or OTTs came into play. Playing the card of being the most trustworthy and reliable provider for their users is a valuable and rare resource that was built over years of presence in the Telecom market, although this resource is of course imitable and substitutable if the quality or prices of competitors are better.

Finally, a more tangible resource that Telecom operators have is capital. Despite their declining revenues, the Telecom industry is multi-billion industry, first because they own the Telecom infrastructure, which is necessary for electronic communications and second because their revenues need to be high enough for them to maintain the current infrastructure and at the same time invest in new technologies to improve the network. This is necessary in order to keep up with the high demand for faster and more reliable networks, in an era where their infrastructure is the platform for not only communication but also e-commerce, entertainment, cloud services and very soon e-health, smart homes, driverless cars and other innovative applications that demand flawless connectivity. This amount of capital although valuable and rare, it does not provide the competitive edge needed for Telecoms when OTT competitors using their networks for free can offer similar communication services that have potential to substitute theirs.

6.1.2.2   OTT Resources

The emergence of OTT services is a trend that has created new business models that have given Telecom networks more value and at the same time have brought more competition in the Telecom market. The nature of the OTT businesses is very different from that of Telecom operators, despite the fact that in some areas, such as voice and messaging, there is direct competition with them. This is also reflected in the following table where the most important resources for OTT players are listed and analyzed in order to find out where OTTs have a competitive advantage against Telecoms and explain the trend that since their

emergence they are seeing increasing revenue growth, reaching 20% in 2012-2013 (ETNO, 2015) but with a rate that is seemingly declining gradually.

Table 6: OTT Resources

VRIN Resources	Valuable	Rare	Inimitable	Non-Substitutable
Open Internet	✓	✓	✓	✓
Indirect Revenues	✓	✗	✓	✓
Content	✓	✓	✓	✓
Platform integration	✓	✓	✗	✓
User base	✓	✗	✗	✗

OTT companies do not own their own network infrastructure. But the open and unregulated internet up to this day was the reason for their growing popularity and the extensive innovation that took place over the networks until today. With no infrastructure to maintain and invest and with continuously improving broadband speeds, OTTs were able to take advantage of this free platform and offer services that traditionally were offered by Telecom providers or other types of networks (cable, TV etc.) and to do so with low or no charges at all for their customers.

The open internet is a very important resource that has given them competitive advantage and which fulfills all the VRIN characteristics. Its rarity can be disputed as this is a resource that is available to everyone and without any net neutrality regulation enforced in Europe, this openness could be partially threatened. But right now it constitutes one of the major competitive advantage for the OTT industry when compared to Telecoms and is rare in

other industries to have a resource that allows small players like OTTs to compete in a market with such high barriers of entry and this is facilitated by the nature of the open Internet.

With no infrastructure to maintain (or virtually no infrastructure – OTT content and cloud providers or search engines, like Google, need to maintain servers or CDNs) and using the open internet platform, companies like WhatsApp, Skype or Netflix are free to earn revenues from charging their customers very low or by offering free services and using advertising or other types of independent revenues to grow.

Therefore, the open internet has two very important aspects. On the one hand OTTs need to make virtually no investments to distribute their content or services in Europe, especially if we are talking about instant messaging apps, as the ones mentioned before, that don't take up a lot of network capacity to operate. And on the other hand, the regulation aspect or more importantly the lack of it, is an enabler for innovation as OTTs are allowed to take advantage of aspects like privacy and personal data usage, among others. This type of freedom isn't possible in other industries and this can be seen as major competitive advantage.

One important resource that not all OTTs have, as it is a specific type of OTTs that have this, is content. The evolution of broadband has allowed for content to circulate on the networks and be streamed globally. This resource has all the VRIN characteristics and it explains the success of companies like Netflix, Spotify and Hulu in this area. Several Telecom operators have their own content services (offering bundles that include IPTV services) but have not had the same success as the above mentioned OTT players. These companies have managed with very low-priced subscriptions or the freemium model to take over the content market and present a competitive advantage that is hard to compete with on behalf of operators. This is also the area where we see most Telecom-OTT partnerships.

In the OTT world another significant resource can be platform integration. The more these services are integrated the better they function. Users can communicate freely through integrated services, which is a very important resource that allows for a more software based rather than a network based integrated platform.

Finally, OTTs have managed to acquire a significant and well-installed user base that is built on the perceived value for their services but other than being valuable, it does not offer a sustainable competitive advantage for them.

6.1.2.3 Telecoms and OTTs through the scope of their resources

In the analysis based on the resources of Telecoms and OTTs done in the previous section, it can be concluded that OTTs have several competitive advantages to Telecom operators, the main ones being that they can operate over the open internet without being charged and therefore can offer users their services for free or for very low fees, while at the same time they have very few running costs and little infrastructure to maintain, which allows them to operate and be profitable with much less revenue. This business model is also facilitated by the fact that they can use alternative sources of revenues besides their users; sources such as advertising, which is not in any case enough for Telecom providers and their operation costs.

At the same time the open internet provides them with instant access to the whole world without significant regulatory restrictions, while Telecom operators are limited to the reach of their networks. Therefore economies of scale are easier for OTTs to achieve, especially since in the OTT world there is often a winner-take-all scenario.

The resource that seems to provide a sustainable competitive advantage for OTTs is the open internet aspect. In the future, the regulatory paths that are chosen by the EU and its members can affect the availability of this resource, either positively or negatively. At the same time though it is interesting to notice that the negative growth for Telecoms has been reducing and is expected to turn positive, while the positive rate at which OTTs are growing, although still quite high, is reducing year by year (ETNO, 2015). The reasons for that could be several, including higher competition, or even that Telecoms are adapting to the new environment better, but the case is still that OTTs have had and still have the competitive edge they need to grow and compete in the Telecom market.

Here it is also important to be noted that the competitive advantage of OTTs, besides their resources, is facilitated by the lack of regulation for this relatively new type of businesses and by the regulation that their Telecom competitors are subject to. OTTs have been growing significantly, while Telecom operators are facing revenue reductions, that could be attributed to regulation of roaming prices, access obligation regulation that brings more competitors to the market and as heavily discussed all over Europe, any upcoming net neutrality decisions, as described in the case study of the Netherlands, that would prevent them from retrieving revenues through price discrimination, especially regarding OTTs operating over their networks.

More specific topics that influence the operation and business models of Telecom operators will be analyzed and more thoroughly discussed in the next sub-chapter, where the European Single Market and its underlying issues are put under the microscope.

6.2 THE UNDERLYING ISSUES OF THE EUROPEAN SINGLE MARKET OF TELECOMMUNICATIONS

The creation of the European Single Market in Telecommunications is a top priority for the European Union and a prerequisite for a Digital Single Market to exist (European Commission, 2015). Yet its completion is far from done and the European Telecom market remains to a great extent fragmented. The issues discussed in this chapter, namely net neutrality and roaming, are not only the two most important steps for this completion, but they also define to a great extent how Telecom operators position themselves in the market during adverse financial times for the Telecom sector.

Besides rising competition from OTTs, Telecom operators are facing these two issues that are to a great extent regulatory issues. As analysed in the market survey on Telecoms in chapter 5.1.1 despite the increase in subscriptions, especially in mobile broadband, the ARPU is dropping for Telecoms, which is largely attributed to price competition, substitution of traditional Telecom services with OTT services and finally regulation on termination fees and roaming charges. Taking into consideration the market settings and the EU's plans for net neutrality and roaming, the following analysis attempts to explore the operators' challenges and efforts to adapt to the latest developments.

6.2.1 Telecom Operators and the impact of Net Neutrality

The Telecom sector in Europe has been reporting negative growth since 2009, the reasons for which are multiple and diverse. From the economic crisis to the competition from OTTs and EU Telecom regulation, this is a critical time for operators. Due to the previously mentioned developments the Telecom model is changing; today the role of Telecom networks as critical infrastructure has grown even more significant as besides communications, they are a means of entertainment as well as doing business, a development that has been facilitated by the idea of the open internet and the development of broadband allowing for IP networks to become a platform of innovation and growth.

This has added value to the operators' networks that for years have been benefiting from economies of scale and billions in revenues. This single-sided model though did not work anymore. Initially national monopolies, operators were afterwards subject to access regulation to allow for more competition in the market, from virtual operators that pay wholesale prices to offer Telecom services to end-users and compete with incumbents, bringing prices for Telecom services down. Competition was also intensified by OTT services

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and Telecom operators started turning into a platform for such services but without being able to leverage profit from it to a great extent.

As more thoroughly analysed in section 6.1.1 of this chapter, Telecoms can be considered a two-sided platform, bringing together wholesale customers and content OTT providers with their huge base of connected users. This made networks more valuable but it also increased traffic significantly. OTTs were seen as a threat that claimed revenues from telcos through having their services substituting for other services in the market that were previously exclusively provided by Telecom operators, namely voice and SMS services. This is reflected in almost all interviews with operators conducted for this project.

In the interviews with Telecom operators OTE, KPN and TDC some of the challenges that Telecom operators have to face mentioned include reductions, sometimes quite significant, in international calls and SMS figures, traditional fixed telephony (which could also be attributed to the operators' own OTT services substituting for it). The reductions in SMS numbers can partly be attributed to messaging services, such as WhatsApp, while the decline in voice services are not solely attributed to OTTs but also to substitution of voice with messaging (Karageorgos, G., personal communication, February 3, 2015) (Knol, P., personal communication, March 20, 2015) (Bartroff, A., personal communication, March 16, 2015).

Indeed the market survey on OTTs in chapter 5.1.2 shows that Facebook and WhatsApp, which is owned by Facebook, that offer mainly messaging services, are number one on the list ranked by the number of users, with 1320 million users and 600 million respectively and on a global scale.

To counter-act the effects of OTTs, Telecom operators either started offering their own IP services, such as VoIP or IPTV services, or began partnering with them in order to offer value added services to their customers and use them as promotional services. So what is noticed here is that the OTT business models were initially thought to be directly competing with those of Telecom operators but it turned out that this was not the case, as ANACOM's principal consultant Dr Carlos Costa also notes (Costa, C., personal communication, February 3, 2015). Operators had the option to either compete with more attractive offers or partner with them in a coopetition model, wherever OTT services could act as complementary to theirs. At the same time they started differentiating their bundles to offer all kinds of combined voice, SMS and data packages, with data being the most attractive service, as broadband popularity is still growing immensely.

Price differentiation and price discrimination are being used to offer each customer the bundle that matches their needs. This could be beneficial to customers as having a uniform pricing scheme would spread costs on all users, even those that do not use or wish to have certain services in their bundles, as expressed by GSMA Public Policy Director Mani Manimohan (Manimohan, M., personal communication, March 16, 2015). He notes that as long as customers are aware of the different tariffs, price discrimination or partnerships with OTTs are not harmful for consumers and it is a practice that is allowed in many industries.

Price differentiation practices together with how network operators manage their networks are under debate in the EU as part of the net neutrality discussion nowadays. The next sections analyses the issues related to net neutrality with regards to operators in order to look into the effects of it on their operation and strategy.

Net Neutrality and Telecom operators:

As discussed many times in previous chapters, there is an ongoing net neutrality discussion within the EU, with no attempts to impose specific regulation, but with a more wait-and-see approach so far. The provisions provided until today in the Telecommunications Package of the EU do not explicitly refer to net neutrality as such, but they cover to a certain extent, the issues of transparency and minimum QoS for users (Leal, M. C., 2014).

This project uses a case study on the Netherlands to pinpoint the subsequent issues of net neutrality regulation and the effect on Telecom operators. Both the proponents and opponents of net neutrality have exhibited strong arguments for and against net neutrality regulation respectively. Following are the points of conflict between the opposing sides of net neutrality in Europe, exemplified by the Netherlands case study.

6.2.1.1 Traffic management

On the one hand operators argue that in order to accommodate the increasing traffic from OTTs, such as content providers like Netflix, they need to invest large amounts of money that they may not be able to earn back through charging the end-users. On top of that they are lobbying for having the ability to reasonably manage traffic which is growing exponentially,

especially in video, calling for more regulatory certainty regarding investments and traffic management, as commented in an interview with OTE's analyst from the Markets Regulatory Strategy Division Mr George Karageorgos (Karageorgos, G., personal communication, February 3, 2015).

In several of the interviews, the interviewees drew parallels, regarding traffic management, for models that will allow operators to manage traffic either similar to the concept of tolls in highways, charging larger vehicles more than the small ones or courier services in the postal sector, where the customer can pay more to get their packages faster.

As one of the few examples in the world where net neutrality regulation is already in place, the Netherlands case study can be used to draw some parallels on the above issues. The issue of network management is stressed by KPN and their senior regulatory counsel Mr. Knol as essential for Telecommunications and he warns that there is a chasm being created between the political and the technical world that could affect the future of networks, noting that especially in mobile networks with the GSM and LTE protocols, differentiation between traffic is embedded in the protocols themselves in order for the network to handle traffic effectively (Knol, P., personal communication, March 20, 2015).

One technical concern, mentioned in the same interview that the net neutrality law in the Netherlands has created, is related to interoperability issues between applications and networks that, due to the regulation in effect, can be blamed on the network as net neutrality violations, which is an issue that can only be observed in countries that have net neutrality legislation in place (Knol, P., personal communication, March 20, 2015).

The complications of defining whether a suspected net neutrality violation is taking place is also mentioned by PhD researcher Roslyn Layton, who added device characteristics and reception as reasons for bad user experience, besides the technical incompatibilities of applications (Layton, R., personal communication, March 13, 2015).

The Portuguese regulator ANACOM and their principal consultant Dr. Carlos Costa also commented on the rarity of net neutrality violation complaints (Costa, C., personal communication, February 3, 2015), although one cannot conclude that they are not present since it is not always easy to define what can be attributed to a net neutrality violation and what not.

6.2.1.2   Investment in the networks

With regards to investment and the impact of net neutrality regulation on it, regulating Telecoms, where it makes sense to do it, such as the obligation to provide emergency calls, is something that operators reckon will always exist, as GSMA Public Policy director M. Manimohan notices (Manimohan, M., personal communication, March 16, 2015). But the fact that net neutrality regulation might impose rules on price differentiation and price discrimination is something that operators and especially in mobile, do not wish for and would prefer that the EU would wait with implementing ex post regulation rather than taking the ex-ante approach, adding that certainty of investment will come if the regulations imposed allow for flexibility from both technical and commercial aspects. Finally he notes that operators are committed to maintain the open internet but that can happen only if regulators allow for multiple pricing and tariff plan approaches that enhance competition.

As additionally noted by Mr G. Karagerorgos and OTE, such regulation should ensure that operators can get a return on their investments in the networks, rather than create an uncertain environment with rules that do not allow operators to recover the expected return of investment. He also notes that if such regulation were to be implemented, the operation of the company would be affected on both commercial and technical levels but it is impossible to know beforehand what the impact will be, as long as the developments in the EU are not finalized (Karageorgos, G., personal communication, February 3, 2015).

Without a net neutrality framework in place, quantifying the impact of such regulation through performing econometric studies are not easy to be done. R. Layton, a PhD candidate on the subject of net neutrality, also notes that countries have not performed a regulatory impact assessment on net neutrality, which creates cautiousness when it comes to such regulation. The EU has partly done that but there is still no definite proposal (Layton, R., personal communication, March 13, 2015).

6.2.1.3   Price differentiation and partnerships with OTTs

Another important aspect in the European debate for net neutrality is how strict the rules should be, especially when it comes to pricing practices and by extension partnerships with OTTs. There has been research on the two-sided nature of Telecoms regarding whether charging OTTs should be allowed or not (Musacchio, J. et al., 2009) (Economides, N.; Tåg, J., 2012). The Dutch legislation on net neutrality has imposed strict rules on pricing, which can

in turn affect partnerships with OTTs, meaning that operators are not allowed to perform negative or positive price discrimination, as described in chapter 5.2.1.

Regarding price differentiation the most popular discussion is the case of zero-rating, a practice used vastly, especially when it comes to partnerships between OTTs and operators as described in chapter 5.1.3. This type of price discrimination is until today controversial, as besides promoting the service to the installed base of operators and allowing them to leverage the growing popularity of such services, net neutrality proponents support that it works at the expense of smaller and newer applications that do not get the same treatment with negative effects on competition and consumers.

In the case of zero-rating the Dutch law is very strict, as proponents of net neutrality and politicians in the Netherlands have stressed many times how zero-rating is a bad practice that harms innovation, discourages newer players with less resources to compete, strengthens the market position of ISPs and restricts freedom of choice for consumers by steering them towards a specific OTT company (Kreiken, F., personal communication, March 31, 2015). The Dutch regulator has already imposed fines regarding zero-rating violations (see Vodafone-HBO case in 5.2.1) since the implementation of the law but Dutch operators support the use of zero-rating for promotional purposes and it would be considered, hadn't the law banned it (Knol, P., personal communication, March 20, 2015).

Slovenia, the second country in the EU with a net neutrality law in place and their national regulator AKOS, decided in early 2015 to also ban the practice of zero-rating and include it in the net neutrality regulation, giving the Slovenian operators 60 days to stop any such practice[102]. On January 21st, 2015 AKOS announced on their website two violations of net neutrality for Telecom operators Telekom Slovenia and Simobil for "unequal treatment of data traffic offered to their users.[103]" The decision referred to Telekom Slovenia's music streaming 'Deezer' service and Simobil's cloud storage app 'Hangar mapa' on the base of differentiation on data traffic.

The European Union on the other hand, has not included this type of ban in any of its proposals (Knol, P., personal communication, March 20, 2015) (Westerink, J., personal communication, March 23, 2015). Commenting on the subject of zero-rating, other operators,

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[102] http://www.Telecomtv.com/articles/net-neutrality/slovenia-bans-zero-rating-price-discrimination-as-the-eu-dithers-12125/
[103] http://www.akos-rs.si/akos-finds-violations-of-the-principle-of-net-neutrality

such as TDC in Denmark, comment that in case zero-rating is banned by the EU, they would have to redesign some services but it wouldn't have any significant impact in terms of revenue (Bartroff, A., personal communication, March 16, 2015). The Dutch are lobbying for the adoption of similar rules on price discrimination in the EU but support in the Council is insufficient (Westerink, J., personal communication, March 23, 2015). This seems to actually be one of the points where there is a significant chasm in the opinion between the EU and the Dutch regarding how to approach net neutrality.

The Council is discussing a more mild approach that includes the intervention of the regulator when price discrimination is applied by large-scaled operators thus affecting a great number of consumers. The approach of the Council on the subject of price discrimination has also been commented on by digital rights organizations, such EDRi (European Digital Rights) that call for strong net neutrality rules, stating that the position of the Council undermines net neutrality[104]. The discussion is still open and the European approach has not been finalized yet.

But the absence of specific regulation in Europe allows operators in different countries to follow different approaches, which contributes to further fragmentation of the market rather than consolidation. As BoF researcher Floris Kreiken commented "*I think it would be a good idea [to have a European framework for net neutrality] if you want to have a digital single market that is competitive, […] because if you don't, you will never attain the EU single market that the policy makers and the EU wanted to have, a single market with complete competition*" (Kreiken, F., personal communication, March 31, 2015).

An example that can indicate how depending on the country, operators can follow different approaches regarding OTTs and the partnerships with them, is that of WTF, an MVNO owned by NOS, the third largest operator in the Portugal, that zero-rates several OTT applications in order to attract more customers.

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[104] https://edri.org/price-discrimination/
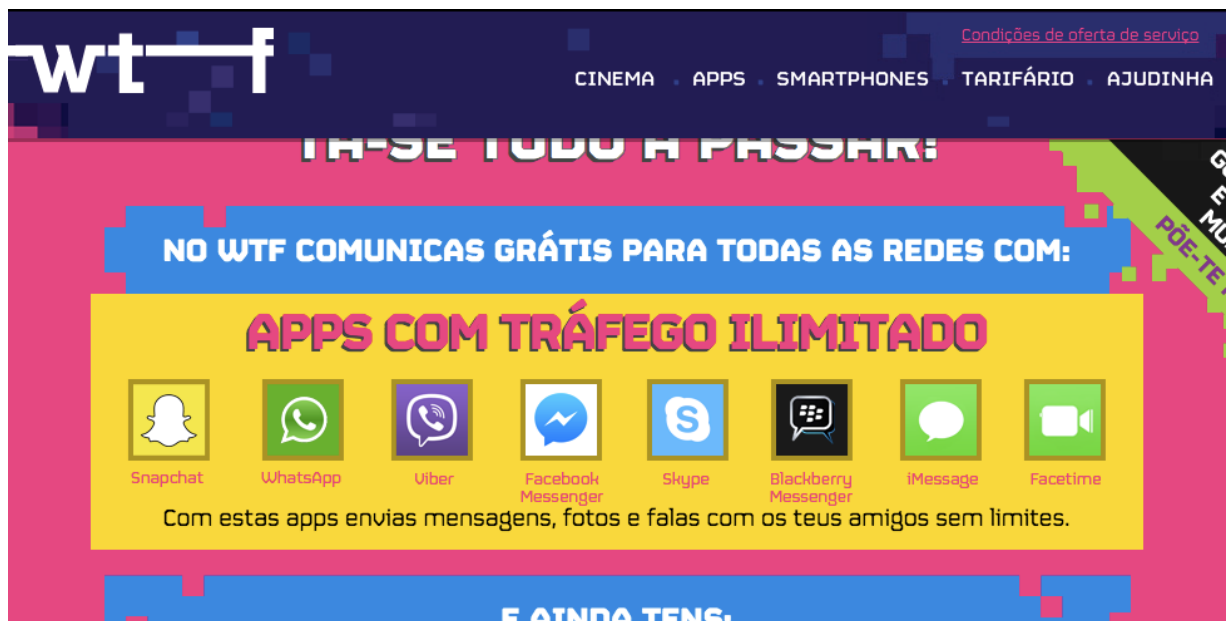
Figure 52: WTF offering zero-rated apps[105].

The above figure advertises how WTF subscribers can use Snapchat, WhatsApp, Viber, Facebook messenger, Skype, BBM, imessage and Facetime without any data limits: *"With WTF you can communicate for free with all networks with: APP with unlimited traffic".* In Portugal this is possible due to lack of regulation but in the Netherlands it would most likely lead to a fine for this company. Such differences in the way Telcos operate does not allow for a single market to exist, without everybody operating under the same rules in Europe.

The next section on specialized services is also closely connected to the issue of zero-rating, as the distinction between what an OTT service and what a specialized service is, will also affect the above described partnerships and possibly force operators to change some of their offers.

6.2.1.4 Specialized services

In the case study of the Netherlands the subject of clarity in the net neutrality law was an important part of the analysis. More specifically, Telecom operators in the Netherlands, like KPN and Vodafone that have already received fines for net neutrality violations called for more clarified definitions of what an internet service over the open internet is and what a specialized service is. In the Netherlands case study in 5.2.1 the example of a KPN app, which they offer their customers, for changing their subscription is mentioned, if defined as an OTT service, cannot be zero-rated and is rendered useless. Commenting on the subject of clarity of the law the Dutch Ministry of Economic Affairs supported the clarity of the law (Westerink,

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[105] http://www.wtf.pt/

J., personal communication, March 23, 2015), while researcher Floris Kreiken from BoF comments that the law demands new clarifications, as some room needs to be left for that to happen with a new law like this (Kreiken, F., personal communication, March 31, 2015).

In the case of a European regulatory framework for net neutrality it needs to be clear what a specialized or managed service is considered to be and thus be exempted by the law. (Layton, R., personal communication, March 13, 2015). The approach on this subject will define what room will be left for applications such as driverless cars, telemedicine services and other applications for which it is critical to have a reliable internet service to be used. It is important for traffic from applications like these to be prioritized in the networks so that unfortunate situations are prevented.

The definition of a specialized service is not just important for Telecom-OTT partnerships and applications with need for prioritized traffic. Its significance is also obvious when it comes to engineering aspects and network technologies. Chapter 4.2 contains a detailed description of two of the most important mobile protocols that are used nowadays, GSM and LTE. Traffic management especially in mobile is extremely important and embedded in these protocols. And as demand for faster networks and more capacity increases, the newest technologies rely more and more on traffic management and prioritization.

In chapter 4.2.5 the VoLTE technology is described. It is a technology with great potential that offers high quality of service for applications carrying voice, making it one of the candidates for the substitution of traditional fixed telephony. Intrinsically this technology needs to prioritize traffic for delay-sensitive applications. A strict application of net neutrality would create hindrances to the deployment of such a technology. The same applies to 5G networks.

In the case of the Netherlands, the law is clear when it comes to technologies like VoLTE, which is considered a specialized service with no complications for its application (Westerink, J., personal communication, March 23, 2015). A clear definition on specialized/managed and OTT services needs to be provided in a future EU regulatory framework for net neutrality in order for technological advancements to be applied, as it can affect technology innovation on the networks and create uncertainty in the market. At the moment there is an ongoing debate in the European Parliament on the extent to which specialized services undermine the open internet (Westerink, J., personal communication, March 23, 2015).

6.2.1.5 Privacy and Data Protection

Regulation is about protecting consumers and creating better market conditions so that they get the most out of what's being offered. Proponents of net neutrality such as the EDRi stress the importance of people's digital rights as well as the right for freedom of choice, privacy and data protection. The Netherlands case study indicates the importance of this role.

Proponents of net neutrality in the country, such as BoF, were supportive of these rights since the beginning on the discussion. In addition, the trigger for the law was KPN's announcement regarding the use of DPI, a technique that allows for looking deeper into the contents of a packet, to investigate traffic originating from OTTs like WhatsApp and explore additional charges to users. The announcement stirred reactions from digital right organizations and politicians not only because it announced discrimination against specific OTTs but also because the use of DPI would violate fundamental digital privacy rights of consumers.

The European Union has also defined in its legislation such rights and condemns any attempt of their violation. At the same time the Telecom sector is subject to strict regulations regarding how they handle traffic and users' data as well as consumer protection in general (Westerink, J., personal communication, March 23, 2015) (Knol, P., personal communication, March 20, 2015) (Layton, R., personal communication, March 13, 2015). Net neutrality regulation in the Netherlands is about making sure that everybody in the Telecom market has equal chances to compete and thus the strong position of network operators as gatekeepers is important (Kreiken, F., personal communication, March 31, 2015) (Westerink, J., personal communication, March 23, 2015). Privacy and data protection are two important issues that are related to net neutrality, as certain practices that net neutrality protects consumers against contain privacy aspects (Layton, R., personal communication, March 13, 2015).

At the same time though, lack of OTT regulation in this respect leaves consumers unprotected and OTTs, like Google, or Facebook, are not subject to many rules regarding how they use and what kind of access they have to their users' data. BoF researcher Floris Kreiken comments that there should be more regulation regarding consumers' data also on OTTs, but that does not put OTTs under the same category as Telecoms (Kreiken, F., personal communication, March 31, 2015).

This issue overlaps and is more directly stated in one of the main goals of the current Commission about the second pillar of the DSM ("*creating the right conditions and a level*

playing field for digital networks and innovative services to flourish[106]"): to analyze the role of online platforms, such as search engines, social media etc. and more specifically, how they use the information they acquire, how that affects competition as well as the ways to combat illegal content on the internet.

6.2.1.6   Innovation

The innovation aspect of net neutrality is a very important and widely discussed one. The absence of regulation and rules on the open internet has allowed for a lot of innovation in the application and services world that has in turn helped small companies with very few resources to compete and have an impact on Telecom giants in a market with high barriers of entry. This can also be observed by the RBV analysis used for both Telecoms and OTTs in chapter 6.1.2.

The resources of Telecoms, such as the networks, their installed based or the amount of capital they possess, despite being important and giving them a very strong position in the market, were not enough to create a sustainable competitive advantage against OTTs. The analysis shows that OTTs used their resources, such as the open internet and the lack of regulation, to their advantage and managed to gain competitive advantage against Telecom operators. Using the RBV framework, it is shown that as a type of business, OTTs look like they have a sustainable advantage, when comparing to Telecoms in terms of usage and based on their significant rate of growth the last few years, but since they operate in a very volatile market, where users are one click away without any significant lock-in mechanism in play, they can shrink in a blink of an eye, meaning that individually, a sustainable competitive advantage is not observed.

The emergence of OTTs has benefited consumers immensely by bringing prices down and offering new types of services that did not exist before. That is what proponents of net neutrality, from the beginning of the discussion by Tim Wu in the U.S., are trying to protect with the net neutrality regulation.

From the Netherlands case study it is not clear that there has been more innovation since the regulation came to place. And the matter of the fact is that there is no way to know whether without this regulation things would have been different (Kreiken, F., personal communication, March 31, 2015) (Layton, R., personal communication, March 13, 2015).

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[106] http://europa.eu/rapid/press-release_IP-15-4919_en.htm

According to the Dutch Ministry of Economic Affairs that is responsible for the law, this law is acting as a preventive measure against harming innovation, and the Telecom operators' strong position could bring about such phenomena (Westerink, J., personal communication, March 23, 2015). The only remark on the side of the operators is for legislators to take into account how innovation is also needed at the network level, with regards to the subject of traffic management (Knol, P., personal communication, March 20, 2015).

But an observation that can be made regarding innovation is that, even in the case where there is net neutrality regulation, as in the case of the Netherlands, there haven't been many European or completely new OTTs flourishing. Looking at the market survey about OTTs in chapter 5.1.2 and the corresponding table, in the case of messaging and voice most OTTs are currently American OTTs that are overtaking the market. Of course the figures about the number of users is global, but all of these OTT providers operate in Europe with great success and in most cases in the OTT market we notice winner-take-all scenarios, a trend which can be explained by the theory of network economics and the network effects that such services are subject to.

The same applies to other types of OTT providers, such as cloud and content providers, where the most notable example of European OTTs is Spotify. The rest of the top OTTs in these fields are companies like Netflix, which are American companies. This brings the question to the table of why there aren't many more European-based OTTs taking over the market and succeeding.

At the same time, after the net neutrality regulation was implemented in the Netherlands companies like Netflix grew even more, creating the question of whether net neutrality creates indeed equal opportunities for everyone and to what extent it strengthens the most successful OTTs (Layton, R., personal communication, March 13, 2015).

The above analysis looks into the most important issues that create a headache for operators regarding net neutrality regulation. More specifically the list includes investment in the networks, the ability for price differentiation and price discrimination, also with regards to partnerships, specialized services, the issue of privacy and data protection as well as innovation in the market. This analysis will be further used in the next chapter for discussion and conclusion in order to see the overall picture and draw some conclusions on the subject.

As a general comment though, net neutrality despite the negative or positive effects it might have on operators, is finding more and more support in Europe. Even in cases where there is no specific legal framework for it, the European debate on it has an effect on the operation of the networks. A good example mentioned in an interview with Greek Telecom operator OTE and analyst Mr. George Karageorgos, is a court decision in Greece which responded negatively to the Greek IPR Authority's request to block access to BitTorrent files, using as one of the arguments for the decisions the net neutrality principle. The decision, the first to mention net neutrality explicitly in the Greek legal system, to the operator's knowledge, took them by surprise and indicates how this European discussion is soon to turn into national debates (Karageorgos, G., personal communication, February 3, 2015).

Provisions on net neutrality are calling for careful handling on behalf of the legislators, who need to take into consideration the impact of such regulation on the market. At the same time this debate has brought to the forefront questions regarding regulation on OTT companies, which up to date are almost completely free to set up anywhere they want, have more freedom to choose a base with less taxes and use consumers' data more freely (Layton, R., personal communication, March 13, 2015). The objective to achieve a level playing field among OTTs and Telecom operators is a difficult one due to the diametrically opposed nature of their businesses and finding a balance is an important task of legislators and regulators.

But the EU institutions have another difficult task to complete. The creation of a Telecoms Single Market, besides setting the rules for net neutrality, necessitates the end of roaming in the Community as the next step to market consolidation in Europe. This subject is taken upon in the next subchapter and analyzed as the other part of the equation for the European Telecom Single Market.

6.2.2 Telecom Operators and the effects of the eurotariff and the elimination of roaming fees

From the Spanish case study what can be observed is the importance of the roaming market to Telecoms in Spain between years 2007 to 2011 as it accounted for between 9% and 6% of the total market. As such it is important to understand why it is so hard to get data from this specific part of their revenue stream. Most of these Telecom companies are listed in the stock market and as such they might interested in showing that such substantial part of their revenue was under threat.

An example can be the Telefonica stock which has been at its highest at the end of 2007 and although Telefonica is not only present in Spain (having access all over the world) and does not only offer SMS and voice services, the Spanish market seems to have a very big impact on the company's revenues. Currently based on the growth of revenues, especially in mobile broadband, it's making its way back.
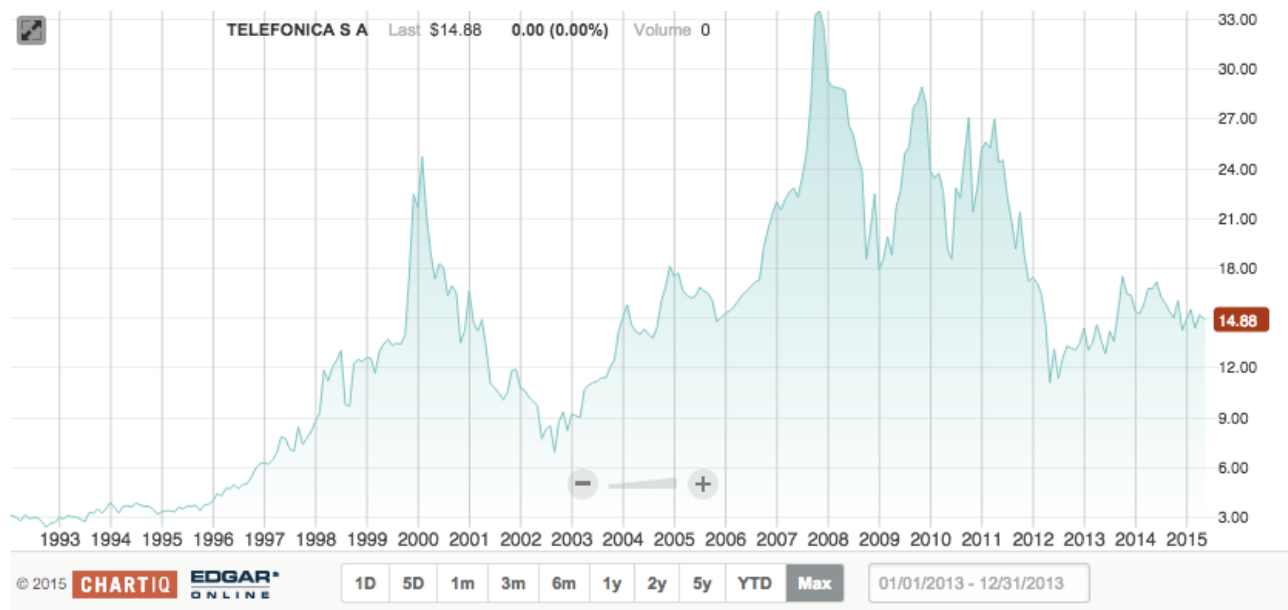
Figure 53: Telefonica stock value fluctuations[107]

Users on the other hand increased their usage after the implementation of the eurotariff but it was not enough to compensate for the sharp reductions in prices. It can be disputed whether users are informed enough about the decline in roaming prices. A study from the European Union from 2011 showed that 72% of Europeans still limited their communications when abroad and 61% were aware that the prices had reduced. Which still left 39% of users that had no idea and this might reduce the number of users that limited their calls and achieve even bigger growth in usage[108].

Going back to the Spanish case it is interesting to compare how the growth in roaming revenues and total revenues evolved.

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[107] http://www.nasdaq.com/symbol/tef/interactive-chart
[108] http://europa.eu/rapid/press-release_IP-11-148_en.htm

Year	Roaming Revenue (Mil.€)	Total Revenue (Mil.€)	Roaming Growth	Revenue Growth
2007	1230	14103.9	-	-
2008	980	13958.9	-20.33%	-1.22%
2009	860	12960.8	-12.24%	-7.15%
2010	760	12348.6	-11.62%	-4.72%
2011	710	11305.2	-6.58%	-8.44%

Figure 54: Roaming growth 2007-2011

Using this table's calculations it is possible to have a better understanding of the extent to which the decline of roaming prices impacted the Spanish market. From 2007 to 2008 most of the revenue loss came in fact from the loss of revenue for roaming but in the next years roaming, although still reducing, cannot explain alone the loss of revenue in the Spanish market anymore. A decline like this can be attributed to many reasons the main ones being regulation, price competition and substitution from OTTs (ETNO, 2014).

The main success in the Spanish market has been the mobile broadband market, both internally and in roaming. This last part has been characterized as a very big success for the EU, because it presented a growth of 630% since 2007 (until 2014) through the Union, in terms of usage[109].

In Spain despite the very fast decline in prices, the traffic increased much more allowing the revenue to keep on growing only declining slightly from 2011 to 2012. The traffic usage in Spain presented a growth of 423% from 2008 to 2012 according to the calculations based on the Spanish case study.

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[109] http://ec.europa.eu/digital-agenda/roaming

Broadband was not the only part of revenue that grew due to the roaming price caps. A study from BEREC already mentioned in the Spanish case showed that roaming grew in an almost transversal way in all Europe (BEREC, 2014). The roaming caps aimed at achieving a model where Europeans with lower prices would be able to "roam like home".

The EU Commission's roaming proposal consisted of:

- "Rome like home" – The consumer pays the same abroad as when at home.

- When roaming, no charges to receive calls or text messages – just like at home.

- Price harmonization – Calling from one country to another should be the same price as calling within a country.

- Required operator participation and no restrictions - EU member states and companies must comply with the rules. No technical or contractual barriers to trade are allowed.[110]

EU claims that this resulted in achieving "retail price reductions across calls, SMS and data of over 80% since 2007; Data roaming is now up to 91% cheaper compared to 2007; Since 2007, the volume of the data roaming market has grown by 630%"[111]. Another reason for the increase in roaming usage can be the growing demand for connectivity (Gentner, 2014).

Although this plan had intrinsic value to the users, for Telecoms there were predictions, made mainly by consulting companies that warned about revenue loss, cost cutting and decline of investment due the elimination of roaming fees (Gentner, A., 2014) (Kennedy, S., 2014). To some extent part of that happened but it cannot be attributed solely to the implementation of roaming caps. At the same time, roaming charges are not completely abolished yet, so the full extent of the change is not obvious to this day.

But one way that the European union found to mitigate the future problems was that "If you sell goods and send them to consumers in another EU country, you need to register there and charge VAT at the rate applicable in that country - unless the total value of your sales to that country in the year falls below the limit set by the country (EUR 35 000 or EUR 100 000)"[112].

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[110] http://www.strandreports.com/sw5671.asp
[111] http://ec.europa.eu/digital-agenda/roaming
[112] http://europa.eu/youreurope/business/vat-customs/cross-border/index_en.htm#

This change was made so that companies could not exploit the fact that some countries have lower VAT than others and as such lead to unfair competition. What wasn't solved is the fact that the Single Digital Market can lead to a very harsh market consolidation movement which the EU might not be very fond of [110]. This was considered a move in the right direction by several Telecoms, not only for the future of Telecoms, but also for OTT services which Allan Bartroff, senior advisor from TDC in Denmark, considers "that was good progress, putting OTT's and Telecoms on equal footing" (Bartroff, A., personal communication, March 16, 2015).

In more recent reports, the EU is starting to show concerns about the original concept of Roam like Home, mainly due to the fact that it won't be easy to apply, due to the cost structure and tax structure of each country being very different from each other. This can lead to border trade and SIM card arbitrage. In order to avoid this kind of exploitation there is a new proposal that instead of a "Roam like Home" approach, proposes a slightly different one that could make a difference for Telecoms. This proposal is "Roam like a Local" which allows Telecoms in countries with higher cost structures to still be able to invest in the network[113].

Another problem that is being mentioned in EU reports is the fact that Africa and Asia are ahead of the EU in LTE rollout. But what EU reports fail to mention is that in those countries, operators are allowed to simply repurpose old spectrum to new technology. In Europe, on the other hand, it was chosen to keep the old model that maximizes national governments profits and it is a very different situation when an operator can use repurposed spectrum or whether they must purchase spectrum and in some cases when spectrum needs to be re-farmed from other uses[113].

Some operators are not waiting for the EU to decide what to do about roaming and are trying themselves to take advantage from the current market status. One interesting case was put forward by the Italian operator Zeromobile, who is trying to propose a low cost roaming solution for chatting. ChatSim is a service that allows the user to chat for free and with no limits when using any instant messaging apps. Covering almost all corners of the world, ChatSim can be considered disruptive in the Telecom roaming market. Benefiting from the roaming agreements from Zeromobile, ChatSim has roaming agreements with 400

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[113] http://www.strandreports.com/sw5700.asp

operators in 150 countries. It allows free usage from QQ, WhatsApp, Facebook, Messenger, WeChat, Skype, Viber, LINE, KakaoTalk, Telegram, Snapchat, Twitter, Hangouts, iMessage and all other apps for devices and also claims that lets the user save up to 85% on the cost of incoming and outgoing calls, text messages and mobile Internet[114].

In a recent interview the CEO of Zeromobile explained this new product, "ChatSim solves the problem of roaming in the EU and around the world. EU citizens can now travel from one country to another and continue chatting with their favorite app without worrying about the cost of roaming" also adding that "Roaming is a way to make users spend a lot of money and to let operators make a fortune. By contrast, ChatSim allows you to chat without limits, anywhere in the world, without any roaming fees. In addition, the European Commission is putting off the elimination of roaming charges until 2018 due to the obstruction of operators. In 2018 will there still be someone making calls, sending SMS? According to recent surveys, including the We Are Social report, the use of text messages and calls is decreasing compared with chatting and VoIP calls. This delay, therefore, almost seems a farce for users." Zeromobile is trying to present themselves as the "smartphone Robin Hood" and take advantage from the fact that EU decided to postpone the abolishment of roaming rates until 2018[115].

ChatSim's cost is 10 euros per year and also 5 euros for the sim card, allowing users for one year to travel and use as much instant texting apps as they want.

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[114] http://www.consumerelectronicsdailynews.com/response-to-eu-position-on-international-roaming-found-in-ChatSim/
[115] http://www.consumerelectronicsdailynews.com/response-to-eu-position-on-international-roaming-found-in-ChatSim/

Figure 55: ChatSim cost and coverage[116]

Although this type of bundles are very good for the users, reports say that they are putting operators' revenues at risk. A very recent study done by Syniverse in partnership with Strategic Economic Engineering Corp (SEEC) showed that many users consider roaming prices are too expensive but the roam-like-home plans can make operators lose up to $16 billion in the US, UK and German markets[117].

This is mainly due to operators coming under pressure from both the media and regulatory bodies to lower fees and increase billing transparency. And this is a subject of more and more interest to users according to Mary Clark, CMO of Syniverse: "Consumers are increasingly viewing roaming pricing as a significant competitive differentiator of mobile operators worldwide," also commenting that "Operators that stay focused and implement intelligent roaming solutions – such as real-time roaming detection, targeted offer campaign management, audience segmentation, discounting and data roaming sponsorship – are in a stronger position to retain subscribers, protect their domestic revenues and benefit from

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[116] http://www.ChatSim.com/en/buy-now
[117] http://Telecoms.com/403291/roaming-bundles-putting-operator-revenues-at-risk-report/

their share of the increasing roaming segment"[118]. As such services like ChatSim could be successful at least while Telecoms don't deal with roaming issues themselves.

At the same time, some concerns can be raised from this service in countries like the Netherlands, because while ChatSim allows all types of instant messaging apps, in order for them to work data is needed. This can be considered zero-rating and might be an issue in countries, such as the Netherlands or Slovenia, where zero rating is not allowed due to net neutrality regulation.   The next part analyzes the EU market in terms of roaming SMS, voice and mobile broadband since the introduction of the price caps.

6.2.2.2   European Union roaming usage

In the European Union, in terms of voice market, there was a general growth, regarding the fourth quarter. The graph from BEREC about this was shown in the introduction of Spanish case in last chapter. For the first quarter of 2014, the perspective isn't so positive. Growth can be noted in a few countries but in the majority of them a decline is observed.
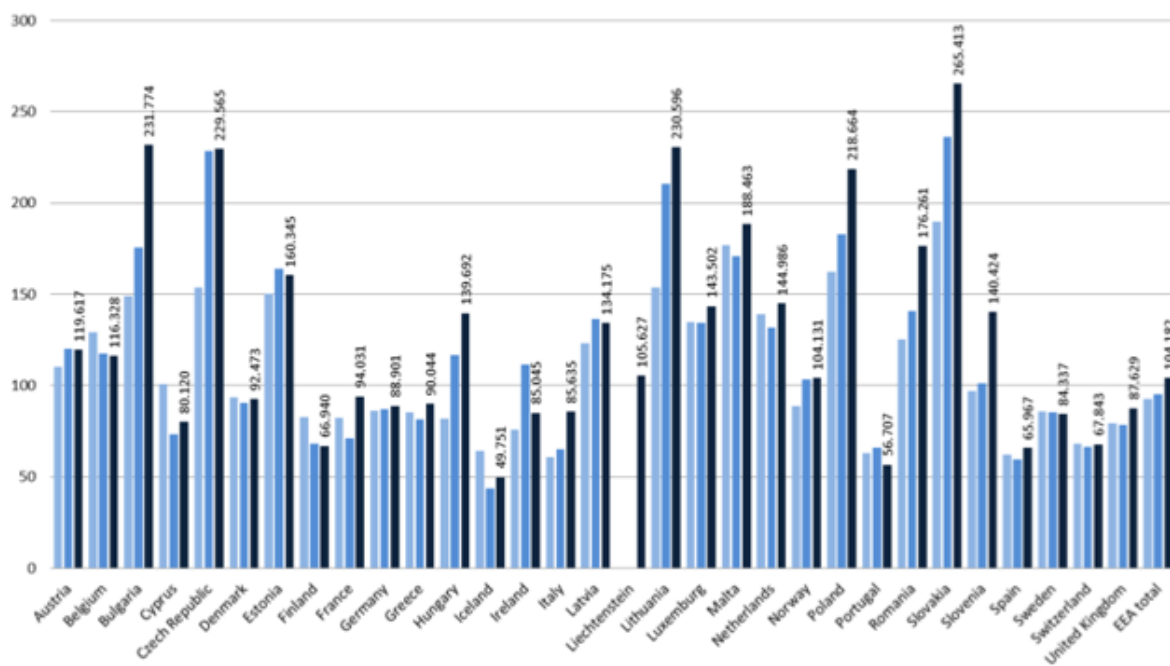
Figure 56: Voice of intra-EEA roaming calls, Q1 2014 (BEREC, 2014)

All the five largest economies in Europe (Germany, France, UK, Italy, Spain) experienced declines in the number of roaming calls in the first quarter. In terms of roaming

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[118] http://www.syniverse.com/content.cfm?page_id=14&press_release_id=599

calls received during Q1 are also similar to the calls made, which doesn't correspond to the better Q4 in the Spanish case.
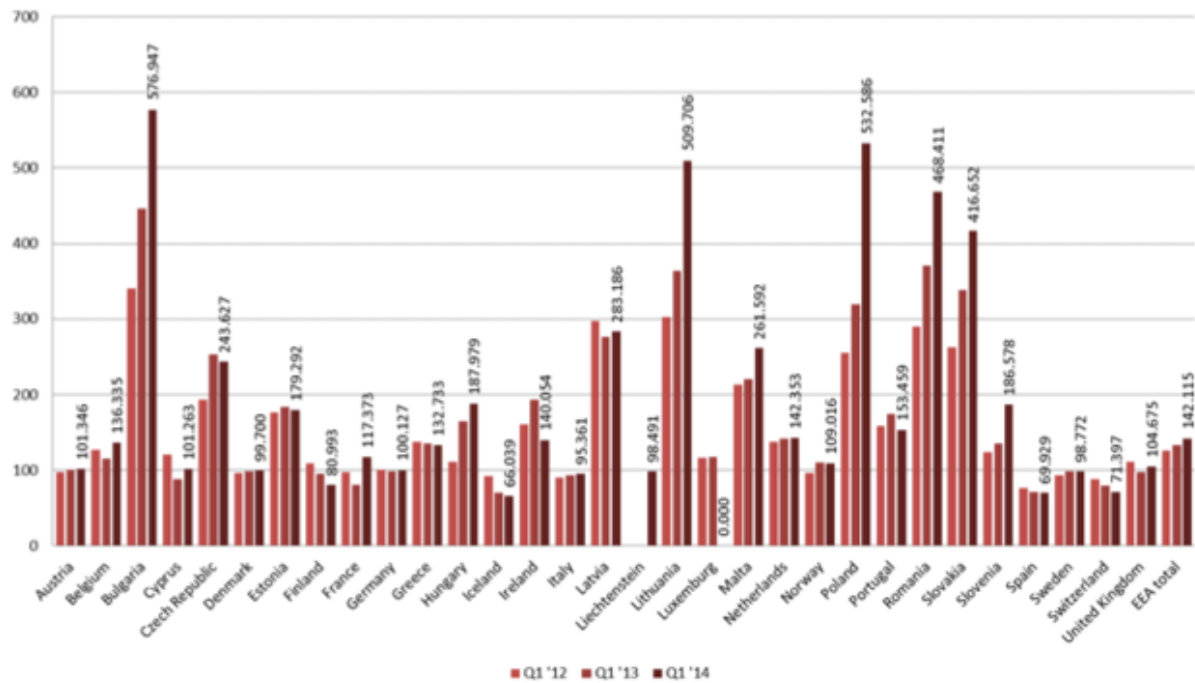
Figure 57: Volumes of Intra-EEA roaming calls received, Q1 2014 (BEREC, 2014)

Regarding roaming and SMS, one can say that from the beginning of the implementation of the price caps, EU operators mostly set the prices very close to the price cap as the figure below indicates.
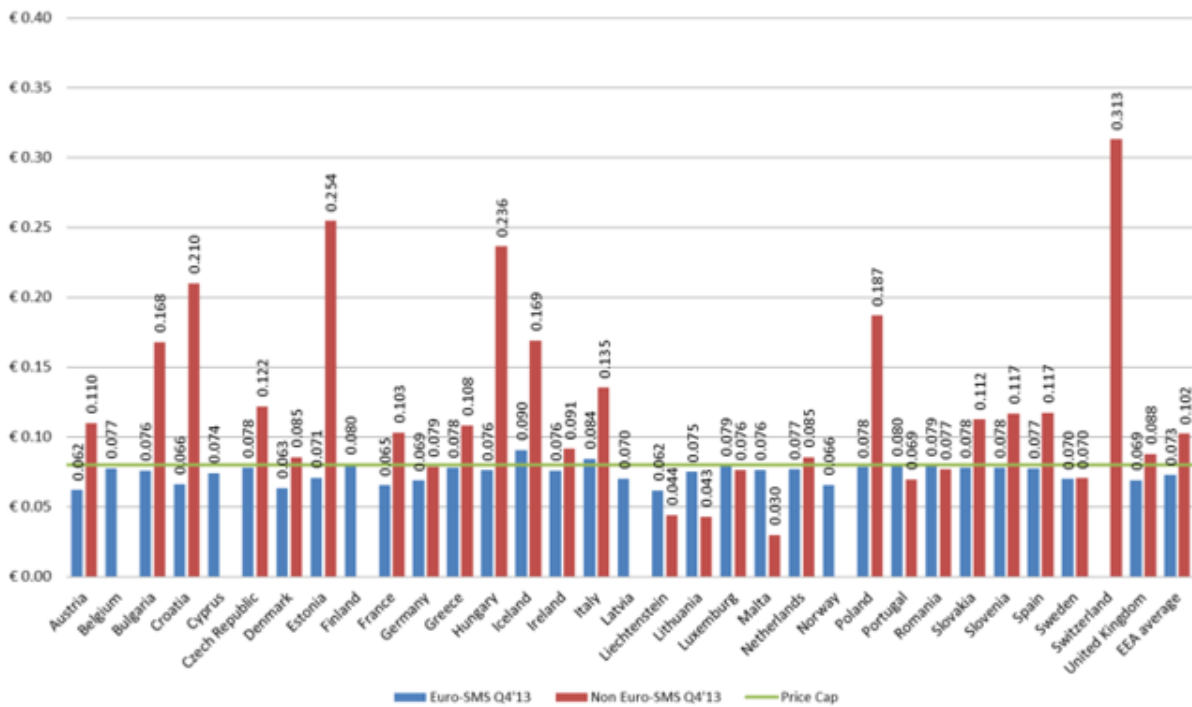
Figure 58: Average price for Euro-SMS and Non Euro-SMS (BEREC, 2014)

In terms of usage there was growth observed both in Q1 and Q4 but like in the voice case the Q4 has done better than the Q1.
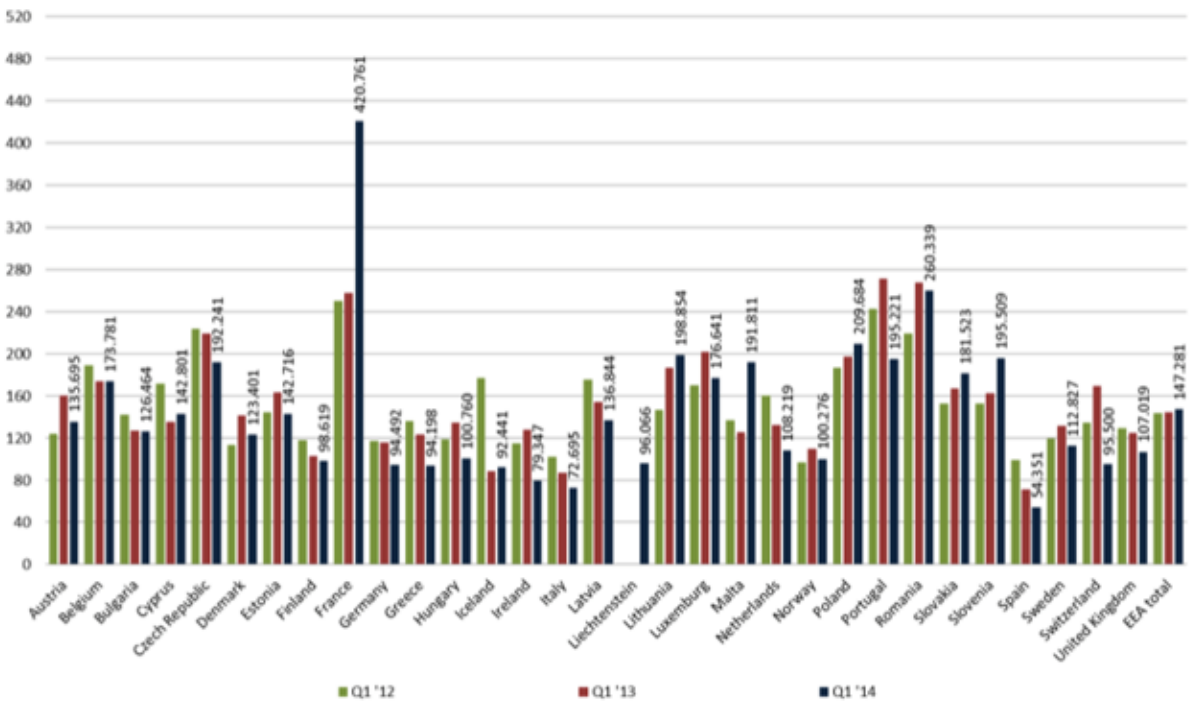
Figure 59: Volumes of retail intra-EEA roaming SMS sent, Q1 2014 (BEREC, 2014)
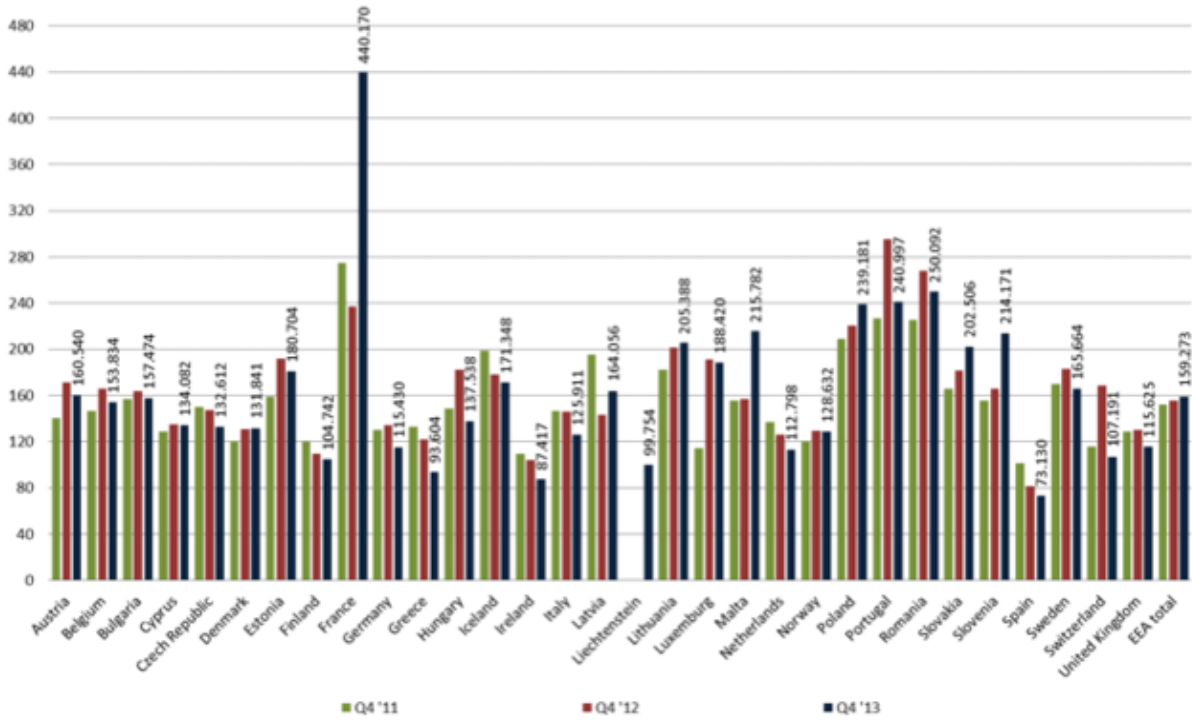
Figure 60: Volumes of retail intra-EEa roaming SMS sent, Q4 2013 (BEREC, 2014)

In both cases the scenario is much better than in the voice case and in the case of France there is an explosion of SMS usage, so at least the EU can claim that their goal was achieved.

And finally about mobile broadband this was the market that European Union have reduced the prices more as the graph below shows.
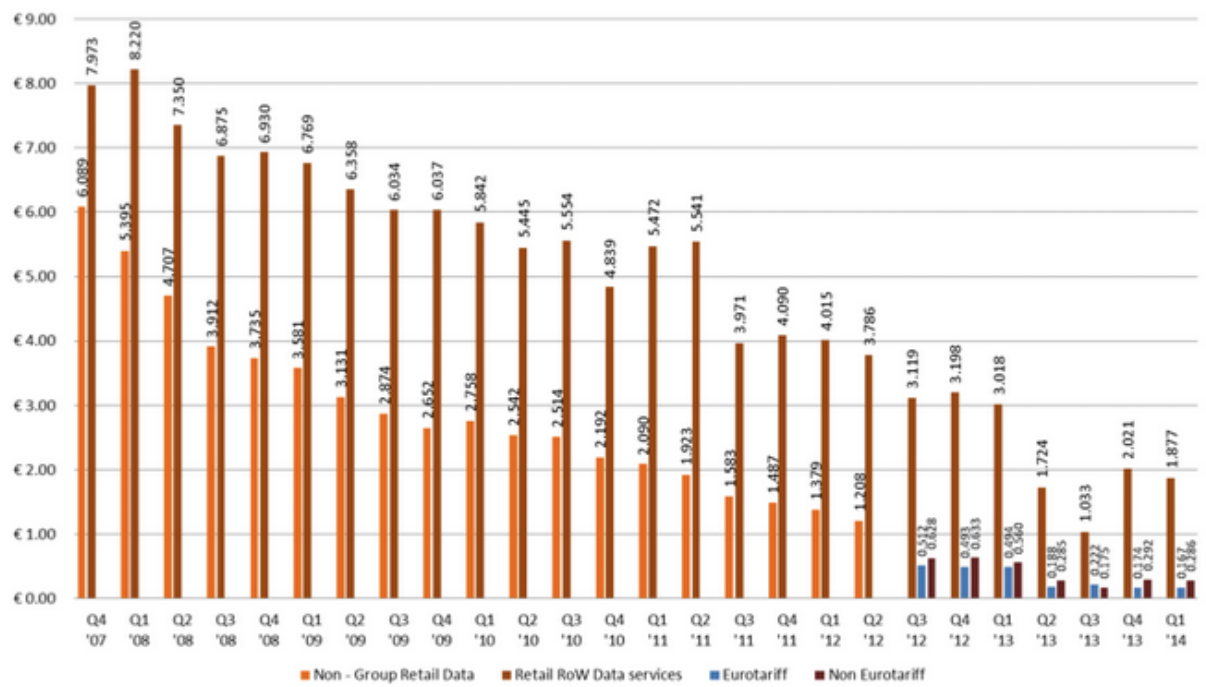
Figure 61: EEA average price per Mb for retail EU/EEA and RoW data (BEREC, 2014)

So it is interesting to see how these cuts have resulted Europe-wide, and as shown in the figure below and in the Spanish case, there was an explosion of usage in both quarters that BEREC covered (Q1 and Q4).
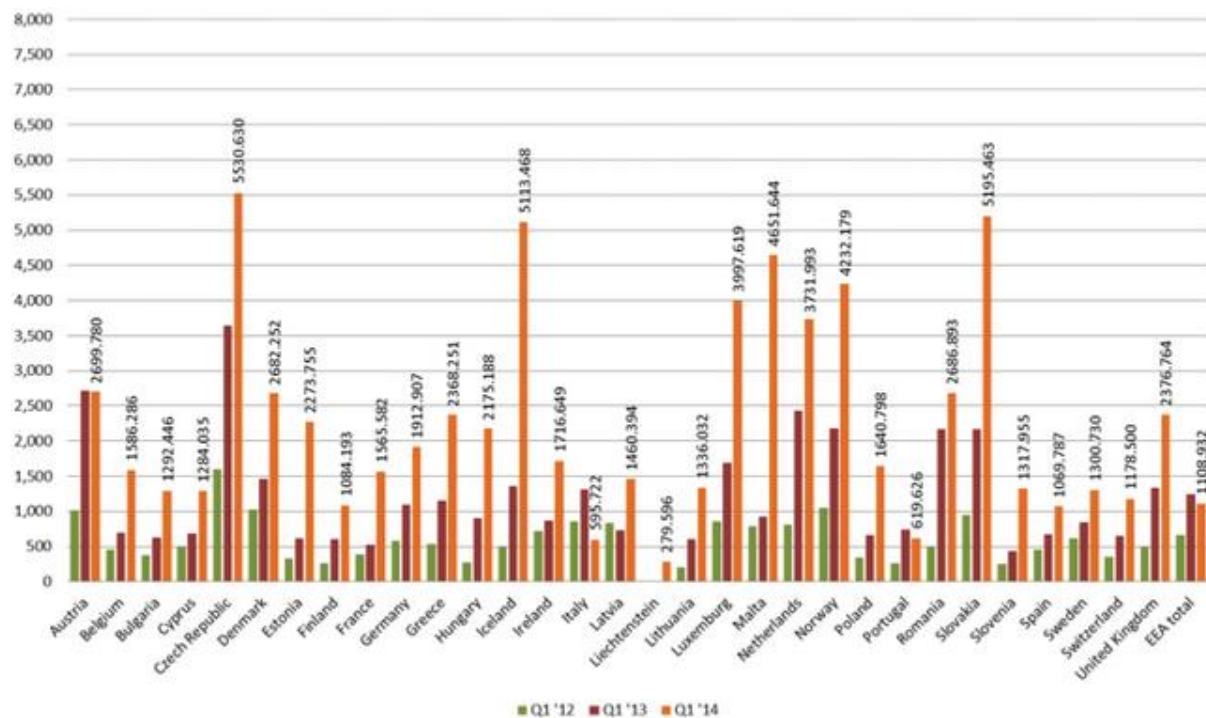
Figure 62: Volumes of retail data, Q1 2014 (BEREC, 2014)

The growth was so fast that certainly price played an important role, but also the OTTs' importance to the users can't be diminished and could also explain why voice didn't do so well. It is fair to assume that many users are substituting voice roaming with data roaming. It is also important to take into account that many users when abroad use WiFi (free or paid) to communicate.

With this part of the analysis dedicated to roaming in Europe, the big picture shows that in terms of calls, SMS and data there was a big disparity in results depending on the country. Some markets had a positive response to the eurotariffs, others not so much, the only constant being that in terms of mobile broadband the growth was very generalized.

At the same time other factors were at play for these results that are presented at a time of generalized austerity across Europe, which shows that in the case of mobile broadband growth could be even more significant if such conditions were not present.

In addition the example of ChatSim shows that there are some companies looking at this sector of their revenue structure with growing interest and coming up with business plans to

innovate and try to disrupt the OTT roaming instant messaging. This is a trend that might be followed by other Telecoms.

6.3 TSM AND THE TELECOM OPERATORS' POSITION

The previous two chapters of the analysis indicated the strong interrelations that political institutions and regulation have with the Telecom market. The fragmentation of the European Telecom market is not wished anymore by European politicians and the appropriate regulatory measures are in the works for unification to happen. The question at this point is how operators will adapt in this new environment of fierce competition and already existing or upcoming European rules, such as net neutrality and roaming regulations under investigation in this work, that will affect their operation in various ways, both revenue-wise and when it comes to their business models.

As analysed in chapter 6.1.1, operators are shifting towards a two-sided or even multi-sided model, whether intentionally or not. The latest trend includes collaboration with OTTs, an issue that has been somewhat controversial, as OTT services have over the years targeted Telecoms' customers and directly competed with them. But this is not the only way to adapt to this environment that consists of OTTs, MVNOs and many other types of competitors. Leveraging the growing popularity of OTTs can possibly come through collaboration with them, even in areas where there is direct competition with traditional Telecom services such as messaging services. Such collaborations, although they can further enhance the OTTs' popularity, at the same time operators will be able to share revenues with them through their growing user base.

Such partnerships, are just one example of the strategic actions operators take. Partnerships in the content service sector are also very common nowadays, but as discussed in 6.2.1, net neutrality regulation has already affected these partnerships in countries such as the Netherlands and Slovenia, and the same might happen if a European net neutrality regulatory framework is applied.

The other side of the Telecom platform, which was mandated by access regulation but is nevertheless there, that will play an important role, especially when roaming fees are eliminated in the future TSM, is the wholesale customers. Provided that regulation of wholesale and retail prices allows for reasonable margins, this is an additional revenue stream for operators, while the elimination of roaming fees will allow for telcos to compete at a European level by becoming themselves MVNOs and growing their user base.

The following chapter will discuss the results of this work and draw some conclusions based on the compilation and analysis of information and knowledge gathered for this work

in an attempt to, at least partially, clarify the complexity of the pending TSM and provide the base for further research in this direction.

7 DISCUSSION & CONCLUSIONS

In his speech at the European Voice event "Creating Europe's digital highways" in March 2015, European Commission Vice-President Ansip commented, "To start with, we do not yet have a genuine single market for electronic communications. Instead, we have a series of national Telecom markets with different supply and demand conditions. Regulatory differences prevent us from making the most of a pan-European Telecoms market where consumers could obtain services from operators present in the EU - regardless of borders - and operators could offer services across different EU countries".[119]

The EU is trying to bridge the regulatory gap in the European Telecom market, a sector that has been losing revenues for several years now, hoping that a single market in Telecommunications will not only benefit European citizens, but also create growth and jobs across Europe. It is questionable to what extent regulation on net neutrality and roaming will create such growth, as Telecom operators are seeing them as challenging developments for their business but as pointed throughout this work, without a European regulatory framework regarding these issues the TSM will be hard to become a reality.

Despite the political will at EU level, regulating net neutrality and abandoning roaming charges have not been made possible yet. Both topics are intensely discussed but the obstacles of implementing in national markets are many and consensus has not been reached for either of those. The difficulties, as analyzed in this work, lie in the degree to which the EU should regulate operators and the structural differences (in pricing, taxes etc.) between the national Telecom markets. Thus the EU remains at mere guidelines when it comes to net neutrality and to postponing the elimination of roaming fees under the pressure of the EU Council.

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[119] http://europa.eu/rapid/press-release_SPEECH-15-4659_en.htm

7.1   A COMMON EUROPEAN NET NEUTRALITY LAW

The Telecom markets have changed in Europe and globally, mainly due to the emergence of OTT players that either compete directly with Telecoms in areas such as messaging and voice or use their networks to provide content and other types of services, making networks more valuable while increasing the need for better speeds and capacity. Their growing importance for the Telecom made them relevant to Telecom operators and drew their attention that watching their revenues decline and the need for more investment in networks had to look for ways to leverage the OTTs' growing popularity and internalize the network effect they create for users.

It is the relationship between Telecom providers and OTTs that net neutrality is trying to balance by protecting what was a given until now for OTTs, meaning the platform of the open internet for these innovative and in many cases small players. While Europe was delaying decisions regarding net neutrality, the Netherlands and Slovenia took the initiative to be the first to regulate it, with the EU remaining, until now, an observer of these laws in effect. The case study of the Netherlands investigated the most important challenges for operators due to the law being in place. The main ones identified were: investment in the networks, the ability for price differentiation and price discrimination (also with regards to partnerships), specialized services, the issue of privacy and data protection as well as innovation in the market.

Out of the above issues there is increasing attention given to the price discrimination and the zero-rating discussion in effect right now in both Netherlands and Slovenia and with the EU not convinced on its necessity as part of a net neutrality measure. The absence of net neutrality law does not facilitate a harmonized European market as at this moment Telecom operators in the Netherlands are obliged to change their pricing strategies to fit the net neutrality law in place, while operators in other countries are allowed to use zero-rating as a promotional service in their bundles, such as the example of WTF in Portugal that zero-rates popular voice and messaging apps for its users. A common framework throughout Europe would eliminate these differences and the different players would be able to compete under the same rules.

Another important topic in the same discussion is overlapping with another discussion regarding privacy and data and the ways that OTTs and Telecoms are allowed to use them, with OTT players enjoying much more freedom in this area. Related to this is also the idea

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proposed by the French Digital Council CNNum calling for "platform neutrality" stating that neutrality should not only be imposed on the networks but also on platforms with significant power such as Google's. This is a more strict application of neutrality that, if applied, will affect both OTTs and Telecoms, although this discussion is not yet in the forefront as net neutrality still remains unregulated across Europe.

Taking those into account and performing further impact assessments, the EU is in the process of creating a European net neutrality framework, a development that troubles operators and national regulators but is viewed as necessary so that the TSM will eventually become a reality, while the market will remain diverse in nature, with Telecoms and OTTs competing and collaborating, innovation flourishes and European citizens enjoy the benefits of competition and freedom of choice, as the EU commission hopes. The conviction is that the TSM will help new European OTTs to emerge and flourish, like the case of Spotify, and give them scale to compete at a global scale, pushing back the overwhelming dominion of the U.S. in the OTT field. It remains to be seen whether these measures will be able to foster such a revolution or the accomplishment will be much more modest. So far though, the success stories of European OTTs are limited compared to their American counterparts.

To this day there is no specific plan for net neutrality. There is discussion on how strict these rules should be, with the Netherlands lobbying for similar rules to their national law. It is yet to be seen how this discussion will evolve into a European framework that will create common ground for European markets to converge and compete in this environment.

7.2 ELIMINATION OF ROAMING FEES: A NEW ERA FOR EUROPEAN TELECOMMUNICATIONS

The elimination of roaming charges, unlike net neutrality, is a much more concrete plan of the EU and it has been happening gradually since 2007. Nevertheless, complete elimination has not been achieved yet. International roaming, being a highly profitable revenue stream for Telecom operators is naturally revenue that operators would like to preserve but one that European politicians regard as unnecessarily excessively priced and a major obstacle for the TSM and European integration.

The data available in public regarding roaming revenues are limited, but the extensive research for this work, exemplified by the case study of the Spanish market, showed that among European countries, despite the fact that international roaming is more important for some than for others, telcos are very skeptical of it, not only because of the impact on their revenues but also due to the implications of bringing down barriers between markets with significantly different costs and structure.

The Roam like Home plan that the EU has suggested is creating questions regarding possible implications, such as SIM card border trade and arbitrage. But the inevitability of the elimination of roaming fees, despite its postponement which is only providing more time for Telcos to adapt, is making them prepare for a new era where deciding which strategy is best to maximize profits without losing all revenues from this regulation is a critical issue.

The case study and further analysis, showed that the trend towards all-IP networks and increasing demand for mobile broadband, is also a trend in international roaming, with demand for data leading the way, in terms of usage, but with declining ARPU for operators, as the regulated wholesale and retail prices do not allow for this increase in usage to provide more profitability. Therefore, Telecom operators need to find other, possibly disruptive ways, to counteract the effect of the roaming regulation.

The different plans that operators can and some of them already are exploring include Roam like Home offers and different versions of it, either for limited countries, or for limited usage, with a small charge on top of the monthly subscription or no charge at all. Other ideas include Roam like a Local plans or other innovative and possibly disruptive offers such as the one from Italian operator Zeromobile and ChatSim.

But the end of roaming charges includes other players as well and that is the main challenge for operators. Here OTTs are again present, with services like Skype taking a large part of international calls already, and telcos need to find ways to either compete or leverage

this growing trend of users wanting to constantly be connected, using their favorite OTT apps. Increasing demand for mobile broadband is a trend that cannot be ignored and will be even more present when roaming fees come to an end.

In the case or roaming, another important topic is wholesale and the presence of MVNOs in the European market, as well as the ability of Telecom operators themselves, expanding in other countries, not through deploying their own networks but through becoming virtual providers themselves. The findings regarding the elimination of roaming fees are more thoroughly analyzed in (Ntarzanou, V., Portela, M., 2015) which is also included in Appendix C.

Choosing the right strategy for Telecom operators will be a challenging task and operators need to find a model that exploits their platforms to the fullest in order to satisfy the increasing demand for mobile broadband and connectivity while remaining relevant in the Telecom services field such as voice and messaging.

7.3 NET NEUTRALITY WITHIN A EUROPE WITHOUT INTERNATIONAL ROAMING CHARGES

The subjects of net neutrality and international roaming charges besides being the points of focus for the completion of the TSM for the EU, are also related with one another as both affect similar parts of the market. Today, the barrier of high prices for international roaming, compared to national prices, did not prevent mobile broadband usage from growing when users are roaming in Europe. This development indicates how broadband is indispensable nowadays and that is to a large extent due to OTT applications and services that are used not only for communication but also for entertainment, shopping and many other purposes.

With OTT services already substituting for an important part of the communication between European citizens, a future with no roaming fees will probably cause for people to keep on using their OTT applications and services when roaming in other countries, even more than they do today that roaming charges are imposed. This means that the demand for mobile broadband will grow even more and operators will need to find a way to leverage this trend either by collaborating with OTTs or using other strategies and innovative ideas such as ChatSim, a SIM card that allows the user to use popular OTT messaging and voice services without limits in most European countries and for a very low fee.

This is where net neutrality comes into play. ChatSim is an innovative idea that a strict net neutrality law such as the one the Netherlands have could take out of the market if implemented. As ChatSim basically zero-rates specific OTT apps for roaming users and this is a practice that the Dutch net neutrality law would not allow. Similarly a European net neutrality framework could have such impact on new ideas that innovate and potentially disrupt the roaming market. This example proves how these are not two separate issues, how their interrelations could affect the Telecom market and that in the future the TSM regulation should be regarded as one package of rules for the European Market.

7.4 GENERAL CONCLUSIONS

- The TSM and the regulation that comes with it, is not viewed as an entirely negative development by operators. It opens new markets and provides new opportunities for operators that want to expand and compete in other countries. Large Telecom groups, such as Deutsche Telekom and Telefonica, that own several operators across Europe are at an advantage in such a market as network owners, but they still need to adjust their strategies in a way that they will be able to compete in these new settings and remain relevant in this diverse environment.

- When the TSM becomes a reality, competition will be intensified and many will be those that will either not be able to compete or whose strategies will fail to allow them to adjust to the new conditions. This implies a possible consolidation in the European market, with mergers and acquisitions taking place and large Telecom groups being the ones that will most possibly survive and expand or new ones being created.

- OTT-Telecom partnerships is a global trend that is also present in Europe. Until now most of those partnerships are made with content OTT providers such as Spotify, but collaborations will possibly come even with OTT services that compete with traditional SMS and voice services as a way to benefit from the OTTs growing popularity and user base. All these partnerships though could potentially be subject to restrictions based on net neutrality rules, if and when they are applied across the continent. Nevertheless operators will expand their multi-sided platform model in order to remain relevant in the market, as operating merely as network operators does not secure sustainability for their businesses.

- As we move towards all-IP networks and technology convergence, new types of players will be created, that will take advantage of OTT platforms, operators' networks (based on access regulation and through buying wholesale data). Google recently announced its interest in creating an operator that combines the characteristics of a MVNO with WiFi networks in order to provide internet access to end users. Starting in the U.S. their vision seems to be global, so in the future we might see this development in the European market (Ntarzanou, V., Portela, M., 2015).

The rules imposed by the regulatory frameworks under study and the specific issues related to them as studied in chapter 6, need to be carefully considered and their impact on the market requires further and detailed study, in the form of academic research and regulatory impact assessments, in order to find the balance that will provide consumer benefits but also allow for the market to thrive.

The technology factor as part of the equation is also significant and more importantly the trend towards faster, all-IP networks with increased capacity, which from a technological point of view, are made possible as technology progresses at impressive rates. The rollout of technologies such as LTE, are fundamental for the world to keep up with the increasing demand for internet access and broadband, but as this project shows, regulation and the ability of operators to invest in networks will define which of the newest technologies will be chosen for future networks and what restrictions will apply from a regulatory point of view, with engineers at the forefront of this development.

But no matter what the developments in the regulatory and technological worlds are, Telecom operators, as owners of critical infrastructure, play a central role in the European Telecom market on its way towards unification. The research conducted for this work pinpoints the numerous challenges they are facing during this process based on the two focal points of the EU plan for the creation of the TSM, namely net neutrality and the termination of roaming fees. Within this framework Telecom operators need to find the right balance between strategies and the application of regulatory mandates, in order to maintain a sustainable business and get back to positive growth in the future.

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APPENDIX A INTERVIEWS

Appendum 1 INTERVIEW WITH MR. GEORGE KARAGEORGOS, ANALYST IN OTE'S MARKETS REGULATORY STRATEGY DIVISION (HEAD OF DIVISION: MR. IL. KOTSOPOULOS)

Phone Interview. 3/2/2015

1) *Could you give us a small description of your job in OTE?*

I work in the general directorate of regulatory affairs, specifically dealing with EU aspects.

2) *How is Network Neutrality (NN) related to the work that you are doing?*

NN has become a priority in our division in light of the growing discussion and debates during the last year/year-and-a-half at EU level in the context of the TSM (Telecoms Single Market) draft regulation. We are following the developments at both national and EU level and participating in this discussion.

3) *What kind of EU regulations are implemented in Greece about the Network neutrality concept (if there are any)? Any developments expected in this field?*

At the moment there no specific legal framework on net neutrality in Greece. It is an issue which is monitored by EETT, the Greek NRA (National Regulatory Authority) and they haven't identified major problems or difficulties in accessing online content or any instances of traffic blocking. What has given us some concern was a decision, in late December 2014, by a local court to reject the request by the Greek IPR authority to block access to BitTorrent files. In this 50-page decision, among the various arguments and points raised, there was a specific reference to the net neutrality principle and as far as we know it was the first explicit reference of such a principle by the Greek legal system.

4) *How does such regulation affect your company? Do you perform any analysis of the cost of regulation for the company?*

It is clear that if such regulatory provisions are applied it would affect our operation. And it would affect us in various activities; commercial, technical, business, pricing and so on. We are normally performing an analysis on the impact of regulation but in order to do that for

this subject we need to have much more concrete developments while at present point things are still under development at EU level. So we are definitely considering it but we haven't entered into that level of detail at the company level, where more than one units and departments are involved, for example the risk assessment department.

5) How often do you renew the company strategy? What makes you renew it?

The OTE group of companies in Greece has a multi-annual strategic plan and this is reviewed annually in the light of developments not only at the company but also at the group level, because as you know OTE is part of the much larger DT (Deutsche Telecom) group.

6) Do you think that there is a conflict of interest, in the relations between Telecom and OTT companies? What is the best option for OTTs and Telecoms cooperation or competition? Do you expect any collaborations like that in the near future?

We have identified cases where there is a direct conflict of interest, for example when they offer services directly competing with ours, based on our infrastructure like VoIP or messaging services. On the other hand there are cases where there could be benefit by the increased traffic they are causing on our network and also there are cases where there is a kind of cooperation like with Spotify for instance.

Is there an impact of OTT services, on your company's market share? Why? For example TDC announced reduced revenues last year.

Here as well we have the same case, especially when we talk about fixed telephony, where there have been reductions in international calls and in mobile, in the volume of SMS messages that has decreased in the last couple of years. Unfortunately I don't have any specific numbers but it would be quite safe to attribute these reductions among other things to the growing number of IT based OTT offers like Skype.

Can you notice increased usage in your network from services like WhatsApp and Skype?

As indicated above we have noticed such increases but there are multiple reasons affecting revenues. For example, people switching to alternative operators, or the economic crisis in Greece, that has brought a general decrease in consumption. Nevertheless some things, like recent decreases in international voice calls or messaging services can be also attributed to the growing number of OTTs like the ones that you mention.

But doesn't that also mean that the number of users buying data plans is increasing?

As far as I know yes, but I don't have any concrete figures on that.

7) ***Many people that defend net neutrality say that if Telecoms have full control over their networks they would favour their own services and their partners' in opposition to those of OTT's, but is that really true? What would happen if Telecoms could manage the network traffic as they wish?***

This a critical question. It covers all the various aspects of net neutrality. One could say it's about principles, traffic management, network exploitation, one could say it's about business cases and business policy or investments, especially in fixed broadband and mobile networks. A probable answer would come by reaching more generally acceptable agreements on two main points. First on how to manage the exponentially growing traffic (especially video traffic) on our network and second on how to ensure a reasonable return on investment required to build these high-speed and ultra-fast broadband networks that everyone is talking about but no one has yet financed. Especially in Europe there are various estimates from a few to several hundred billions of euros. Who is going to invest in that and who is going to get a return on that? I don't think that any reasonable operator would invest without any support and certainty that such an investment would lead to a reasonable return. And on the other hand, on these networks in particular, there are specific cases and practicalities in managing the network and the traffic on it, especially with video which is growing bigger and bigger by the day.

Who should be charged for this traffic? (Netflix, Youtube?) or are we talking about EU or local governments financing the cost of new broadband networks or are we talking about a combination of both?

I don't think there is a straight forward answer to this question. But focusing on the two points I mentioned above, that is increasing traffic and the request for faster networks could lead to developments in this area and bring the discussion to answers acceptable by everyone since I think it is irrational to request increased investments on the one hand and on the other, to create legal uncertainty or impose regulatory measures and rules that affect the expected return of investment.

There is the case of Netherlands where KPN in 2011 tried to charge customers a fee for using OTT services and almost immediately net neutrality legislation was imposed to block that effort. What is your opinion about that?

Yes we are aware of the legislation imposed in the Netherlands and the fines that KPN received because of this. This is legislation that, beyond net neutrality, prohibits price differentiation and in this sense we are entering into relatively delicate waters, since we are dealing with the retail market and this has never been the case in the EU. Even where this could be accepted there should have been major preparations, studies, analyses, impact assessments and so on.

A good analogy we think might be useful to consider in this discussion is that of a tolled motorway. There are differentiated tolls for different types of vehicles, a motorcycle wouldn't pay the same as a heavy lorry travelling and on the other hand, as I am sure you've seen across Europe, there are traffic management practices everywhere. For example when it's raining the speed limit is reduced, or trucks are not allowed to use the fast lane etc.

8) *How is a possible single market of Telecommunications in EU seen in OTE - as an opportunity or a threat? What are the implications of being part of such a market?*

We are already a member of a big European group as you know but even before that OTE group had subsidiaries in several Balkan countries. In this sense we are in favour of a single market and we see it positively. On the other hand, it is true that the EU market is fragmented and there are issues to be examined there- so in general, we think that such a consolidation would be beneficiary to the European Telecoms market. But there might be reasons other than the EU Telecom regulatory framework, which has been there for almost twenty years now, that are behind this fragmentation; issues that are wider and go beyond Telecoms itself, for example e-business and e-commerce on taxation, invoicing etc. where there is still a lot to be done at the EU level.

9) *How did OTE see the move from EU to cap roaming fees? How important were the roaming fees before to OTE?*

Unfortunately, I cannot give you any data on this, first because our department does not have them as it COSMOTE, our mobile branch that is dealing with roaming. Also I believe that it is quite difficult to specifically calculate these figures and, in any case, I don't think that

any provider would publically disclose them. From our point, however, we would make two more general remarks: first, this is really a political issue that is selling nicely to the European public. Second, we don't think that opening up this discussion just a year after the roaming regulation started being implemented does any good to what we call regulatory certainty.

Greece receives a huge amount of tourists every year. And a lot of them are using their cell phones to communicate. Will abandoning roaming fees affect revenues?

It is reasonable to assume that this is possible but, as I already said, we don't have specific figures to give you.

Appendum 2 INTERVIEW WITH ANACOM PRINCIPAL CONSULTANT DR. CARLOS COSTA

Phone interview. 3/2/15

1) Could you give us a small description of what the role of ANACOM is in Portugal? What are the main responsibilities?

Yes for sure I can do that, but I would like to refer you to our webpage where you can find very detailed description of our services. Our Website has a version in English and if you look at it is a brand new updated version of it we believe it to be incredibly easy to find anything you want to look at. In the previous webpage there were some minor issues finding the information. If you look in the institutional section at the mission and responsibility or in the legislation, you will find the status of ANACOM. Please be aware that the statutes of ANACOM were reviewed quite recently and at the beginning of this year the new status of ANACOM was approved by the council of Ministers but it isn't published yet in the official journal, it's going to be published soon.

So it is better that you keep looking in the website for the new version of ANACOM status. I will refer you to this status because the competences of ANACOM are quite wide, and there you will find a detailed description.

Anyway, in a broad manner I can tell you that the status of ANACOM and other legislation like the communications law, that is Law nr 5/2004, of the 10 February, suffered also a number of updates. It establishes 3 main roles for ANACOM. Regulation, Supervision and Representation of the communications sector.

So in the regulation part, our role focuses not only in the communications but also in the postal service and we attempt to ensure that the communications operators have equal

access to the network. In terms of transparency we attempt to achieve a competitive scenario to develop the communications market and in particular regarding the scenario of convergence between Telecommunications media and information technology. We grant the rights for the postal and Telecommunications activities, we also manage radio frequency spectrum and we also attempt to achieve coordination between military and paramilitary communications.

So you also manage the spectrum and everything related to it?

We attribute frequencies but we do it according to conditions that are established in the law or in the laws by the government and the Assembly of the Republic. So we do not manage the spectrum according to our own will. We have strict rules established in the legislation and there are two roles; one role is to advise the Government of the Republic when preparing these rules and the other role has more to do with regulation, not as an advisory role, more as to implement the rules dealing with spectrum management. We also have some competences concerning numbering. So this is competence number one; Regulation.

Number two; supervision. With regards to supervision we are ensuring the application and enforcing of laws, regulations and other technical requirements, for instance establishing international conventions. We also see to it that the communications operators and services providers duly comply with the provisions which are a part of their licenses or concession contracts. We guarantee the existence and availability of universal service in the Telecommunications and postal service and we assure that the obligations which are described to a particular service are duly fulfilled.

We assure that the spectrum that was allocated is put to good use and the same for a number of resources. We also have some competences in regards to safeguarding the interest of consumers especially and in particularly in regards to the field of universal service.

We have also the responsibility of coordinating with other bodies of the public administration such as, for instance, the director general of consumers or the competition authority and we are also interested in promoting transparency in the market and keeping consumers properly informed.

With regards to the representation sector we represent the state in international bodies such as the Universal Postal Union, the International Telecommunications Union, the Organization for Economic Cooperation and Development (OCDE) and this in addition to our representation competences that we share with the state. Besides representing the state we

also represent ourselves in the international organizations that join together regulators from different countries such as BEREC, in which we participate very actively. Currently the chairman is also the Chairman of ANACOM, Professor Fatima Barros. We also participate in the independent regulators group and ARCTEL which is the Association of Communications and Telecommunications Regulators of the community of Portuguese speaking countries. We participate actively in the EMERG which is the Association of Regulators of Mediterranean basin. Another one we participate in is REGULATEL that is the association of Portugal and Spain with countries of Latin America.

In regards to functions of representation we are also involved in promoting scientific research applied to Telecommunications, postal services, electronic commerce, etc. We are engaged in technical standardization, we are the delegated body for standardization in postal services and Telecommunications and delegate competences from the Portuguese association of quality.

Finally we are also involved in defining civil law in the sector of communications and providing technical support to bodies which are responsible for operating the integrated emergency communications network.

Furthermore besides these three competences, regulation, supervision and representation of the communications sector, we are also very active in our advisory role to the government so when the government prepares legislation, or prepares international treaties, or when the government is taking care of public policies, it is frequent that we have a word in.

Do they ask you for advice about regulation?

Well in terms of regulation ANACOM acts as an independent body, ANACOM has a policy of autonomy so I wouldn't say exactly that the government asks us for advice about regulation, because regulation is what we do. So the government probably could ask us for advice in the role of public policies where the government is for example involved in the preparation of the targets for the Digital Agenda in the EU, when the government is negotiating an international treaty or when the government is preparing legislation in the communications sector, for example in regards to spectrum or in regards to the promotion of the ICT.

2) What kind of EU regulations are implemented in Portugal about the Network Neutrality concept (if there are any)? Any developments expected in this field?

It depends on your own definition of net neutrality, every time I speak to a different person I see a different definition of net neutrality. So we have to be clear about the concept first. I have spoken to hundreds of persons about this and it is rare that two persons have the same opinion about this. So what you think is net neutrality?

Basically in the sense that we have understood it means that there are some practices that Telecoms and ISP providers can enact that are not acceptable according to net neutrality. Examples of this are managing traffic, prioritization of different types of traffic according to the service, slowing down a service like Skype because it's causing traffic congestion on the network. Practices like these are not acceptable according to our definition of net neutrality. Also giving different types of priority to different services, for example a company that owns a service would prefer that that service be faster than the competitive service on their network. So in the case of Portugal, a company like Portugal Telecom, that is very big, would have a service in a certain area and there would be another competitive service in Portugal from another company that would arrive with less quality of signal to the clients of Portugal Telecom. Does that make sense?

I don't know if it makes sense so we will start from your definition. Let me tell you one thing first. I was speaking a couple of months ago with Professor Martin Cave and Prof de Streel. They both have written a lot about net neutrality, just as Professor Pier Luigi Parcu has done, who is the head of the Florence School of Regulation. We had a very interesting talk about net neutrality and I have a question to bring to the debate. It's the following; you have probably seen the different editions of special communications of the Eurobarometer from the European Commission, yes?

Yes

So you will find every section about Europeans. They have inquired about 1000 persons in each European Union member state, plus Turkey and some other countries. Around 33000 in total. And this is supposed to be a representative survey of Europe, right?

Yes

And if you see the proportion of people that have encountered problems related to net neutrality it is very rare. Like I said in this meeting, we have an endangered species here in Portugal, like the lynx of "Serra da Malcata" you know?

Yes

In the last 20 years or so there were two people that have seen the Lynx of the "Serra da Malcata" alive, and if you look to the Eurobarometer there are two or three people that have complained that they founded problems related to net neutrality. So if you are asking if there are people complaining about this, it is very rare that we find people complaining specifically about net neutrality.

The second question would be whether people actually know exactly what net neutrality is. It could be so but anyway the question was put in regards to traffic shaping, traffic management, etc. so the answer is that you don't find significant problems about this anyway.

3) So the fact that until now ANACOM hasn't found any need to enforce any kind of Regulation means that there was no reason do it?

It's not that ANACOM did not find any need to enforce regulation. Let me explain something. Throughout Europe it is very difficult to find cases, as you can see in the Eurobarometer. That's one point. The second point is that ANACOM didn't find it reasonable or it wasn't reason enough to enforce any regulation. We do not create regulation, we enforce regulation, so if we look at the legislative scenario in Europe nowadays, it's very difficult to find provisions that can be applied specifically about something like net neutrality. But there are provisions that can be applied in cases of, let's say, discriminatory behaviour in the sector of regulation for Telecommunications or in the general competition law. If you forget about the general concept of net neutrality for a couple of minutes and if you think about the practical issues that might be associated typically with net neutrality, let's say discriminatory behaviour, you might find interesting problems and questions and solutions.

So let's think for instance about traffic management, right?

Yes

In your definition it would be a violation of net neutrality to practice different prices for different Quality of Service to deliver the same service, right?

Yes

So if you have someone who is paying 30 euros to have a download speed of 20 Mbps, and an upload speed of 2 Mbps and if you find someone with 50 Mbps of download speed and 5 Megabytes of upload speed is it a violation of net neutrality?

No our definition is more to the service itself not to the client side. Imagine for example Skype. For some reason Portugal Telecom or NOS or someone else, has a competitive service and that service for some reason is arriving with better quality than Skype. In this case we are looking at net neutrality, not on the client side, but more on the service side, where one would be discriminating against Skype's services in relation to that competitive service. Do you see our point?

Yes I think this is a potential problem from a competition point of view but there are competition elements to deal with it. But let me say that you are already departing from your initial definition because if you speak about management and you have different categories of services for different customers that is already traffic management. As it is in the example I was giving you.

Let me place another question and this is from a recent case that was decided a couple of days ago in a national court in the Netherlands. Let's say you have an operator which struck a deal with a particular OTT TV channel. What happened was that in the case of that TV channel the traffic wasn't included in the normal upper limit of traffic that the operator offered. But in the case of the competitive OTT TV channels it counted, the traffic was included in that upper limit. So the regulator in the Netherlands also accumulates competences of a competition authority in Holland. They decided that this was a discriminatory practice because the operator should not be capable to influence the viewing quality of spectators.

Since you mention the case of Netherlands which is one of the very few countries that actually have had to enforce net neutrality regulation, there was a case with KPN where in 2011, they tried to block services, such as VoIP services and instant messaging, unless customers paid a fee. This was actually when they passed the law for net neutrality and so this was a very good example. Our question is, is there are any kind of regulation in regards to traffic management or something related to that in the case of Portugal?

We don't have legislation that is specific to net neutrality, besides some provisions related to the deterioration of QoS which are established in article 40, nº 4; article 48, nº ; article 47, nº1 of the Electronic Communications Law, but we have legislation that deals with issues that are typically or commonly associated with the concept of net neutrality.

Let's see for instance the question of discriminatory behaviour regarding traffic management. Operators are not allowed to discriminate when it comes to quality of service. In this case all the clients are in the same tariff plan. They have to accept the traffic from other operators and service.

So blocking is not an acceptable practice?

No they are not blocking anything. It seems that here for the time being there is no problem.

4) Do you think that there is a conflict between net neutrality and competition law when Telecoms and OTT companies work together so that some OTT's can get better network services in exchange for a fee?

You mean intrinsically? Since the appearance of OTT companies, their business model seemed to imply that there will be competition with communication service providers. So they have opposing business plans and there wouldn't be any cooperation between them. More recently experience shows that there might be a strong case for coopetition between services providers and OTT's. So the question you are asking is whether this cooperation is always in detriment of the end users?

My personal point of view is that it isn't. We have to see it case by case. When I am saying case by case I am not saying we should analyse every cooperation and partnership between service providers and OTTs. But it is something that we cannot say from the onset. There might be some situations where it can be detrimental to end users but in other cases there might be advantages, in terms of lower prices, in terms of innovation of new services that can appear in the market and so on.

5) When the European Union applied the price caps in roaming was there any complaint from Telecoms or were these new prices very easily accepted by the three largest Telecoms in Portugal?

Well you know that, as you should be aware, the operators are never satisfied when there is regulatory intervention that forces prices down. So they being unhappy is one thing and about whether they have been vocal? Yes, you know that there are two associations in Europe, ETNO (European Telecommunications Network Operators) and ECTA (European

Competitive Telecommunication Association), which aggregate in one the incumbent operators and on the other end they aggregate the alternative carriers. So these two associations have been very vocal throughout Europe in regards to these reductions of prices. In particular, in the more peripheral countries in Southern Europe operators are particularly dissatisfied because this might be a strong if not the strongest revenue.

For example Portugal is a country that tourism is very important in, so you receive a lot of foreigners and this was probably an important revenue for the Telecoms there.

Do you believe that abandoning roaming charges completely will create a need for new regulation?

You mean about regulation, are you speaking about Telecom Single Market?

Yes, exactly. Do you think it is possible to create a Single European Market or is it too complicated without new regulation?

In this regard I can only give you my personal view, ANACOM has its own views. Or better, there is national position about this, which is conveyed by the government to the European Commission, European Parliament, etc. It is in dialog with the European Parliament and the European Council. If I think that the single market is possible? Yes, I mean it is an objective of the European Union to have a single market in any field, right?

Yes

But there are different ways to achieve this single market. You have to take a look at the different issues that the Commission is bringing to the table for justifying measures that are being proposed in the Telecommunications single market initiative. One argument that the European Commission and European Parliament are sometimes bringing to the table is the case of the so called market segmentation, right?

Yes

The European Commission thinks that in the first version of the Telecommunications Single Market we need a more consolidated market, so we would have four or five big European operators, right? and they were pointing out that in China and in the United States there were only four or five operators. Well this is not exactly true. To begin with, the positions being taken by the competition authorities in the United States, show us that they are extremely concerned with the excess of consolidation in the American communications market.

On the other end, there are thousands of operators in the United States with regional focus. So it is not exactly true that there are for four or five. There are four or five Pan-American Operators and this causes concern to the competition authorities in the United States. But besides them there are thousands of other operators.

The other argument that the commission brings to the table is the lack of innovation. But if you look at the European Commission's own publications, they have this index of research and development which is published yearly and you can see that according to their own European data in the fixed markets and in some cases in the mobile markets, the European operators are more innovative than the American and the Asian ones.

The issues might be that at this time the American companies and by association the Asian companies are earning more money because they are more active in the OTT market. But it is not a case where regulation can be blamed for the lack of innovation. This market is a fairly deregulated market and there are other causes that are not directly connected to regulation, when justifying the not so good position of the European companies in the OTT market.

6) In the case of a construction of a Single Digital Market in the EU what do you believe that the role of ANACOM will be afterwards? Will it be integrated in a Pan-European (like the ECB) regulator or will it maintains its independency working in a network with other regulators in Europe?

I can also here give you my personal view and not an institutional view. I have been working in ANACOM for about 20 years and in these 20 years maybe 15 I have been dealing with European Issues and during this period I saw three proposals from the European Commission to create a Pan-European regulator, so these proposals were not fulfilled so far for a number of reasons. To begin with, because the member states did not find it reasonable and the operators, manufacturers in most cases, prefer to deal with a regulator that is closer to their market than a single regulator in Brussels, so this is what has happened so far. Besides that, we already have an institutional framework that allows some cooperative work to be done between the different regulators in Europe and between the different regulators and the European Commission.

I could suggest that you also have a direct look at the regulation and there you can see the role of BEREC and you can see that they have a very strong role in advising the European

Commission in regards to the market analyses that are produced in the member states. In some cases they reinforce the position of the European Commission and in other cases they advise the European Commission to review their position in the light of arguments put forward by the NRA (National Regulatory Authority) sector of the market analysis procedures. In addition, you could also have a look at the " BEREC Guidelines on transparency in the scope of net neutrality: best practices and recommended approaches"

You can also see that when you take a look at the ANACOM webpage one of the ANACOM obligations is to promote the Single Market, so we are also active in the measures to achieve the Single Market, for example, in regards to standardization, putting forward proposals to safeguard the consumer interest and so on. At this point the case for a single European regulator in a model similar to that of the European Central Bank is not justified yet. There is no strong support for it from the part of the Governments, NRAs, manufacturers, service providers, etc.

Appendum 3 INTERVIEW WITH AALBORG UNIVERSITY PHD FELLOW ROSLYN LAYTON

Skype interview. 13/3/15

1. **The Netherlands seem to be the strongest hot spot regarding the net neutrality discussion in Europe. Even in the US, in the light of the recent pro net neutrality ruling of the FCC, the Netherlands case is being mentioned as an example where "Net Neutrality has worked" (Bart W. Schermer, Considerati) and where competition is working well with companies competing on price and speed.**

   - **Was the net neutrality discussion in the country mature enough when the law came around?**

   - **Would you agree that the law actually works?**

Have I sent you my case study for the Netherlands?

Yes we have the paper you published in a conference a couple of years ago about this case.

Yes that is fine. What I would say in the case of the Netherlands, what's very hard when you're doing an econometric study and you want to prove the effect of net neutrality whether it's positive negative or nothing, it's very hard to isolate it. When you start the rules the operators change the pricing models and there are a lot of other things that happen so it's

hard to say whether it's only because of that. The biggest difference in the Netherlands is called the Netflix effect, have you heard about that?

Actually, no.

Ok, the Netflix effect is sort of a new problem. The idea with net neutrality is that it should help the content providers in the Netherlands, help the freedom of speech and all of those things, so you should really have a lot more Dutch content, a lot more Dutch activities but after this happened, Netflix, which is an American company offering American content, increased dramatically. With only a few users in the beginning, almost overnight it started to take up 20% of the traffic.

Now that has also to do with engineering aspects, but the question is whether the net neutrality rules are really for the "little guy" or is it helping the big content provider like Netflix? Does it give them an advantage over a Netflix competitor in the Netherlands? Would they be able to compete as well? That's a big question. Obviously, when Netflix comes to the Netherlands they spend a lot of money on marketing, they made a relationship with the Amsterdam Internet Exchange, they opened up an office in NYC, Netflix is moving its headquarters, so is it only because of net neutrality? There are a lot of other things happening. Why don't we see the Dutch Facebook? Isn't that supposed to be what these rules are doing? Is it making Dutch competitors? We don't see that kind of thing.

So I would say if you wanted to be more scientific about it, we really can't prove either way that it has changed anything. You shouldn't make the argument that net neutrality makes it better, it's hard to make that suggestion. You can say that maybe it doesn't do anything because large operators have the ability to change their practices etc. There is a kind of view about regulation, that it helps large providers, because large providers can hire lawyers, they can hire the staff, they have the bigger network so they can absorb the regulations by lowering their prices. It's harder for the third or fourth, the smaller operator because they can't launch their competitive services.

So for example, KPN already has a deal with Spotify. What would be interesting is, if you had the small player like T-mobile, the entrant would be doing that kind of thing. T-mobile does a lot of that. What's sort of ironic is that the Netherlands has the most competitive broadband market and from the European perspective, the European regulators always said "we don't need net neutrality because we have a lot of competition as it is. There are four

mobile networks, there are two lines in every home, there's lots of virtual providers". So net neutrality on its own wouldn't even be needed.

What's interesting with that video where KPN said we are going to use Deep Packet Inspection is that they only actually said they would do it. It's curious because if they went ahead and did, people would be so outraged that they would have left KPN and maybe they would have just lost a lot of customers. So that's an interesting question. We don't know what would have happened. KPN had the permission from the Dutch regulator to do the Deep Packet Inspection as long as they would tell the customers "if you use WhatsApp you'll pay extra". But it never happened because Bit of Freedom was able to create the media outcry and create the rules within two months.

2. **KPN was charged by court ruling of net neutrality law violation regarding the issue of free WiFi hot-spots. Do you think that since this was a free service net neutrality should still apply or is it that since it's being offered by KPN, you can only give away the part of the service decided by the company? KPN claimed that the law was unclear in that respect and they expected guidelines.**

This to me is what I call the regulatory nightmare. So here is what happened. This law was made in 2002 and yet here we are in 2015 and nothing has happened, no violations, no problems, KPN is very concerned they don't want to break the rules. But then the regulators are under a lot of pressure from the EU asking whether the Dutch rules work, so they are looking for violations, they have to kind of prove this was the right thing. And if nothing happens either the rules work very well or they're not doing their job. There is a pressure between the EU and the Netherlands as the Netherlands don't want the EU to take less strict rules because it makes them look like they were too strict or they were stupid. So they need to justify that this was the right thing.

Now KPN forgot that they had this program in the airport, which is a free basic level WiFi service, when you get off the plane you want to just check your emails, download your SMSs, get off the plane no problem. If you want to do a lot of other stuff, like sit down in a café, download videos and so on, then you need to pay. So they were just offering a basic level service for stuff that travellers need when they get off the airplane. That was a convenience for travellers that they don't have to pay, use a credit card and all that stuff. Well you know

this has become a net neutrality violation. It wasn't the KPN trying to purposely trying to hurt anyone, they had this in place before the rules were even there.

There are also issues with interoperability where some kinds of phones, and this is a whole different issue, but certain kinds of smartphones work better on some frequencies in networks than others. So depending upon what spectrum you have, whether you're using Wifi or 4G, 3G and so on, your device will operate in a different way. This has nothing to do with net neutrality, this has to do with your device, how it's configured, the apps you have on your device, your battery power, all these kinds of things.

So now what we can have in the future, is users having a poor experience and blaming it on the network, even though it may be their own fault. And we will have a very difficult time to prove that one way or the other. Or we have to go through a tremendous amount of activity to check the users' device, what was the situation etc. So in the case of Schiphol airport where this happened, there were issues with this particular network on how well the equipment that's used is operated with the various devices.

In the Dutch case they actually downsized the regulator, they combined them with the consumer authority, so the Telecom regulator to save money to save resource etc. If you spend your whole life responding to net neutrality requests you have to hire more staff, you need more expertise. With a regulator that has limited budget you can't do other things. You have limited time for public safety spectrum and so on. So this is going to a challenge for regulators, regarding how much they want to make their regulatory activity about net neutrality and not other issues like universal service etc.

3. **In one Interview we had with the Portuguese Regulator he characterized the problems that clients have with net neutrality in EU as an endangered species that no one sees and knows for sure if they exist? Do you agree with this view or are there actually cases of infringement besides the one in the Netherlands?**

Well, no country has conducted what's called a regulatory impact assessment. The regulatory impact assessment is a standard methodology used before you make any new regulation, where you collect the data, suggest alternatives, prepare the costs and benefits. No regulator has done that. The EU has done parts of that. They have done some data collection. The official EU reports of the Content Markets and the Internet connection markets say that there is not systematic abuse and that actual instances are very rare.

If you are a society you can say to yourself do we put lots of resources, time and energy to police, monitor and surveil the network to make sure we can watch the violations when they are happening or prevent them? Those activities could be spent upon other things that might have to be done. So if you look at the cost benefit then you would say that you're spending a lot of resources for fears that have not been proven. If you had the amount of net neutrality violations as in the U.S., which was two or three cases, compared to the literally quadrillion times people go on the internet, in any other industry that would be a success. You would say this is a great industry, it's very competitive but for some reason people say we must apply very strong regulations against the Telecoms because they are going to hurt us and stop the openness and so on.

The main deficiency I think is that these rules do not protect users from government intervention. So governments regularly block websites, they can surveil citizens. There is nothing in the net neutrality rules that say people can be protected from government intervention. So they are really missing out on a big part of the blocking that's going on, or the invasion of privacy and so on.

4. **Many people that defend net neutrality say that if Telecoms have full control over their networks they would favour their own services and their partners' as opposed to those of OTT's. What do you have to say on that? What would happen if Telecoms could manage the network traffic as they wish?**

In two-sided markets if you are degrading your services you are lowering your profitability, because the more services you offer the more customers you can get. So if you degrade certain services you will disappoint a segment of your users and that lowers your profitability. The one thing I would say is, I don't buy that the operators are lowering their competitors' services because for instance Netflix has become larger in terms of users than any cable company in the world. We have more alternatives today than we've ever had. So if it was the case that operators had wanted to favour their own services, they've done a bad job, they have not succeeded because the alternatives to cable as a form of content are more diverse and more numerous than they've ever been and they keep increasing.

So I would say if they were trying to block or throttle they have failed. Consider that Netflix was only a company that did DVD by mail and they decided that was an expensive way to deliver videos and said let's do it over the internet. If the networks were not working, they

could not have turned themselves into an online company. Today Netflix is paying less for its transit than it's ever paid. The reason why they pay less by connecting directly to Comcast and Verizon is that before they had to pay someone else to do it and that cost them more money. So the case where Netflix says that the customers have a bad experience is that they actually slow down their own customers so that they can go to the regulator and complain. Their filings revealed that they purposely did that. What happened was that they were releasing higher definition content but they did not hire enough ports. They didn't get enough transit in place by the time they made the release so the traffic got backed up on their side. So rather than admit what GUI didn't provision very well, they blamed it on Comcast. So they are paying less than they ever did.

5. **We also had an interesting interview with the incumbent Greek operator OTE and they told us that one analogy to consider for networks would be to charge differently to different types of traffics like tolls in highways, motor bikes and trucks are charged differently on highways also the highway operators do deals with companies that have very big fleets given them discounts. Would you agree with this metaphor?**

Well I don't have a problem with it. What happens is when you use that type of discussion people will say "you put me in the slow lane" but you know we have fast and slow lanes today. If you are a rich company and you can hire CDN, there are so many types of fast lane services available today. There are companies which need special services, like for example Amazon or Credit Card companies.

If you want to make a credit card transaction you want to make sure that the transaction goes through as fast as possible and you would be willing to pay to ensure that and you don't to have your credit transaction on a best effort, when-you-get-around-to-it traffic treated the same. You want your customers to get their confirmation immediately. So you will employ a fast lane or however you want to call it.

You can say it another way; that the fast lanes save the internet every day, that there is traffic that needs faster treatment whether it's VoIP or anything else. For example this call we are making now, if we didn't get a fast lane for this call, voice would be too slow. There is a legitimate reason why VoIP should have a fast lane. If my email or my pdf comes to you a few seconds later you don't notice and you don't care. So why should we have to pay for the priority and I am sure that's how the Greek operator sees it. To compare it with the highway

can also be misinterpreted. I like the post office metaphor better. If you want to have DHL overnight express you pay for that when you need it but the regular mail is also there. It's not discriminatory for you to send a post card at a regular rate but you need to send and overnight package at a fast rate. And both of those exist without problems.

6. **Do you believe this law will be transcribed to other countries in the EU or that a harmonized European regulatory framework would be better (the Netherlands are pushing for it in the discussions)? What would the impact be on the European single market?**

I think the European case is very important and there are many things going on in Europe. You have to understand the political context. Ten or fifteen years ago there was a belief that Europe was going to be number one in the world for mobile. They had the GSM standard, there were companies like Ericsson, Nokia etc. But today it's the opposite; Nokia has fallen down the drain, Ericsson doesn't make phones, investment has fallen behind etc.

The interesting thing you can say is in many respects, the net neutrality rules make it better for the big American companies, the Facebooks, the Googles, the Netflixes of the world. It really doesn't help European start-ups. If we really wanted to help European start-ups we would make a rule that says put the European start-up on the front of the Google homepage if you are in Denmark. The Danish start-ups have to get first billing on the search results, that kind of thing. We would do a kind of, not neutral, but an affirmative action to promote the European choices. But there is absolutely no evidence that net neutrality improves the competitiveness, that it increases employment.

The sad thing is that Neelie Kroes spent three or four years talking about a digital single market and all she could conclude that net neutrality, it doesn't help Europe out of the economic crisis, it doesn't help give new jobs, doesn't make Europe more competitive. If we go back to the case of the Netherlands we should be able to see the increase in Dutch content, Dutch start-ups, Dutch activities and we see the opposite.

We see the increase of American Internet players. In terms of this important issue about managed, specialized services, even Angela Merkel has come out and said we have to have an exception in net neutrality rules to allow for innovation in new services. So if you have a connected car you want to ensure that the signals get through however they need, there

needs to be quality of service, no packet loss. And if you are on the best-effort neutral internet you cannot guarantee. That connected car is not going to work. The heart monitor, the telemedicine applications will face similar problems.

Essentially if you look at that, what it's saying is the innovation we see in the future is not going to be on a best effort internet, it's going to be on the part of the internet that's not regulated. Angela Merkel has been admitting that, the operators and innovators have been admitting that. Essentially what you are saying is we believe that the best-effort internet is done, the innovation is over and let's call it a day. So it's kind of sad because if you talk to engineers they say there's many problems with the internet. We can make it a lot more robust, we can improve the security, we can improve the speeds, we can do so many things if we allow it to roll. Net neutrality is basically saying this is the internet today, since 1995, the way we envisioned it, we are not going to let it change anymore. That's really a conservative argument.

7. **The amount of regulation that applies to OTT's and Telecoms is very disproportionate. Would you say that Telecoms are being over-regulated while their OTT competitors have much more freedom to shape their business strategies? Is it bad for innovation (especially in the networks) and competition in the market?**

That has definitely been observed. If you are a Telco you have a lot of restrictions about privacy, how you must encrypt your data, you can't study the data the same way the OTT can. OTTs don't pay taxes, they can set up anywhere they want etc. But I would say I am not for adding more regulation to OTTs. What I would say is you should have the same standards for everything, which is limited modern technology neutral framework, so that everything is created equally and that all the consumer protections are the same. That the idea about regulatory modernization, which doesn't mean I am suggesting applying the old rules to OTTs, I would simply say remove the rules on the telcos so they can have the same conditions that the OTTs have.

8. **In your paper you mention that "keeping in mind what good regulation is countries should not adopt the Dutch approach". Earlier in the paper, in the part about what good regulation is, you also mention that "regulators will never be able to produce outcomes**

as efficient as a well-functioning market". What is a well-functioning market according to you and do you believe that the Telecoms market is one of them, taking into account the competition from OTTs? What is best in this case, no regulation or little regulation?

Absolutely. If you look back ten years ago, 2005, we didn't have i-phone. Or even 1995. If you went to someone in 1995 and told them in the future you will have an i-phone and you can have a video conversation on your phone and it's only going to cost you this much and all these things you can do on the internet, no one would have believed you. If you had tried to download a movie to a phone it would have cost you 10000 euros and take you a week. Today you can download a movie on a phone in a very short time, it doesn't cost you so much and you know off you go. If you believe that that is progress, that has happened without regulation. That is the market providing things that people need.

So if you believe that regulators do better than that, let's say that regulators could produce something better than what we've had with i-phone with the kinds of explosion we've had with OTT services, Facebook, which is really the world's largest country in terms of users, then go with net neutrality, let's see what happens. That's what I study in my PhD, which is; do the countries that have net neutrality rules have better outcomes and more innovation? And we don't show anything conclusive. Because there are case where there are no net neutrality rules and things are great and there are cases where there are net neutrality rules and things are great. So it's really hard to prove what net neutrality is doing.

Appendum 4 GSMA Public Policy Director Mani Manimohan

Phone interview. 16/3/15

1. **What is the role of GSMA in the debates for net neutrality and the termination of roaming fees in Europe?**

GSMA is an association of all the mobile network operators around the world. We have all the leading operator groups and through them all the operating companies, which means we represent about 800 operators around the world. In some campaigns and in some discussions we also engage companies like Ericsson, Qualcom, who are very closely affiliated with the mobile industry. Our goal is to create an environment which is very conducive for the industry, for our members to invest and operate in different markets. So that might imply we are working on early stage technology projects, for example NFC or we might engage with

governments and regulators in different markets to create the right environment for investment.

Coming to the particular topic you identified in terms of net neutrality and roaming our aim there is to present the other side of the argument in those two cases, to policy makers and regulators, so that they make a very informed decision. After that we create public collaterals, or public materials sometimes, which we publish. We respond to consultation from the different regulators on this topic. We have bilateral meetings or closed door workshops to educate political leaders, regulators and stakeholders on this issue. And in all those cases we try to follow as much as possible an evidence-based approach also guided by what our members think. If you look at some great associations it might be pretty much the voice of their members and we are also trying to do that but we are also trying to bring a bit more of a balance and that's partly because we are a very global organization and we have operators who have very different strategies in this issue in the different markets. Either because the markets are in different stages of development and therefore they have different strategies or operators are positioning themselves as different types of players in the market, so because of that we tend to also try to reach consent but also bring new evidence to the debate.

But that is our main role, to be the voice of the industry in terms of public policy issues as well as new market opportunities, new technologies. So GSMA did a very early work on VoLTE before it was passed on to 3GPP, we also did some early work on Near Field Communication and in the public policy side we have worked on net neutrality, roaming etc. We work on a number of issues and we engage other organizations to create a policy and also to present our views. And as part of that we organize the Mobile World Congress which is an event, where we discuss a number of matters including the policy areas and that is an open forum. We are not only inviting people that are presenting our views to come and engage and talk.

2.   How does GSMA see the FCC decision in the U.S? We talked with some experts on the field from the US that told us that the FCC went too far, in fact further than even the net neutrality proponents expect. Is such heavy regulation going to hurt the market, competition and investments? Is Europe in need of a similar harmonized European regulatory framework?

For the first question, you ask whether the regulation impacts investment. Our members recognize that in certain areas there will always be some form of regulation. So for example if you look at consumer law, or some kind of consumer protection rule there needs to be some kind of regulation area. Emergency calls are one example, where there has been regulation to facilitate emergency calling by operators and despite the large number of solutions available to consumers to call each other, it is very difficult to foresee that regulation going away in the very near future. So that type of regulation will always be there.

Then the question is in terms of economic regulation, the kind of regulation regulating prices; access prices, network prices or regulation restricting price but operational freedom to some degree as would be the case of net neutrality. Our position would be that most mobile markets, the vast majority of them, have the power to be competitive, comparing with other similar industries where competition is considered to be sufficient and there is a significant degree of competition. Our kind of main task is that regulation should move away from ex ante regulation to more ex post regulation. So rather than having more sector specific regulation, it's preferable to have a competitive market coupled with some kind of competition law, a framework which is able to look at potential abuse and then investigate and make laws.

Returning to the question that kind of framework would give the certainty of investment to operators. We prefer that regulators are not going to come up with ex ante regulation but come up with an established framework which is saying that we are for competition, we would promote competition, we will let the market have flexibility in terms of technical solutions, commercial propositions but we have this framework which we will use if there are any cases of potential market failure and investigate, collect evidence etc. Returning to net neutrality, there is a broad widely accepted definition of what it is and there are also many contexts used from freedom of expression to other issues like the open internet, open internet meaning that consumers should have the choice to access websites and content services of their desire within the subscription that they have agreed to purchase. Operators are in principle committed to this principle of an open internet that consumers should be able to access anything they want but operators also believe that a competitive market which offers multiple offers, different types of tariff plans or propositions that combine different quality, different data volumes, different types of features, different types of applications, that is probably the right instrument to allow an open internet to be maintained. And therefore

they feel that rather than having specific net neutrality regulation, regulators and policy makers should focus more on strengthening competition.

3. The amount of regulation that applies to OTT's and Telecoms is very disproportionate. Would you say that Telecoms are being over-regulated while their OTT competitors have much more freedom to shape their business strategies? Is it bad for innovation (especially in the networks) and competition in the market?

According to factual evidence, there is more regulation on network operators compared to internet players. For example, network operators have to offer emergency calling and they don't get compensated for the cost of that. VoIP providers in most markets don't have to support emergency calls, so they don't have the same burden to comply with. The other example is in terms of privacy law in the EU, that there is much stricter requirements on mobile operators, Telecoms operators in general, compared to internet players. Most of these are partly due to the fact that sector specific regulation applies only to providers or electronic communication networks and many of the internet players are captured under the definition. So the way the legacy regulation has been drafted, most of the rules do not apply to OTT. So it is actually correct that there is more regulation for Telecoms than internet players.

On the subject of whether it hurts competition and investment one can say that there is a correlation. For example if you look at market growth of internet players and their revenue and profit margin growth versus those metrics for a European Telecom operator you will see that internet players have a much more positive story, whereas until recently, the last few years, revenues for most Telecom operators in the EU have been pretty much flat, even falling in some cases. That correlation can be shown but I don't know if that means there is a causation in those two.

So certainly on the first part about regulation asymmetry between the types of players yes. And then there is a yes also on different profitability and the investment story but on whether there is a proven causality, it's hard to comment on.

4. What are the implications of net neutrality for the network itself? What would happen with technologies that use priority codes like VoLTE that are considered technologies that can replace wire-line networks and carry a lot more traffic on mobile networks in the future?

Certainly net neutrality regulations create an uncertainty in terms of those services. So some services like VoLTE as you mentioned and the other example used by both the German Chancellor Merkel and the European Commissioner Oettinger is driverless cars. So both of those I guess illustrate a case where there is need for a priority access between two endpoints, an example that I commonly use is remote health monitoring, or with the broadband infrastructure we can use for many other services including video streaming and others. The questions is if net neutrality rules are drafted very strictly, as they did not so much in the Netherlands, but Slovenia is a better example, where they say that you should not discriminate based on content type providers or destination etc, if you apply that rule very strictly, it would mean that an operator can't prioritize VoLTE because that would mean you are prioritizing one type of content over another. Certainly it creates an uncertainty. The policy makers intent to not stop but the way the text is drafted it creates that uncertainty for investment. And if you look at one of the most recent rules, as for example the ones from the FCC and also the current discussion within the EU, you would see that they tend to make exceptions for this. There is a recognition that some of the services, VoLTE, driverless cars or remote health monitoring need to be prioritized and can't be subject to the same rules. Obviously these rules right now make these exceptions conditional on maintaining the effectiveness, as it is put in the FCC text or the availability and quality mentioned in the European text, it is not very clear whether it is a complete exception or there is something else that they have to do to provide VoLTE or support the driverless car. Will they be allowed to throttle, how far can they throttle etc? I think this is at the core of the debate at the very moment, that people recognize that in the very early 2000's a net neutrality rule wouldn't work and that you need to make some exception. So if you make that exception, how do you put those exceptions in law? There is a need for certainty for it. A lot of the regulators come from a very voice-oriented mindset and it's very difficult to apply a single-service regulation to a multi-serviced world. For the GSMA field that is very difficult to regulate in this complex world, it is much more preferable to have some kind of high-level principles like yes you should have an open internet, operators should transparent in the way you manage your traffic, you should be allowed to manage traffic but you should not engage in anti-competitive behaviour, while leaving the much more granular details of network management to the market and to rely on competition law for cases of anticompetitive behaviour and make appropriate remedies, rather than say upfront you can't

do this, you can't do this, you can't do this. It creates the kind of uncertainty you are mentioning.

One final point on VoLTE, the GSMA position is, and this is more related to termination regulation, because as you know 2G, 3G, voice services in, not all countries, but in the EU are at the moment regulated, that VoLTE should be considered a voice service and therefore it should not be subject to the net neutrality principles. That is our view about VoLTE and because there is no net neutrality rule widely adopted in the EU.

5.   In one Interview we had with the Portuguese Regulator he characterized the problems that clients have with net neutrality in EU as an endangered species that no one sees and knows for sure if they exist? Do you agree with this view or are there actually cases of infringement besides the Netherlands one?

I think they are extremely rare to be honest. There have been some very early cases of discriminating pricing of VoIP applications in some markets but if you look at the market today, at least in Europe, most of the pricing is mostly data-centric. I think there isn't really a big issue with that in terms of consumer action regarding open internet. I think consumers are given the choice to choose a package, there are a large number of tariffs available, some of them focused on high voice, text and low data, some of them more focused on high data, so consumers have the option to choose the package that best suits them. As far as I know, there hasn't been consumers' complaints about this issue. Of course there may be a few examples somewhere that I am not aware of. But there have been cases in Netherlands recently, where Vodafone was fined for anti-net neutrality behaviour for zero-rating HBO. So there have been these recent cases where regulators in Netherlands have had to enforce net neutrality and my understanding is that it was partly because there was somebody complaining about it, rather than the regulator pro-acting on it. Operators have been focused on network infrastructure and trying to incentivize consumers to use that infrastructure. But there hasn't been a case of active degrading of consumer access to internet.

7.   We also had an interesting interview with the incumbent Greek operator OTE and they told us that one analogy to consider for networks would be to charge differently to different types of traffics like tolls in highways, motor bikes and trucks are charged differently on highways also the highway operators do deals with companies that have very

big fleets given them discounts. Would you agree with this metaphor or there is a better way to do it?

I guess you are talking about whole-sale pricing? In the retail level of course there is no prohibition today and the rules are not intended to prohibit a different quality of service and pricing for retail consumers. So on the whole-sale, the question is whether operators can charge for priority?

In this case he was talking about services like Netflix passing through the network and using their network without paying anything and they would like to have a toll-system for such services.

It's about whether an operator can charge companies like Netflix?

Yes.

Even from an economic point of view price differentiation and price discrimination could be beneficial to consumers and that's because, fundamentally, if you have a uniform pricing model then everybody would pay more because the cost has to be distributed equally to different players. If you allow price discrimination that would allow you to co-subsidize between the different users. And co-subsidization and price discrimination are widely used in all industries. From that point of view I think there shouldn't be any restriction on that kind of arrangement. If an operator and a content provider can commercially agree to some kind of business arrangement, then net neutrality should not prohibit that arrangement as long as consumers have a choice of different tariffs, whether they want to access Netflix or just open internet access. If you look at the net neutrality rules in the EU I don't think they prevent that kind of arrangement. They state that operators can have agreements with consumers and third party content providers to offer services other than open internet access. And we need that kind of arrangements. Let's say you have a driverless car and you want to offer this service to BMW and then you need to prioritize it and therefore you have to make certain service-specific investment then I think it is not unfair for those two parties who benefit from it to come into a commercial agreement. Of course there are practical issues about it. The principle is that the possibility for that kind of arrangement should not be prohibited.

9.   What was the real impact of the roaming price caps to the Telecoms revenue in Europe? Didn't the price cap gave Telecoms a way to compete with OTT services?

I haven't seen any data on this. There were some data, I can't remember the data now, I think they came three or four months ago about whether the volume has changed after the price caps were imposed. Generally I would say that at least at the very early stages when they applied this there were some price adjustments in other markets. So as a profit optimizing private operator, you would expect that kind of behaviour, that if the cost and revenue in one country are being restricted, operators would exploit the freedom in other markets. And we saw that behaviour at the very early stages. Again it is very difficult to create a causality and say that there is a wide use of WiFi services for roaming consumers so they can have access to other types of services such as VoIP. So operators have to commercially offer attractive offers to consumers for them to continue the use of data services, so there could have been a price reduction from that point of view, there could have been a volume increase from that point of view and so on. There is some public information from the EU you can look at and you can make up your own mind but I wouldn't want to create a link between them. The only point I would say is if you go back to the GSMA main argument that regulation should not be imposed unless there is a clear market failure. And of course there are practical issues.

10.   Telecoms claim that prices were going down anyway in international calls but the roaming prices are always at the maximum of the cap. Cannot then one assume that if the price caps weren't in place the prices would be much higher?

What the European Commission did initially was that they had a safeguard at the retail level for operators to price their own services. I think the principle in general is fine, but I think the Commission has been too ambitious in the sense that they are introducing roaming regulation in a very quick fashion, one, two, three years after the previous one, before the first one gets embedded. And that could be a reaction to the fact that it's not moving the way that they want it. Initially they had a structural solution with expectations that a lot of players would enter this market and offer services and that didn't happen. The principle is fine but they try to do all this in a very quick fashion. It's probably not helping operators to embed one regulation and then go to another one, creating uncertainty in the market. I think that's where the Commission might want to take some time, rather than being driven by political ambitions. And politicians want to see quick action and sometimes I think because of that the wider consequences of that policy are not being considered fully. So they should create a high level

principle and give the ideas of they want you to do and provide flexibility, rather than build a lot of very complex rules.

Appendum 5 INTERVIEW WITH TDC SENIOR ADVISOR ALLAN BARTROFF

Personal interview. 16/3/15

1) Could you give us a small description of your job in TDC?

I am working in the public affairs group, with regulatory issues mainly EU regulatory aspects and access regulation, the Danish access regulation. We are a small team so we all have to handle different issues.

2) How is Network Neutrality related to the work that you are doing?

Quite related, we have an industry association in Denmark "Teleindustrien" where all the network operators are members, well almost all of them are members, the only exception is 3. There we have a working group on net neutrality. Teleindustrien is responsible for a net neutrality forum which is a platform where Teleindustrien and the national regulator and other stakeholders regularly meet to discuss it. It is a little bit inspired in by a Norwegian approach and we have developed a code of conducts to meet and anticipate some of the issues that could come up on net neutrality issue. So it's a part of my job.

3) There a very interesting section in your annual report about the cost of regulation for TDC.

- **How does such regulation affect the company's revenues, business strategies?**
- **How you measure this cost what is the data that you use for doing it?**

You are still referring to net neutrality?

Yes.

Well so far, I don't think it has affected our cost, I mean the regulatory costs in the annual report is another issue. It's the price control and the margin squeeze control. But we have seen different drafts from the European Parliament and Commission, some of them definitely would affect our business opportunities. I mean you have this ridiculous discussion around zero rating, we would have to redesign some of our services if that was introduced. In terms of revenue it wouldn't have any great impact but there would be some additional costs to do some changes. If you look at the most far-fetched ideas from the European Parliament

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about network management that would be a catastrophe because we simply couldn't do that. Network management, in the perception of the European parliament, is something you do at extraordinary conditions and if you run a network you do network management all the time, there are some basic misunderstandings, and the position that the Council represents now is reasonably balanced. I think would be pretty unlikely that these radical interpretations would ever come to reality. What net neutrality would mean is that we wouldn't be able to offer some of our specialised services and it would kill our most popular services like IPTV for example. It would be extremely difficult to deliver in a satisfactory quality and again I think there is an understanding for this so at least if you look at the council text which we can live with and that wouldn't affect our revenue.

Are there any plans for net neutrality regulation in Denmark?

No

No? not yet?

No

It is because we are doing a case study on the Netherlands and we were wondering how it is in Denmark.

I mean I guess the Danish regulator's position has been to wait until the NRA sees what the outcome of the TSM will be and then you have to implement and it will be done in the net neutrality forum. But of course if you've got very rigid requirements from the TSM we would have to implement them. But the Netherlands shouldn't be the standard.

4) The amount of regulation that applies to OTT's and Telecoms is very disproportionate. Would you say that Telecoms are being over-regulated while their OTT competitors have much more freedom to shape their business strategies?

I mean that discussion is not too easy, because there are different rules that apply to Telecoms and OTTs. And essentially it is because they are two different types of companies and if what the OTTs did the same as we do they would fall under the definitions of the framework directive so the same rules could apply to them. But they are not network operators yet. But if they become network operators they will fall under the regulatory framework as network operators.

But for example in terms of privacy..

Yes that is one of the issues where they might have an advantage and also privacy, data protection and to some extent the tax rules, where they have some opportunities to deal with VAT.

Yes, the European Union changed this year the Law to make OTT's pay VAT in the country they provide the service.

Yes that was good progress, putting OTT's and Telecoms on equal footing.

5) Do you think that there is a conflict of interest, in the relations between Telecom and OTT companies? What is the best option for OTT's and ISP's cooperation or competition?

Well it is the usual you can guess the answer, both. I mean we are in competition on content delivery with Netflix, that's a direct competition, and if we can conclude an agreement and include Netflix in our service we would have cooperation.

6) Is there an impact of OTT services, on your company's market share? In which sectors do you see bigger impact (SMS, Voice etc.)?

No

There is no reduction?

Well we see a significant reduction in traditional fixed telephony and which is also replaced by our own VoIP services, by Skype, by whatever application you can dream of.

7) Many people that defend net neutrality say that if Telecoms have full control over their networks they would favour their own services and their partners' in opposition to those of OTT's, but is that really true? What would happen if Telecoms could manage the network traffic as they wish?

Well is it an issue of management or an issue of access?

We are talking if the Telecoms had the power to decide which service they provide over their networks.

It's a bit difficult again because we have the access obligation so if someone wants to deliver their service we can conclude an interconnection agreement and we have to provide access, that's the basic European approach, which is different from US as you know. So we can't deny access at the access level. The issue of network management is if we could put the alternative content provider's service aside or downgrade it, but it would be pretty stupid to

do so. Let's say we have a wonderful service that is competing with Netflix so we downgrade Netflix and if our customers cannot get Netflix then they just change to another operator and it would happen so quickly. Yes we can block Google but I mean we can't live without Google. One of the reasons to buy broadband is because people want to access to this services. I guess is a bit hypothetical that we should block or downgrade although I hear the concern sometimes but…

In Greece they tried to block the peer-to-peer files but it didn't work.

Yes but that's another story it's not because they are competing with your service but it's because they are occupying too much capacity in the network, we have the same experience we can't deliver general satisfactory services to customers our services but also other services. If you have a really huge burden of peer to peer traffic by the way more or less illegal downloads. So then in some instances and in peak situations we have to put P2P back in the queue because peer to peer traffic is not sensitive to delays.

8) What are the implications of net neutrality for the network itself? What would happen with technologies that use priority codes like VoLTE that are considered technologies that can replace wire-line networks and carry a lot more traffic on mobile networks in the future?

Yes that's true but that was one of the reasons that was so important in the Council discussions about net neutrality to make clear that if there is a ban of discrimination, it is a ban of discrimination inside of the same traffic types. Because you have to discriminate between traffic types that are more sensitive to delay than others.

9) We also had an interesting interview with the incumbent Greek operator OTE and they told us that one analogy to consider for networks would be to charge differently to different types of traffics like tolls in highways, motor bikes and trucks are charged differently on highways also the highway operators do deals with companies that have very big fleets given them discounts? Would you agree with this metaphor or there is a better way to do it?

It is a question about data termination and I am not sure it makes much sense from our perspective because again one of the reasons is that we are providing broadband because we can provide access to these different services. We might invoke a regulation we don't want

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in data termination that could be one danger. But the other thing is, it's our business to provide broadband access so I am not quite sure it makes much sense.

What is your approach for managing such kind of services that cause a lot of traffic in the network?

Our policy is that if our end customers expect, when they buy broadband connections, then we can deliver broadband, in the end our position is that it's the charge of broadband for end customers that finances the network. And then you could imagine the case where the end customer concludes an agreement with Netflix that they want to get high priority service from Netflix and then Netflix contact us and says ok I want to pay you as network operator because I have an agreement with an end customers so I want to ensure high quality for the end customer, but then it is up to the end customer to decide and to pay.

10) How is a possible single market of Telecommunications in EU seen in TDC - as an opportunity or a threat? What are the implications of being part of such a market? Would net neutrality regulation impact the creation of the single market?

We have really no strong feelings on the Telecom single market because we are focusing on the Danish national market, we have our business operations in Sweden and Norway.

But if there is a single market you can provide services to all Europeans.

Yes but we have no business case for doing so, it is not interesting.

But other companies will try to provide here I believe!

Yes but there are different companies and different business models, I mean for companies like Belgacom or TDC it's probably not so relevant. It is much more attractive for Deutsche Telecom and those guys…

Vodafone for example.

Yes and Orange and Telefonica.

11) How TDC saw the move from EU to cap roaming fees? How important were the roaming fees before to TDC? How did TDC cope with it. Are roaming fees an obstacle to the creation of a European Single Market of Telecommunications.

Well it is a part of our revenue of course, but I don't know the percentage but I guess you could find other companies that it would be more important for to put it that way, Telenor for example, Telia also.

But it was pushed back lately.

Yes but if you maintain a balance between wholesale charges and retail price reductions we can live with it.

12) There are some companies that see roaming in Europe as a chance for them to acquire new customers by making prepaid packages that include free calls to some countries in EU and even outside. Does TDC also see this as an opportunity or to acquire more customers or is just a gimmick that most people won't care about?

Yes we have all developed different packages but again we are mainly addressing the Danish market. But then this can be interesting for business and some residential customers.

13) How does TDC intend to make up for the losses of the roaming revenues when roaming fees are eliminated completely in a few years?

Well it is a good question, but what we have to recognize is that we see a drop in roaming income but the role of roaming for us is simply too small in our case. Again it's unpleasant but it will simply be a part of the budget plan to compensate. What we don't believe is that we don't expect to see a significant growth in roaming. This idea that if you just give up roaming you are going to see and explosion of intra-European calls and you will earn your money that way, that's not likely.

Why you don't think it is likely?

Well I don't think it is likely because we have seen some dramatic reduction of roaming charges and for the last 5 years or so since the first roaming regulation, and the roaming traffic has been growing but not that much.

Appendum 6 INTERVIEW WITH KPN SENIOR REGULATORY COUNSEL PAUL KNOL

Phone interview. 20/3/2015

1) **Just as a background, what is your position in KPN? How is Network Neutrality related to the work that you are doing?**

Within KPN, I work in the regulatory department, my background is law. Within our team I am responsible for most of the discussion about net neutrality.

2) The Netherlands seem to be the strongest hot spot regarding the net neutrality discussion in Europe. Even in the US, in the light of the recent pro net neutrality ruling of the FCC, the Netherlands case is being mentioned as an example where "Net Neutrality has worked" (Bart W. Schermer, Considerati) and where competition is working well with companies competing on price and speed. Was the net neutrality discussion in the country mature enough when the law came around, was it too early but due to circumstances some grabbed the opportunity to push for this agenda? Was there need for it?

If you ask me it was the latter. There was no trouble in the Dutch market at all. There is fierce competition and there has to be fierce competition in the Dutch market, in fixed, as well as in mobile, not because of net neutrality regulation but because of the fact that we have cable competition, so every household is connected to two networks. Historically, the cable TV network and the Telecom network, in most cases KPN historical network. There has been fierce competition. So regarding any statement that net neutrality allowed competition is pure non-sense.

The reason why net neutrality was included in the Dutch Telecoms law was a remark made by our CEO, because at the time our income was reducing rapidly, especially in mobile, due to, for example, WhatsApp and other over-the-top services. They had to convince the shareholders that whereas income was decreasing, to increase the investments. That's a very problematic message on the first occasion as CEO. Maybe not too willingly but he had said, we will be investigated, how we should go on with WhatsApp and other applications that take away most of our voice and net revenues. But the fact that he would investigate potential alternatives for the cheap OTT services led to the discussion. And everyone guessed, maybe it means that they will start blocking. And that's not what we want. And then came a lot of political discussion and there was no way back for us. So we could say "that is not what we meant" etc. and the discussion in the U.S was ongoing so.. There was no actual plan within our company but it led to a lot of political discussion and ultimately the law. It was rather a coincidence that the implementation of European directives law was that month in

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parliament, so it was very easy for the parliament to include an announcement on the implementation act and then net neutrality was regulated within a couple of weeks.

3) **What is your view on the Netherlands law in this matter and do you expect this law to be transcribed to other countries in the EU so that all Telecoms operate under the same rules?**

Well everyone is using the Netherlands as the example in the discussions about net neutrality. A better question would be what are the problems with the law as it stands? But I don't think the market has really changed since. So you can't claim that the Dutch provision created a better market. The market was capacitated and most competitive even prior to the net neutrality law. So there is not proof in any way that it helped the market. What I cannot say is that without this net neutrality regulation, one or the other operator might have considered by now to test-block some applications. It hasn't happened but you can't prove it wouldn't have happened without this legislation.

4) **Knowing that it's hard to predict how things would be if the law wasn't there, can you tell us what has changed after the enforcement of the law for KPN? What has been the impact of the net neutrality law enforcement in the Netherlands on the company's network, revenues, business strategy?**

I don't know whether you've been able to study the text of the Dutch legislation. One of the things that hasn't been included currently in European proposals is the ban of every tariff differentiation.

So you mean different types of tariffs for different types of services?

Yes. The ban of tariff differentiation based on the content of data services used. We have the famous zero-rating discussion on mobile, which is clearly prohibited by this law. It is not only prohibited to have higher prices for some services over the internet, but it's also forbidden to have lower prices. And this creates discussion on the question, what is actually a service over the internet? If you read the text, it hasn't been defined. And even the explanatory note doesn't make it very clear, it is a rather general statement. And there is that statement that of course managed services are not internet services, but it hasn't been clearly defined, what is a managed service and what not? So there is a lot of room for discussion. How far does the prohibition on tariff differentiation actually go?

There has been one fine by the regulator recently on Vodafone. Vodafone introduced a television app for its mobile network together with HBO, and this HBO television program was zero-rated. You just paid for subscription but no additional payment for the data you actually used and then the regulator decided that this was a violation. But since the content internet services are hardly defined, or at least not defined precisely it might be difficult for operators to decide whether a service is indeed an internet service or a managed or specialized service. And that creates a lot of uncertainty in the market. I know that within our company there have been a lot of questions, very detailed questions sometimes.

I'll give you one example. We have an application, called myKPN, on which the customers can see their bills and give them the opportunity to increase or decrease the monthly bundles and if you exceed your bundle you can have additional bundle and so on. So it's an app which can be used to manage the subscription. And that's all it does. Now is that an internet service or is it a specialized service? It's not specialized under any definition I have seen, because it's not an increased quality of service or anything like that, it's just something that helps you manage your subscription. The question is, is it allowed for us to do that zero-rated? Because if it was an internet service it wouldn't be allowed, because if you have exceeded your bundle, you can't change it, because the bundle has stopped and if it can't be zero-rated then you have to pay for it, but you can't buy the extra megabits. So it's a totally strange situation. The ban of tariff differentiation has these consequences. No one can tell us whether it's allowed or not.

5) KPN was charged by court ruling of net neutrality law violation regarding the issue of free WiFi hot-spots. Is the law unclear for cases like these?

The example I gave you before was a very detailed example of this law being unclear. There are a few questions that are not clear as I said. But this case with the WiFi was an internal mistake. This has nothing to do with the problem of zero-rating. What happened was that historically we have this agreement with Schiphol airport that we are allowed to offer WiFi services in the territory of the airport, paid by the customer. So if you are in this airport you can buy WiFi access. But then the airport asked us to prepare for them a service that is free for customers. So they paid us for the traffic of these free access customers. But then they asked us, back in 2008-2009, before the net neutrality legislation, to make this service so that these free customers could not access all the internet, but just use it to check emails etc.

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because otherwise they had to pay too much. So we implemented that upon their request. And when the law was enforced, KPN forgot that this service, managed by KPN, was made this way and until the first complaint came five months after, no one realized that it was wrong. Because after the implementation of the net neutrality regulation, no blocking at all, including this. So the choice we offered in Schiphol airport, the free and non-free services, had to change. So it was a stupid mistake that was simply forgotten.

Coming back to the previous question, did the law change something for the network or did you see any decline in revenues, did you change your business strategy after the law for example?

We did of course. But it was so hard to compare the situation without this net neutrality legislation. Because in the recent years, mobile data users have increased extremely. So a lot of things happened. But you can't say what parts of that would have been different if the legislation was not there. Some of our bundles have changed. We have made changes inside the bundles themselves. And the price of bundles have changed over the years but I guess that this is not due to net neutrality legislation but by market forces.

6) **Many people that defend net neutrality say that if Telecoms have full control over their networks they would favor their own services and their partners' as opposed to those of OTT's, but is that really true? What would happen if Telecoms could manage the network traffic as they wish?**

I don't think it's true the way that it's stated. Of course all mobile networks, if we start with mobile, are somewhat similar. They are highly standardized, offering LTE or 3G services at the highest quality available. Well there might be differences in network quality and coverage and capacity but not on the technology issues. So operators have to differentiate themselves. They can do that by creating a better quality of coverage, they can do that in pricing or they can do it in additional services. But the main properties are somewhat similar. Other things they can do in differentiating their services, is to attract customers, for example, by offering free Spotify traffic. Now that's very questionable under Dutch law. We have one type of subscription that generally would allow us to do it, but it is too difficult to explain right now. In general, they wouldn't accept that differentiation. Now I get that if Vodafone would have chosen Spotify, or T-mobile would have chosen another and we would have picked another and so on it wouldn't have been a problem for any of the parties, neither for the

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operators nor the music streaming services. Because it's just a promotional service. It could be different if you exclude other types of traffic or degrading technically competitive services but that I don't think anyone would do. Because all customers say, we want full access to the internet, so by definition all operators offer full access to the internet. Because if you don't do that you don't get any customers. That's competition. So I guess that ultimately on the level there would not be any real problems.

What happens on the other hand now with the Dutch interpretation including the ban of zero-rating is that you start a promotional service to offer something extra to your customers because that's all it is. I don't see any reason for that to be wrong. The Digital Fuel Monitor, the Finnish consultancy organization, claim that zero rating is the worst thing that could happen to an industry. I don't believe that. It was a narrow report, a narrow economic analysis of zero-rating. And their analysis was based on an economic justification that zero-rating is not any problem at all. So there's another debate on that. My personal view is that zero-rating is something that we would have been considering if the law hadn't been what it is. These are not services that violate competition, they are ways to differentiate yourself with promotional extra services to your customers, without violating the idea of open internet that calls for equal traffic by law.

On the other hand there is the debate about the European Council proposal from April last year that equal treatment doesn't create problems. Because for example there might be a need for emergency services, which need to be prioritized. So saying that all traffic should be treated equal, it is not possible. A call between police officers is different technically, from a call between you and me. So the strict interpretation of net neutrality doesn't allow all these types of emergency services.

7) What are the implications of net neutrality for the network itself in the future? What would happen with technologies that use priority codes like VoLTE that are considered technologies that can replace wire-line networks and carry a lot more traffic on mobile networks in the future?

If you read the text literally as it is, if I read it to a network engineer, they would say that we violate the law every day. Because especially in mobile, we need some kind of differentiation. And it's not something that we create, it's in the standards of GSM and LTE.

Because some politicians seem to think that network management is something bad in itself. If we didn't have network management, we wouldn't have Telecommunications. Network management is the core of Telecommunications. We need to have networks used as efficiently as possible with the highest quality. And that's network management. It requires planning, rules and so on and that's what we do all day. Simply the idea that every bit is the same and every bit is treated equally, it doesn't work that way. Networks don't work that way. So what we see is that there are two worlds that don't speak the same language.

The technical operational world where everyone agrees that network management allows the best service quality for networks and the political world saying it's bad. And I guess that these two worlds are drifting apart. Politicians keep saying their "phrases", while network management engineers just keep doing their work. For example, some mobile operators, if you have a picture made for a website for the screen of a PC, if you put that on mobile it's rather inefficient, because it can't be shown on the mobile's small screen. So someone created a technique where not all bits are correspondent to the mobile device's screen, it's a bit downgraded. It's violating the principle of net neutrality but no person at all sees the effect. It's more efficient in the network. It's more efficient for the user to have the picture on the screen in the way that they can see it, so there are a lot of technical issues that politicians tend to neglect. They are far too complicated to be explained in simple words but they are a technical reality.

The problem I have, that is important for us, is that we have a technical debate with application developers. Sometimes their applications don't work on our network. Technically. Because the internet isn't fully interoperable, it's not fully standardized, there are choices to be made. You know when sometimes you install new software on your PC, sometimes it doesn't work immediately, you have to change some settings. It was the same with the internet, especially mobile networks. We implemented firewalls, not to block traffic, but to protect our customers from botnets, from whatever bad traffic there is on the internet, and these firewalls are very essential to mobile networks, they protect the integrity of the network and protect the integrity of Telecommunications. Sometimes things do not work the way and application developer thinks they work. Well that's just fine. Then we start discussing. But every question, is being rebranded as a violation of the net neutrality law. Developers say "net neutrality is violated because my app doesn't work on KNP's network".

From a network perspective we are always now in the defense, when it's not a net neutrality discussion. It's an interoperability discussion. But what we see in the press all the time is "you are blocking the network". Well it's just a different type of discussion and I guess that no one really understands the implications of this legislation in this perspective, until you are confronted with it like we are in the Netherlands.

8) The amount of regulation that applies to OTT's and Telecoms is very disproportionate. Would you say that Telecoms are being over-regulated while their OTT competitors have much more freedom to shape their business strategies? Do you believe that this has to change? In what ways?

I completely agree that Telecoms are over-regulated. I am not sure that OTTs are under-regulated. I think that one of the great challenges, regarding the revision of the Telecom law announced by Juncker, will be to have more technology neutral concepts, because if you look in detail at what especially Google is doing with traffic, on some level of the value chain, they have the same role as Telecom operators but they are not considered Telecom operators. Their role as gate-keepers if you look at it on a high level, is not very different from ours. And that's the challenge. They are also gate-keepers. Especially Google, they have the Android system, the search engine, they have a large capacity across the Atlantic because it's not transferred over public networks, they have their own lines, so they have a lot of Telecommunications functions, without being considered as a Telecom operator.

In France recently there was a suggestion that is going even further from net neutrality to the concept of platform neutrality. What do you think about that?

It seems to be a disease in our time that only regulation creates the market. I don't believe that actually. Like I said before, I haven't seen any real problems in regards to net neutrality being implemented. And it might have been a real problem in a monopoly situation. And that is why the U.S. is a rather different case. Because initially the problems that 10 years ago created the net neutrality debate in the U.S. was some of the cable networks that blocked some of the traffic. It was a rather stupid thing to do but they were local monopolies. Then it is a problem. If there would have been competition on access level like we have in the Netherlands, there's a lot of competition here on fixed and mobile. You can always choose. In the Netherlands one of the cable operators that one time did something prior to the net neutrality regulation, they slowed down peer-to-peer traffic. That was before we had the

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legislation. They immediately stopped it after it was discovered. Why? Not because there was legislation, because there was none, but because of the publicity. They feared that customers would go to KPN or Vodafone or others. So the reason was here was competition. And not legislation. Somehow fifteen years ago all politicians said competition is the answer to our regulatory problems and now that there is competition, they have forgotten that and they say we need to regulate for eternity.

9) **Is there an impact of OTT services, on your company's market share? In which sectors do you see bigger impact/decline (SMS, Voice etc.)? Can it be solely attributed to OTTs?**

There is a very big decline in SMS. Our SMS traffic has dropped immensely. I think WhatsApp is exceeding the messaging services compared to Telecom operators in the Netherlands by far. In voice, in international calls, they have a large market share, on a national level on the other hand, it's there but it's not the same amount. Voice traffic is decreasing constantly in the Netherlands, but it's not sure whether it's because of VoIP services or because people can choose from a large number of communication services. So voice can be replaced by Facebook messages or by other means of communication without being voice. So you cannot say it's Skype that takes the traffic from traditional communication services, it could also be messaging or other types of services. So yes voice is slowly decreasing.

Appendum 7 Interview with Dutch Ministry of Economic Affairs Policy Advisor Jeroem Westerink

Phone interview. 23/3/15

1) **Just as a background and as summary, what is your position in ministry of Economic Affairs? How is Network Neutrality related to the work that you are doing?**

I am a policy advisor here at the Ministry of Economic Affairs in the Telecom markets department, but before this I worked in Brussels for four years as a representative of the Netherlands in the Telecoms sector so I was involved in the negotiations there and I joined again the ministry in August last year (2014).

2) **The Netherlands seem to be the strongest hot spot regarding the net neutrality discussion in Europe. Even in the U.S., in the light of the recent pro net neutrality ruling of the FCC, the Netherlands case is being mentioned as an example where "Net**

Neutrality has worked" (Bart W. Schermer, Considerati) and where competition is working well with companies competing on price and speed. Was the net neutrality discussion in the country mature enough when the law came around, was it too early but due to circumstances some grabbed the opportunity to push for this agenda? Was there need for it?

At the time it started with some national Telecom incumbents who were planning to charge more for the use of certain services, so if you wanted to use services like Skype and WhatsApp you would be charged more for this subscription in order to use these kinds of services. The incumbent was quite clear about that, they thought they were talking to their shareholders saying "Look how we respond to the rise of these competitors" but of course consumers were also listening and the parliamentarians were listening too and that created some controversy and then our parliament, not the cabinet or the ministry, initiated a national law banning practices like blocking, throttling and price discrimination. So it was the response to the initiative of these few Telecom companies, because others were planning to do the same.

3) **Bits of freedom and many others claim that the law has been a successful decision, would you agree that the law actually works? Was competition in the market not enough for a well-functioning market before the law was passed?**

Yes the law is working well and we think that there was a need for it. I am not a competition law expert but I guess in that case you would have to prove the dominance of a certain party and if the party is not dominant but it is at least hurting its customers by blocking or throttling, then the competition law cannot really do anything. So parliamentarians thought, because this was accepted by our parliament as well, that the law was necessary to prevent customers from these practices of telcos.

Do you expect this law to be transcribed to other countries in the EU so that all Telecoms operate under the same rules?

That's the big debate now of course. We are in the middle of negotiating this proposal in the Council and now it's being finalized and the negotiations will start with parliament. I am not sure how much you know about that?

We are following it very closely.

We have been trying to get our own national rules copied into the European rules that will apply directly in the future. And we have started to get support for this ban on price discrimination that we asked. Within the Council it was not blocking and throttling, which were more or less accepted that they should be banned, but price discrimination, this being negative or positive. So we are talking about a ban on charging more which prevents negative price discrimination and a ban on zero rating, not charging your customer for certain services within the bundle. Those two forms of discrimination are prohibited in our national law and there was no sufficient support for that in the Council. So now in the Council position, they just talk about whether there is harm from the scale of certain practices. So it first says companies can set their own terms for commercial contracts but if they are sufficiently large-scaled and sort of harm the consumers' choice, then regulators can respond, but it is made dependent on scale so I guess it brings it closer to what would happen if you brought it under competition law. If you are dependent on scale I guess all or most Telecom companies would have to apply certain practices, certain price discrimination and then there is no choice left for the customer and then it's time for the regulator to intervene. Whereas in the Netherlands there is just a ban on discrimination for individual companies so no individual company can do this to their customers. This is what we will continue to push for and we tried to get support for in the European parliament.

4) **Many people that defend net neutrality say that if Telecoms have full control over their networks they would favor their own services and their partners' as opposed to those of OTT's, but is that really true? What would happen if Telecoms could manage the network traffic as they wish?**

Yes they may say that of course but we would like to make sure that they won't. Traffic management is still an issue, we've had a discussion with the Council, how strict you are on traffic management, what you can do with blocking and throttling when you apply traffic management. For instance now there is some room left for discriminating or slowing down a whole class of services when you apply traffic management. Of course it depends on how positive or negative you want to be about the behavior of Telecom companies, but it can be used to just slightly slow down the service of a competitor. If you for instance want to offer Voice over LTE in the future and a competitor offers Voice over Internet, which is a different category, then in theory they could slow down slightly the Voice over Internet service to make

their VoLTE service more popular. This is hypothetical but we want to make sure that it is prohibited so that there is a basis for action for the NRA when necessary. So this is on the issue of blocking and throttling in traffic management.

Then there is negative price discrimination. There I can indeed see the argument that they say that as soon as we start charging more for Skype or for WhatsApp, customers will walk away because they are so used to that type of service, I can see that. And of course the popularity of these services has evolved. So maybe by now they wouldn't dare do that anymore. But positive price discrimination, meaning giving your customers certain services for free and that doesn't count in your bundle, that is more subtle. That is something that they would probably like to do, to make their bundles more attractive to customers and many people say that it's just a commercial practice, you can do that to create attractive bundles and innovate with the bundles you offer but you must also realize that this doesn't leave any chance for small, more innovative challengers on the internet, over-the-top companies to offer their services. For instance, if there is a challenger that offers a similar service to Spotify, but Spotify is included for free in bundles of many companies then how would any challenger be able to compete with Spotify? So it's our position, and of course it may be far-reaching, but it is our view that the consumers should have freedom of choice, and companies should compete under the same conditions.

5) **What are the implications of net neutrality for the network itself in the future? Do you think that future network technologies can be developed without problems within a strict net neutrality regulatory framework? What would happen with technologies that use priority codes like VoLTE that are considered technologies that can replace wire-line networks and carry a lot more traffic on mobile networks in the future?**

We have done research on this, we have had an external company about what this would mean for VoLTE for example and whether it would qualify as a specialized service and in fact it does qualify, we think, according to the definitions that are most common now, and this is also the European parliament's position. For instance, VoLTE would be a specialized service and therefore be allowed to be offered enhanced quality and their own capacity. So we don't think net neutrality rules block innovation in that respect.

6) **Vodafone was recently fined for the app they offered in collaboration with HBO. Do you think that there is any problem with the law allowing partnerships between Telecom and OTT companies so some OTT's can have better services than others? Is the law unclear in some cases?**

No, the law was supplied by our regulators so it is clear I think.

7) **How are Telecoms being monitored for violations of net neutrality?**

That's the job of our regulator to do that. But I don't know exactly myself how they do it.

8) **Without some management of networks it would be very expensive for Telecoms to keep up with the QoS necessary to provide good broadband services to their users. Is it acceptable to you that different types of traffic have different types of priority as long that inside each traffic type all traffic is treated equally or not?**

We think that all traffic should be treated equally as a basic rule and only in case of congestion on the network, then there might be reason to prioritize certain types of traffic.
What about emergency services or remote health monitoring services in the future? Could those also be exceptions to that rule?

Those are all specialized services, so just to be clear the Netherlands have no law against specialized services. Some services need enhanced quality and their own capacity for different reasons like traffic management, health and also some commercial applications, there is no regulation about that. We allow that. We only regulate the open internet and as long as you offer something as open internet, then it should be neutral and if a service is specialized then you can do so. There's of course the big debate that takes place in the Parliament. The European Parliament is emphasizing this all the time, that specialized services are undermining the open internet, but that's not our struggle, it's not our fight.

9) **The amount of regulation that applies to OTTs and Telecoms is very disproportionate. We recently read a report by Telefonica and we have also interviewed several Telecoms which are asking for less regulation in the Telecom market, rather than more regulation for OTTs as this would initially bring a balance but in the end it would lead to reduced revenues for Telecoms. Would you say that Telecoms are being over-regulated while**

their OTT competitors have much more freedom to shape their business strategies? Does that hurt competition?

It's not quite fair that OTT's are not regulated. It is an issue that you need to take a look at the regulatory framework that has been followed. We do need to look into that. But it is clear that they don't fall in the same regulation as the Telecoms.

The discussion is going on that Telecoms should be able to make more money, that they are being challenged by the OTTs therefore we do think that is important they are still able to differentiate their offers in terms of volume, speed and be able to change their subscriptions on that qualities.

10) How do the Netherlands view the end of roaming in the European Union and the start of the Digital Single Market as a threat or an opportunity to its economy?

It is an opportunity of course. We are also coordinating spectrum law, we are in favor of that. In mobile we would like to see a more bottom-up approach, we would like to see more collaboration between the states not so much a dictate from the European Commission, we would like to see the end of roaming, although that proves to be difficult. We should do it in an ambitious way but also in a sensible way. We can't stop roaming straight away unfortunately and the Parliament would like to see this too. It will take more time to get rid of differences in wholesale tariffs but it is something that we would like to see. And on net neutrality for instance we would also like to see if we can, a pan-European harmonized approach and hopefully still have room for our own national rules, but in general it is something that we can benefit from and we are in favor of.

Appendum 8 INTERVIEW WITH TELEFONICA REGULATORY ECONOMICS MANAGER FERNANDO HERRERA GONZALEZ

Phone interview. 25/3/15

1. Just as a background, what is your position in Telefonica?

I am the regulatory economics manager and I am in charge of making economic analysis of regulation for Telefonica. So I cooperate with business universities in doing this kind of job.

2. **The Netherlands are pushing for a harmonized European net neutrality regulatory framework. Would such regulation harm competition in the Telecom market? Do you think it's completely unnecessary?**

There are several parts to that question, first one is if net neutrality regulation is or is not necessary. That's not difficult to answer and by now you should have read a lot of economic theory about net neutrality so you know by now that most economists are against net neutrality regulation because it doesn't have a sound basis. When you see the issues from the economic analysis point of view, what you want to know is whether the welfare of society will increase with the regulatory action. And the fact is that there is no analysis showing that there are social welfare benefits by having a net neutrality regulation. So what they normally allege is that without a net neutrality regulation operators can choose between services and that they can influence the behavior of customers and so on.

But what is very important to keep in mind about the net neutrality issue in my point of view is that there isn't infinite capacity in the operators' networks, somehow someone has to choose which services and content pass on the network. If you have infinite capacity you can deal with every content and every service the same way because everything can fit in that network. But if it isn't the case, and it's not the case because there is capacity constraints, someone has to decide which content has to be prioritized if there is a congestion. If there is enough capacity for all the demand of the users of course there is no problem but there are moments or there can be a moment in the future that not all contents can fit there so one has to decide what to prioritize.

So the question is, how do you prioritize the content? The answer, if you are trying to improve the value of your network, is to prioritize the content and services that is seen as most valued by them the users. Because otherwise if you are pushing content that they don't like then they move to other networks where someone is pushing them the content they like. So in the end there is some kind of alignment between the preferences of end-users and what the network has to do. But if you break this link and you don't own your network you are not interested anymore in increasing the value of your network then things change completely. Because in that way you don't care what users want to access, you just put the first thing or based on other criteria. The whole point is if you are not concerned about increasing the value of the network, if you are for example a politician you don't own the network and you don't care what kind of content the users can access.

The thing you always have to keep in mind when analyzing net neutrality is that the network capacity is not infinite and not everything fits there and someone has to decide what does fit there. There are two possibilities basically; either it is decided by the owner of the network or it is decided by any other guy. If it is decided by the owner of the network, the owner will try to increase the value of the network and in order to do that they have to provide the content that the customer wants. If it is decided by any other person like politicians for example, they won't care about that, they will use some kind of criteria which won't be aligned with the preferences of the users.

3. **Based on the paper you send us, we would like to ask to you to elaborate in which areas Telecoms should in your opinion be deregulated so there could be more sustainability for the Telecom networks?**

    In Telecoms in general or just in net neutrality?

Yah in Telecoms in general. Which areas are most problematic for Telecoms and should be deregulated?

From my point of view the main problem with Telecommunications in Europe is the access regulation, you know what access regulation is?

Yes.

The incumbent or the ex-monopoly operator has to grant access to whatever operator wants in regulated conditions so from my point of view this regulation is very harmful because new operators will just rely on the network of the incumbent operator and the problem is since they rely on it they won't try to innovate. They have something that is easy to use and is given to them under regulated conditions which very likely are much better than the market conditions, why should they innovate?

In Spain we have a lot of investment in engineers and not in optical fiber. And that was happening from 1998, where the market was opened for competition, until 2013. There was no investment from alternative operators. Suddenly after 2013 they started investing. In Spain this happened because there isn't any regulation on wholesale market for accessing Telefonica's fiber network for connections higher than 30 mbps a lot of companies are investing many millions of euros to build optic fiber because companies want to compete in this market and they cannot get it in the wholesale. So from my point of view this is evidence

that when you lack regulation other operators start investing to serve the customers and that's why I think access regulation is very likely the most harmful part of Telecom regulation.

4. **What are the implications of net neutrality for the network itself in the future? What would happen with technologies that use priority codes like VoLTE that are considered technologies that can replace wire-line networks and carry a lot more traffic on mobile networks in the future?**

You have to take into account what I just said, an operator tries to increase capacity or innovate in a way he manage the capacity. You have two options, you either improve the management of the network or you increase the capacity. But normally increasing the capacity is always a solution but ultimately you will want to optimize the capacity you already have. For example if you think about a shop or a supermarket they have a limited capacity on shelves and storage. Of course they can buy another building and increase the capacity of the shop that may be a solution but they have to optimize too. And they innovate by thinking how they distribute the products on the shelves. So once again if there is regulation that says that you can't manage the capacity freely, all the limitations you are imposing on your capacity to manage are in fact reducing your capacity of innovation. Imagine if someone says to a supermarket that all the shelves have to be at the same disposition, so you can't innovate on how you provide the products.

So regulation can limit the way the Telecoms can manage their capacity. As such this would limit innovation because there would be fields where operators wouldn't be allowed to innovate or even think how to innovate there.

5. **With the introduction of the European single market do you see that as an opportunity to grow or a threat to your existing business model?**

From my point of view this is mostly a political issue, there is nothing right now that stops operators to deploy networks in other countries. But the European commission wants to be the one to regulate the market. I don't think for operators it is very different to be in a single market or in many markets. You don't want to have a single market with bad regulation, what we need is good regulation no matter if single market or not.

6. **How you see a single digital market being regulated, with local regulators or with a model like ECB where there is an Pan European Regulator with local bodies like in the banking sector?**

That's a very difficult question. What I could say is not based on any economy analysis, it's just my personal view. But the EU Commission will get more power because every revision EU commission gets more power. In the last review in 2006 they wanted to have a European regulator it was moved down and became the BEREC. But still BEREC is more powerful than the previous European regulator was. So you can see that the EU commission has more power.

Appendum 9 INTERVIEW WITH BITS OF FREEDOM RESEARCHER FLORIS KREIKEN

Skype interview. 31/3/15

1) Just as a background, what is your position at BoF? How is Network Neutrality related to the work that you are doing?

I work for Bits of Freedom for a year now as a researcher and I work on net neutrality, data protection and copyrights. Before this I worked at Delft University of Technology and did a PhD on Copyright enforcement. And Bits of Freedom is the digital rights organization in the Netherlands that defends digital rights by doing research, by lobbying at policy levels etc.

2) The Netherlands seem to be the strongest hot spot regarding the net neutrality discussion in Europe. Even in the US, in the light of the recent pro net neutrality ruling of the FCC, the Netherlands case is being mentioned as an example where "Net Neutrality has worked" (Bart W. Schermer, Considerati) and where competition is working well with companies competing on price and speed. Was the net neutrality discussion in the country mature enough when the law came around or was it circumstantial because the Telecommunications law was being revised at the time? Was there need for it, considering there were no real cases of violation of the net neutrality principle other than the expression of the intention to apply such practices?

First of all what made your question difficult to me is that I don't understand what you mean by "having a mature discussion".

We mean is that at the time there was no real problem regarding net neutrality, no documented violations. And then KPN announced that they were going to use DPI and stirred discussion and eventually the law. So our question is was there a problem and was there need for regulation?

Yes I understand, thanks. There was a debate on net neutrality before KPN announced their plan. But I must say that I think that the debate took place at specific policy areas, so we talked about and some policy makers talked about it and some other people talked about it but it wasn't really as big as it became when KPN announced their plan and when we started talking about the Telecommunications directive. So in a sense you are right, the plan launched by KPN and the discussion on the transposition of the new EU rules sort of brought it to the forefront but there was already talk about it before.

3) Bits of freedom and many others claim that the law has been a successful decision, does the law really work? If yes, could you tell us why it works?

There are two things I can say about this. First of all, I think it works in an economic sense, as there is a lot of competition in the Netherlands, Telco providers are competing on data volume and on speed which is really good, so this is good. On the other hand this law is preventing negative stuff from happening. If you ask me whether it works or not, I can't really prove a negative, so it's very difficult for me to answer. I can say a lot of bad stuff didn't happen but I can never prove that of course.

4) Do you expect this law to be transcribed to other countries in the EU so that all Telecoms operate under the same rules? Is a pan-European net neutrality regulatory framework the best approach?

Well the EU is of course talking about it right now. I think it would be a good idea if you want to have a digital single market that is competitive. I think you need a European-wide net neutrality regulatory framework as well, because if you don't you will never attain the EU single market that the policy makers and the EU wanted to have, a single market with complete competition. But if you don't have net neutrality you allow big Telecommunications providers that have almost no competition in their respective countries to sort of keep dominating their market instead of allowing other Telecommunications providers to compete with them in their countries. Because that's one of the problems. Not having net neutrality

sort of strengthens monopolies in these countries, because it allows Telecommunications providers to influence what happens, so they can do all kinds of stuff to strengthen their position.

5) Many people that defend net neutrality say that if Telecoms have full control over their networks they would favor their own services and their partners' as opposed to those of OTT's, but is that really true? We interviewed several Telecoms that told us that competition in the European market would be enough to prevent net neutrality violations and blocking and throttling services wouldn't make sense since dissatisfied customers would switch to another competitor.

Well I am not surprised that they say that they wouldn't do any bad stuff if they had the power, they have a clear interest in saying this. I also have my interests of course, but this is sort of a hypothetical question. I can't be sure, but I think they would yes. They would throttle and so on, the plans had been there, they announced them while we were talking about net neutrality law in Europe and in Netherlands. They already said that they would favor their own channels. So I understand that they would tell you this but we've seen a lot of plans in the media that were stopped because of the net neutrality law.

6) In an Interview with KPN, we were given an interesting example of how net neutrality law can be unclear. KPN has an app that has only one use case for their clients to be able to change their subscription whenever they want. So for example when they are almost out of data in their data package they can buy some more using the app. Now because of net neutrality KPN doesn't know if they can zero rate that app. So their questions was, is this a specialized service and as such they can zero rate or is it an OTT service because it goes over the internet and as such they cannot zero rate? Is the law unclear in cases like these?

That's an interesting example. About the particular case, there would probably be a way to work around that problem, I am not sure about the particulars. But I do agree that the law is now sometimes unclear, the ministry of Economic Affairs is working right now to clarify the rules and we tried our best to clarify the rules as well, but it's a relatively new law and the internet is constantly evolving and there are constantly new services and new ideas being

launched so it's only logical that it would be unclear in some cases and I think that clarification will come in time.

7) What are the implications of net neutrality for the network itself in the future? What would happen with technologies that use priority codes like VoLTE that are considered technologies that can replace wire-line networks and carry a lot more traffic on mobile networks in the future? How about the new generations of networks should they be allowed to have prioritization?

Well this is also a topic of discussion in the Netherlands and in the EU. I am not a technologist, but I think that VoLTE is a completely different technology. But in such a case it would be allowed because it's not about offering the open internet, through internet access. It's a different network. So that would be allowed as a specialized service and there would be some prioritization, I guess. If we look further in the future there might be new innovations that require adjustments in the law but we have to see.

8) The amount of regulation that applies to OTT's and Telecoms is very disproportionate. Would you say that Telecoms are being over-regulated while their OTT competitors have much more freedom to shape their business strategies? Is the solution to have more regulation on OTTs or less regulation for Telecoms?

That's a very interesting question. I think it is difficult to compare amounts of regulation. I agree that there should be way more regulation about protecting citizens from unfair use of their data, also in the case of Facebook for example, with all due respect, it's crazy what they get away with. But I am not sure if you can ask this question in terms of quantification. So it's a very difficult question to answer.

But do you think that we should regulate less the Telecoms and regulate more the OTTs, to achieve some balance?

I am not sure what balancing would be per se. So I am not sure whether you should have to make a choice at all. I do think that Telecom providers play a very important role at all in granting access to the internet, I think that it's pretty important. So there have to be some safeguards, whereas you're not dependent on specific OTTs for other services. So I need to have access to the internet because I need to be able to do my taxes, things like that. So there should be more safeguards there.

9) Do you think that there is a problem with the law allowing partnerships between Telecom and OTT companies so some OTT's can have better services than others, like for example the Vodafone-HBO partnership in the Netherlands (we recently saw a violation of net neutrality and a fine on Vodafone for that), and why?

The Vodafone-HBO case was a case of zero-rating. Zero-rating is very bad for the market, because it grants ISPs a lot of power over what happens. So first of all they get to steer users in the direction of particular services, in this case in the direction of HBO, which would be bad for other platforms that want to offer video services. At the same time it strengthens the position of the ISP, like Vodafone. Because let's say that they have more money than another ISP. They have the power to offer this and the other ISP doesn't. That strengthens the position of Vodafone and that would be very bad for the market.

So zero-rating is ok if they zero-rate basically everything.

Yes that's true. And that's a very good example because by banning zero-rating you force ISPs to compete on bandwidth and speed, which is essentially zero-rating everything or making stuff cheaper. So you're right. And this is more and more present in the south of Europe where you often have a limited amount of ISPs in one country and less competition. So if you have one big ISP, for example in Spain, they have the money to offer zero-rated services, which strengthens their position in the market, which strengthens their monopoly, which makes it very difficult for other ISPs to enter the market.

In Portugal it is also like that. The main ISP has a lot of power to do that.

Yes exactly. It's very bad for the market and it's also bad for the European market because they want to make ISPs from different countries to compete with each other but if you strengthen the position of one ISP in one country no other ISP will be able to enter.

10) In France there is a proposition to go further than net neutrality but move towards platform neutrality, which means that it isn't just Telecoms that cannot slow down or block traffic, but also platforms like app stores or video stream services would not be able to refuse to add content there from content creators. What you think about this point of view?

I think this is a very interesting perspective. I am not sure if it's the right way to go but I think there should be something as commercial freedom as well. I know that this discussion is right now coming up everywhere, also in the context of search engines, but I want to explore

that issue. I am not sure about whether we should think about this, because it could also be a competition issue, there are many ways to look at this, it could also be a data protection issue even, especially in the case of Google.

Yes Google is almost like a public service, everyone uses it.

Yes you are right the question is very relevant. Because Google to a large extent decides where we end up and what kind of services we use so it really needs more research, but I haven't made up my mind yet how to fix that problem. Because the problem is there.

11) What are the benefits to have a law like this in the Netherlands? For the consumers, for innovation, for international OTTs to invest in the Netherlands?

11.1) Has the Net Neutrality law allowed for more competition from smaller players? Have you seen an increase in Dutch startups after the law was passed?

There are lots of benefits. So first of all, consumers get to decide what internet connection they want, what they want to do and that's a big benefit. I think for innovation it is very important as well because it allows startups and companies that don't have very deep pockets to compete with companies that do have very big pockets and equal access to the markets. I think it is also good for consumers that they get cheaper prices and more bandwidth, because it forces ISPs to compete on those things, instead of competing on what kind of service they can offer faster. The only downside is for ISPs, actually they are the only ones that are against it. Because they don't get to make more money.

We know that startups are very important right now in the Netherlands. Do you think that this is contributing to a raise in the number of OTTs?

Yes I think so. And there is also a group of startups, called startups for net neutrality that are constantly lobbying, also in Europe, to ask for a net neutrality law, because they think it's very important for the startups.

APPENDIX BABBREVIATIONS TABLE

Abbreviation	Definition
2G	2nd Generation standard for mobile communications
3G	3rd Generation standard for mobile communications
3GPP	3rd Generation Partnership Project
4G	4th Generation standard for mobile communications
5G	5th Generation standard for mobile communications
ACM	Autoriteit Consument & Markt
AKOS	Agencija za komunikacijska omrežja in storitve Republike Slovenije
ANACOM	Autoridade Nacional de Comunicações
ARP	Alternative Roaming Provider
ARPU	Average Revenue Per User
AS	Access Stratum
AuC	Authentication Center
AuR	Authentication Register
B2B	Business-to-Business
B2C	Business-to-Consumer
BEREC	Body of European Regulators for Electronic Communications
Bits/s	Bits per second
BoF	Bits of Freedom
BSC	Base Station Controller
BSS	Base Station Subsystem
BTS	Base Transceiver Station
CA	Carrier Aggregation
CDMA	Code Division Multiple Access
CDN	Content Delivery Network
CEO	Chief Executive Officer
CMO	Chief Marketing Officer

CMT	Comisión del Mercado de las Telecomunicaciones
CN	Core Network
CNMC	Comisión Nacional de los Mercados y la Competencia
CNNum	Conseil National du Numérique
CS	Circuit Switched
DPI	Deep Packet Inspection
DSL	Digital Subscriber Line
DSM	Digital Single Market
DTV	Digital Television
EC	European Council
ECTA	European Competitive Telecommunication Association
EDGE	Enhanced Data for GSM Evolution
EDRi	European Digital Rights
EEA	European Economic Area
EETT	Εθνική Επιτροπή Τηλεπικοινωνιών & Ταχυδρομείων
EIR	Equipment Identity Register
EIS	European Interoperability Strategy
EPC	Evolved Packet Core
EPS	Evolved Packet System
ETNO	European Telecommunications Network Operators
ETSI	European Telecommunications Standards Institute
EU	European Union
E-UTRAN	Evolved Universal Terrestrial Radio Access
FCC	Federal Communications Commission
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
GMSC	Gateway Mobile Switching Center
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Services
GSM	Global System for Mobile communications
GSMA	GSM Association

HD	High Definition
HLR	Home Location Register
HSPA	High Speed Packet Access
HSS	Home Subscriber Server
ICT	Information and Communications Technology
ID	Identification
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IOT	Inter-Operators Tariff
IP	Internet Protocol
IPE	International Political Economy
IPTV	Internet Protocol Television
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITU	International Telecommunication Union
Kbits/s	Kilo-bits per second
LAN	Local Area Network
LTE	Long Term Evolution
MAC	Media Access Control
MB	Mega Byte
Mbits	Mega bits
ME	Mobile Equipment
MHz	Mega Herz
MME	Mobility Management Entity
MS	Mobile Station
MSC	Mobile Switching Center
MSP	Multi-Sided Platform
MVNO	Mobile Virtual Network Operator
NAS	Non Access Stratum
NFC	Near Field Communication
NN	Network (Net) Neutrality

NRA	National Regulatory Authority
NSS	Network Subsystem
OCDE	Organization for Economic Cooperation and Development
OMC	Operation and Maintenance Center
OPTA	Onafhankelijke Post en Telecommunicatie Autoriteit
OSI	Open Systems Interconnection
OTT	Over-The-Top
PCRF	Policy Control and Charging Rules Function
PDCP	Packet Data Convergence Protocol
PDN	Packet Data Network
P-GW	PDN Gateway
PhD	Doctor of Philosophy
PLMN	Public Land Mobile Network
PS	Packet Switched
PSK	Phase Shift Keying
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RBV	Resource-Based View
RF	Radio Frequency
RLC	Radio Link Control
RN	Relay Nodes
SAE	System Architecture Evolution
SEEC	Strategic Economic Engineering Corp
S-GW	Serving Gateway
SIM	Subscriber Identity Module
SMS	Short Message Service
TB	Terra Byte
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TDMA	Time Division Multiple Access
Telco	Telecommunication Operator

Telecom	Telecommunications
TSM	Telecoms Single Market
TV	Television
U.S.	United States
UDP	User Datagram Protocol
UE	User Equipment
VAT	Value-Added Tax
VLR	Visitor Location Register
VoD	Video on Demand
VoIP	Voice over IP
VoLTE	Voice over LTE
VRIN	Valuable, Rare, Inimitable, Non-substitutable
WiMAX	Worldwide Interoperability for Microwave Access

Conference paper:

Telecom operators and the aftermath of the European Commission agenda for the termination of roaming charges within the EU

[To be published at the 26th European Regional Conference of the International Telecommunications Society

San Lorenzo de El Escorial, Spain, 24th – 27th June 2015]

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Abstract:

The telecommunication sector within the European Union is facing fundamental changes, both because of global developments such as the introduction of OTT services and because of the hurdles along the way towards the transition to a European Digital Single Market. In this unified market many European operators possibly won't survive in their current form but it is expected that the resulting ones be more resilient and strong.

This leads to extended interactions between technology, market and regulation and the possible outcome scenarios, deriving from these interactions, shape to a great extent the developments in the European Telecommunications market, bringing changes in the strategies of OTT and Telecom operators and leading the evolution of their surrounding ecosystem.

In a unified market in the telecom sector, mandated by EU regulation and developments in the field of communications, there is potential for fundamental changes that will ensure that the market evolves and adjusts successfully to this new frame and that the consumers' needs are fully met. On the one hand, it is important that the EU regulatory frameworks are clear and well thought, but in return Telecoms need to make their own strategic adjustments to survive within those frameworks. This paper explores the possible effects of the termination of international roaming charges on Telecom operators and sets the ground based on which strategic changes can be made in order to compensate for the loss of this revenue stream.

Inside the European Union several voices have been raised about the economic gains of a Single Market of telecommunications. The scale of these gains are difficult to predict but the transition to a more unified telecommunications market is a vision that the EU attempts to complete gradually, demanding that Telecom operators eventually comply and adjust.

There is a big sea of possibilities for corporate strategies that telecom operators can follow to grow in revenue and profitability and some companies are already showing signs of what

they plan to do. Also there are already trends observed in terms of capital for concentration and consolidation in this sector which leads to a basic conclusion that companies are trying to get ready even in adverse financial times.

This paper aims at identifying the players in the roaming market and making clearer which strategic trends are being popularized and have more chances of resulting in a successful strategy for telecom operators.

1. Introduction & Background

The EU Telecom market has for years been a fragmented market with each national Telecom market initially being dominated by national monopolies. The EU has been trying to change that for over two decades now first through the liberalization and harmonization of the European markets and the Open Network Provision and nowadays with policies that promote competition through the creation of a European Telecom Single Market (Liikanen, E., 2001).

Nevertheless, one of the most awaited regulatory decisions that the previous Vice President of the European Commission, Neelie Kroes, has been pushing for but hasn't been implemented to this day is the elimination of roaming charges in the EU. This paper focuses on this subject from the Telecom operators' perspective as part of the broader discussion about the Telecoms Single Market in Europe.

The absence of regulation in mobile communications regarding international roaming had for many years allowed significantly high prices for roaming services and an important source of revenue for mobile operators. In Spain they accounted for more than 8% of total revenue before the euro tariffs were being implemented (Portela, M.; Ntarzanou, V., p.p. 115-123, 2015). Roaming fees are what the EU is viewing as one of the most important obstacles for the creation of the single market. Since 2007, roaming charges have been gradually lowered through the implementation of caps on roaming prices, which has led to more than 80% lower fees in the retail prices for voice, SMS and data[120].

The next step came in 2013 when the "Connected Continent Legislative Package" was passed, a proposal that came to remove barriers, enable competition throughout the whole union and create further progress in the creation on the Telecom single market[121].

The price caps on roaming fees from the EU and their consequences have been extensively discussed throughout Europe since their implementation. Price caps, while highly beneficial for the roaming citizens of the EU, threaten to make a market worth 4.8 billion euros in 2014 disappear, during a time when operators' revenues are reporting negative growth consecutively since 2009 (ETNO, 2014) (Gentner, A. 2014), which could in turn create a negative environment for investment if operators feel dissatisfied with this development and reluctant to spend billions on infrastructure[122]. This effect can already be observed in the deployment of LTE that has been slower in Europe when compared to the U.S. or even some African and Asian countries[123].

On the other hand, this development has increased competition with operators offering "Roam like Home" roaming plans, as suggested in the 2013 Commission's proposal. Alternative Roaming Providers, or ARPs, meaning local providers that are allowed to offer

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[120] http://ec.europa.eu/digital-agenda/en/roaming
[121] http://ec.europa.eu/digital-agenda/en/node/67489/#roaming
[122] http://www.strandreports.com/sw5664.asp
[123] http://www.strandreports.com/sw5700.asp

the roaming user roaming services, instead of his or her home provider, is another possibility facilitated by this proposal (Gentner, A. 2014).

The proposal for the termination of roaming charges by December 2015 was voted and passed by the European Parliament in April 2014[124] but the approval from the European Council and the Italian Presidency at the time did not come due to the presidency's significantly different proposal on the subject[125]. The elimination of roaming charges is reported to stay on hold until 2018[126].

In the meantime, there has been significant increase of data in the mobile market and this also applies to roaming, while prices are dropping due to EU regulations and competition in the market. European Telecom operators and more specifically mobile operators are looking for strategies to restrict the losses from the roaming revenue stream while keeping up to the demand for mobile communication across Europe (Gentner, A. 2014).

These challenges and strategic trends are under investigation in this paper. The new regulatory developments have fueled the creation of new and innovative ideas from mobile operators regarding roaming plans and even though the elimination of roaming fees has not been achieved completely, operators have gained time to come up with strategic plans to counteract its imminent implementation.

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[124] http://europa.eu/rapid/press-release_IP-14-373_en.htm
[125] http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2015923%202014%20INIT
[126] http://uk.reuters.com/article/2015/03/04/eu-telecomunications-idUKL5N0W62K220150304

2. Theory

The subject under investigation in this paper, namely the EU plans for the elimination of roaming fees and the extent to which it affects European Telecoms, is an issue that involves on the one side political institutions, such as the European institutions, including the Commission, the Council and the European Parliament as well as national legislators and regulators, and on the other, Telecom operators and MVNOs that are affected by their decisions and the pending TSM (Telecoms Single Market) regulation that will define to a certain extent their future business strategies.

Due to these close interactions between the Telecom market and European and national institutions this paper explores the elimination of roaming fees by exploring how the interrelations between the two influence the business choices and strategies in the Telecom world. Besides, this relationship between political institutions and Telecom operators goes way back as the Telecom industry, previously dominated exclusively by state-owned network operators, has always been subject to national and later European regulations and adding the ambitious European vision of a single market in Telecoms, the interactions are even more substantial. This approach will be based upon the mother of the modern science of Economics, which is Political Economy.

Political Economy has for years studied the relationship and interactions between socio-political and economic systems of a society, traditionally at a country level. Society provides the legal provisions and rules within which the market activities and developments take place and political economy studies the interrelations between the two and the results of their interactions on the economy and the political system itself (The SAGE Glossary of the Social and Behavioral Sciences, 2009).

Whether on a national, urban (Urban Political Economy) or international (International Political Economy), Political Economy, due to the developments of the analytical tools in the field of economics, has been used by economists to perform the economic modeling of the political processes in order to study more closely those models in relationships with companies, thus deviating from the field of political sciences and relating more to the modern science of economics (Dewan, T. and Shepsle K. A., 2008).

The fact that the field of economics, which originated from Political Economy, is re-approaching the effect of political institutions and in essence the field of political sciences (Besley, T., 2007), has created a New Political Economy which marks a new era where global economies and political systems are subject to major changes (Gamble, A. 1995). Both are shifting to accommodate more large-scaled businesses that cross over national borders and need to adapt to the political systems of each country, some of which are also converging, which can be exemplified by the unified political processes taking place in Europe.

The New Political Economy can be broken down to four areas of study, namely international political economy (IPE), state theory, comparative government-industry relations and public choice. The new political economy reflects the changes made in the global economy and political systems of today (Gamble, A. 1995).

The Political Economy approach will be used to show how regulation and the rules imposed by the political system in Europe affect the operation of a market facing significant challenges in the light of the unification of the market across European countries. The way the data gathered and the empirical evidence are being used to perform the analysis for this paper is explained in the following methodology section.

3. Methodology

This paper was written in parallel with a master's thesis when it became apparent that there were important results from the research that the authors wanted to explain and discuss as well as go further and deeper than the platform that they were using (their long thesis).

The research comprised of two main sources of information: desktop research in the available literature, such as books, papers and reports published both in the academic world and by European institutions. In addition, research from consultancies was also studied and analyzed and finally a set of interviews with leading experts in the field were conducted for the collection of empirical evidence. As the paper focuses on the regulatory impact of EU rules on Telecom operators, the interviews were conducted mainly with experts in the regulatory field in leading European telecom companies but were not restricted to that. There were also important research contributions gathered from interviewees within the regulatory authorities, governmental institutions, associations and consulting companies.

The contributions from these experts together with all the material collected will be used to analyze possible effects of the termination of international roaming charges on Telecom operators and strategic adjustments that telecoms implement to comply with the EU regulatory frameworks.

As a political economy approach is used, emphasis is given to the regulatory aspect of the implementation of roaming caps and the plans for the termination of roaming fees. Initially the base for the work is provided by the EU documents regarding the TSM (Telecom Single Market), and the announcements of the different EU institutions such as the Council and the Commission, in order to get the background and history of the roaming policy of the Union. Subsequently, there was a thorough examination of the data gathered from the interviews and the academic papers and consultancy reports in order to extract information and form a better picture of the size of the roaming market and its importance for European operators. With the objective of making it more clear and easy for readers to relate and understand, examples of practical situations and how companies are reacting to the current uncertainty are going to be provided. At this point, a case study on Spain, from the author's more extensive work for their master's thesis, will be used to exemplify the above and provide a better understanding of this market sector. Finally the data from this analysis will be used to look at the trends regarding the business strategies of operators when it comes to international roaming within Europe and commence a discussion on the future of roaming.

The forthcoming analysis attempts to shed some light on the roaming market in Europe and the choices of operators in their attempt to recover part of the loss that the EU regulation on roaming has brought.

4. The European Roaming Market

4.1 The European Roaming Market Structure

The roaming service is based on the provision of wholesale roaming services for access and capacity offered by a Mobile Network Operator (MNO) to foreign MNOs, whose users roam in the respective countries creating the need for retail roaming services, including voice, SMS and mobile broadband. Roaming services costs consist of mobile origination, mobile/fixed termination, international transit as well as billing and accounting costs. Although these costs imply that the cost for international roaming is higher than the costs of providing the service within one's network, roaming charges have always been characterized as unreasonably high compared to the actual costs for providing them (Scott Marcus, J.; Philbeck, I., 2010).

Before the EU regulation was implemented the roaming market presented very low competitiveness due to inelastic demand for the services, very few or non-existent alternatives that substituted for the service, lack of transparency regarding charges and natural oligopolies with low competition (Scott Marcus, J.; Philbeck, I., 2010). Another reason for the high international roaming prices can be the low customer awareness regarding roaming tariffs, as this is in principle, not a criterion based on which customers pick their mobile operator, which remains an issue today (Gentner, 2014).

Nowadays the situation is to a certain extent reversed due to the proliferation of MNOs and MVNOs, technological advancements, roaming substitutes such as VoIP services, global SIM cards, WiFi access, harder negotiations and alliances at the wholesale level, increased transparency due to EU regulation (Scott Marcus, J.; Philbeck, I., 2010).

Since 2007 the EU roaming regulation has initiated regulatory intervention in the EU roaming markets based on a price-cap mechanism that annually reduces prices in both retail and wholesale roaming prices (Official Journal of the European Union, 2012). This development is strongly supported by the political world, where the belief among European politicians is that the elimination of roaming fees is a key step towards a true Single Market of Telecommunications and its completion, despite being re-scheduled to 2018[127], rather than 2015 as ex-commissioner Neelie Kroes and the European Parliament strongly supported. Nevertheless it remains an inevitable goal of the EU.

The European international roaming market is a large market, which presents important differences between member states. For touristic countries such as Spain or Greece the revenue stream that roaming fees produce is relatively significant. In Spain, a market that has seen a significant decline of revenues in the mobile communications sector since 2007 (CMT, 2014), roaming revenues have also been declining due to the price caps every year, reduced to almost half in 2011, accounting to 6.28% of the total revenues, compared to 8.72% in 2007 (Portela, M.; Ntarzanou, V., pp. 115-123, 2015). Voice services account for the majority of roaming traffic, with data and SMS following (CMT, 2013).

The importance of roaming revenues for Telecoms in more touristic European countries is also reflected in the interviews conducted with operators for this work. The same observation can be made for operators in countries with much less tourism (such as

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[127] http://www.reuters.com/article/2015/03/04/eu-telecomunications-idUSL5N0W62K220150304

Denmark) where balancing the costs after the implementation of the eurotariff is easier, provided that the wholesale and retail prices are also kept balanced. The different conditions and structure of the roaming market in each European country are an important reason why the elimination of roaming charges is still impossible to put in effect (Scott Marcus, J.; Philbeck, I., 2010) (Infante, J.; Vallejo, I., 2011).

The decline in prices in the roaming market due to the eurotariff have been followed and accordingly implemented, while roaming services usage grew all over Europe according to BEREC (BEREC, 2014). The European Union notes that this resulted in achieving "retail price reductions across calls, SMS and data of over 80% since 2007; Data roaming is now up to 91% cheaper compared to 2007; Since 2007, the volume of the data roaming market has grown by 630%"[128]. Nevertheless the implementation of roaming price caps has not had the desired effect on competition, as can be noticed by the fact that prices have been kept close to the level of the caps, which can be attributed to low competition and inelastic demand (Infante, J.; Vallejo, I., 2011) (BEREC, 2014)
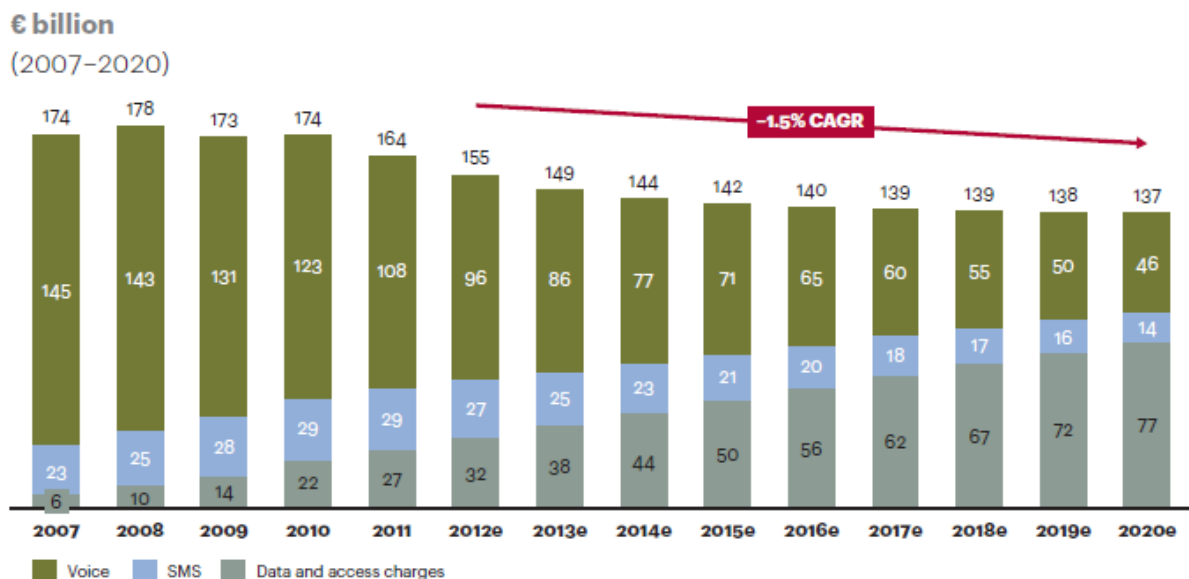
Notes: Data refers to EU27, Switzerland, and Norway. Actual data was used through April 2012; all subsequent numbers are estimates. Figures may not resolve due to rounding.

Sources: IDC; A.T. Kearney analysis

Figure 63: Mobile revenues 2007-2020 (A.T. Kearney, 2013)

The leading sector that grew and keeps growing significantly in the European market is mobile broadband and the same trend seems to be present in the international roaming market. This trend in roaming, can be attributed not only to the rollout of LTE networks all over Europe, but also to the substitution of traditional communication services with OTT services, such as Skype and WhatsApp, and people's desire to be connected and use their social networking apps constantly. In addition, substitution could also be attributed to the use of WiFi in order to use OTT services, as an alternative to making calls or sending SMSs from a mobile phone (Portela, M.; Ntarzanou, V., pp. 145-169, 2015). The evolution of networks towards an all-IP model, driven by the transition to LTE and the wide availability of electronic devices, is leading towards this substitution and in the case of roaming makes

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[128] http://ec.europa.eu/digital-agenda/roaming

roaming data services more relevant to operators that are deploying strategies to deal with the declining revenues in this sector.

The case of Spain, is also pointing to the same direction when it comes to mobile broadband, where we see a generalized positive performance with a growth of 30%, in a market that shrank about 15% on an annual basis. Another observation from the Spanish case study though, can be that despite the increase in usage of roaming services, there was a decrease in total revenue, meaning that the decline due to the price caps was higher than the influx of revenues from the increase in usage (Portela, M.; Ntarzanou, V., pp. 115-123 2015).

At this point it is important to make a reference to the wholesale market. The European Union stresses the importance of regulating both wholesale and retail prices, as regulating only retail prices would not be enough and would possibly leave very thin margins for profit to the wholesale buyers that do not own network infrastructure (Official Journal of the European Union, 2012). But despite the additional reduction in wholesale prices it was observed that these reductions were not passed on to the retail level, where charges remained close to the price caps (Infante, J.; Vallejo, I., 2011). Cross-border alliances and the ability of some operators to provide roaming services using their own network infrastructure as alternatives to the wholesale roaming market, have not been very fruitful in bringing down wholesale and retail prices (Falch, M.;Tadayoni, R., 2013). And while the part of the plan of the EU to increase transparency and protect consumers from bill shocks has succeeded to a large extent, the second part, namely competition and innovation is not as apparent[129].

An example that came up in the interviews conducted for this work, was that of the wholesale market in Spain, where in the part of the market that is regulated, that is the mobile market, there is almost no investment in networks, as it is more profitable to rely on buying wholesale to provide mobile communication services. On the other hand, in the part of the market where there is no wholesale regulation, such as fiber networks for speeds over 30Mbits, there is much more investment in the networks. At the same time, in Spain, although there is an increase in usage, driven mainly by third party operators and international call termination, wholesale revenues are declining (CMT, 2014). As reflected by the interviews with operators in Europe, regulation in wholesale prices will define to a great extent the impact of roaming regulation on the revenues of Telecoms but this is a complicated matter that needs further study.

4.2 "Roam Like Home" and alternative offers in the European Roaming Market

Under adverse financial times for mobile telecom operators that are facing annual losses of 1.5% annually (A.T. Kearney, 2013), there are warnings, made mainly by consulting firms, about revenue loss, cost cutting and decline of investment due to roaming regulation, amidst a more generalized negative growth in the Telecom sector. The revenues at risk account for 2% to 6% of the industry's revenues (A.T. Kearney, 2013) (Kennedy, S., 2014) (Gentner, A., 2014).

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[129] http://www.europedia.moussis.eu/discus/discus-1343718686-976307-8045.tkl

The plan of the EU is for operators to start offering "Roam like Home" plans, offering the consumer the ability to roam in other countries and experience charges that are similar to those back in their home network when they use their electronic devices. At the same time inbound calls or SMSs will not inflict any additional charges to the roaming user, just like when they are in their home network. The final goal would be to achieve similar prices across Europe so that communication from one country to another won't differ from calling within the same country[130].

Several companies in countries such as France, Germany, Sweden and the UK have decided to make such "Roam like Home" offers to their customers changing the way that international roaming was being charged until today and avoiding shocking bills for consumers as intended by the EU. These services come with different variations from operator to operator, with some offering them for a limited amount of days, for a restrained amount of destinations, based on the user's type of bundle chosen in country they reside in, or paying an additional fee to their monthly bundle, or even limiting the user to consume minutes or SMSs only towards their home country. The launch of such services by several European operators indicates how there is an effort to adjust to this new reality of seamless international roaming at the expense of part of their revenues (Gentner, A., 2014).

The problems identified with "Roam like Home" offers, besides the difficulties caused by the different cost and tax structures across Europe, are also border trade and SIM card arbitrage, where customers would choose to buy their SIM card and a subscription from a cheaper country instead of the one they are residing in[129].

Another change that the Roaming regulation brought to the market, in an attempt to increase competition, is the ability of operators, other than the home network operator of the user, to offer roaming services, allowing for these Alternative Roaming Providers, also known as Virtual Roaming Operators, to compete with the home telecom operator of the user with more attractive offers (Gentner, A., 2014). Providing support for these virtual operators requires additional investments on behalf of network operators for billing and customer handling (Kennedy, S., 2014).

With Average Revenue Per User in roaming dropping and with the fierce price competition that operators with "Roam Like Home" offers and ARPs can induce due to their disruptive nature, a very large part of roaming revenues can vanish, leaving mainly network operators at a disadvantage[129] (Gentner, A., 2014).

Another option considered is "Roam like a Local" schemes, meaning the consumer paying according to the national prices in the respective country they visit, but this is a less consumer-friendly offer, as the consumer needs to be aware of the charges of each country they visit, but allows for better margin squeeze for operators (European Commission, 2011). In this way, the charges would allow operators to cover costs while it would provide a possible solution to border trade and arbitrage[123].

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[130] http://www.strandreports.com/sw5671.asp

4.3 MVNOs and the rise of competition

The concept of Mobile Virtual Network Operators, or MVNOs, is by now very well-known, but until the wholesale regulation was implemented by the EU, these virtual network brands would have to negotiate and get wholesale deals directly from telecoms. This regulation was very successful in helping the proliferation of these operations especially in Europe [131].

There are Mobile Network Operators (MNOs) that host 943 Mobile Virtual Network Operators (MVNOs) with 255 of them being MNO sub-brands, as of May 2014. This represents a total of almost 1,200 mobile service providers worldwide hosted by MNOs, a number that was down to 1,036 in 2012, according to GSMA Intelligence[131].

Most of these MVNOs are situated in Europe like the figure below indicates.
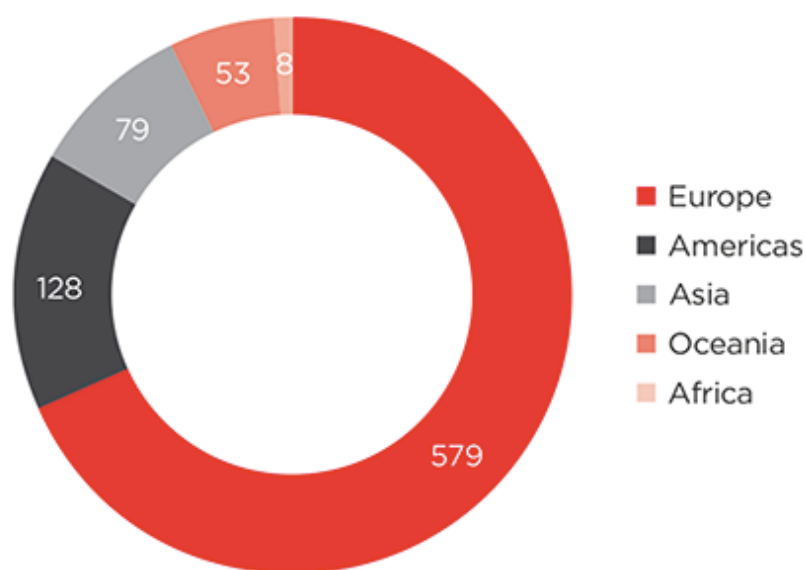

Global MVNO split by region, 2014
Source: GSMA Intelligence

Figure 64: MVNOs globally[12].

The fast growth from these MVNOs, which benefited from a favorable EU regulation is explained in part by who owns them and who their target group is. In the GSMA Intelligence report there were eight separate categories of MVNOs identified, namely discount, telecom, media/entertainment, migrant, retail, business, roaming and M2M. This market is owned at a percentage of 46% by discount and telecoms, 19% by companies with adjacent industries (e.g. retailers, banks, TV or media organizations), leaving 34% of the market focused on segments such as business, migrant, M2M and roamers[131].

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[131] https://gsmaintelligence.com/research/2014/06/the-global-mvno-landscape-201214/433/
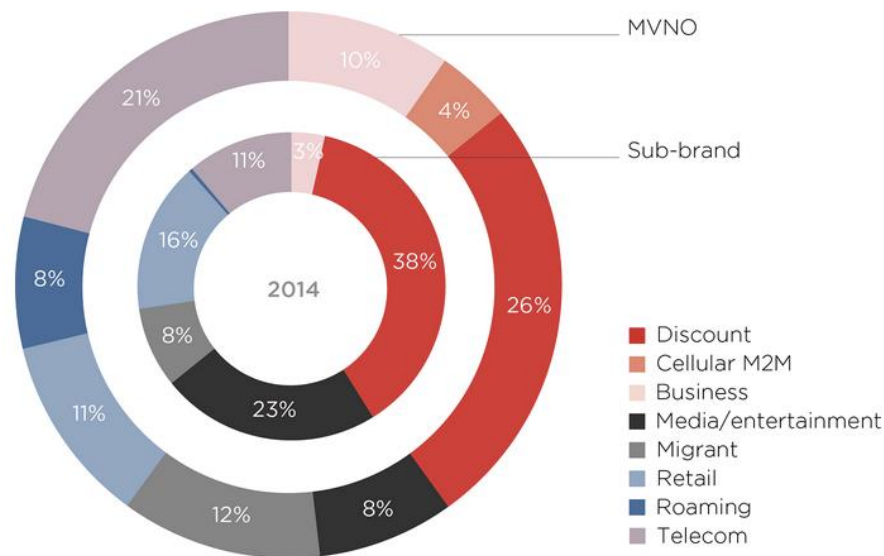
Market segmentation by category, MVNOs and sub-brands, global, 2014
Source: GSMA Intelligence

Figure 65: Market segmentation[132]

Due to high competition, especially in the European market, and low margins on top of the capped wholesale prices, many MVNOs have gone out of business. The fact that MVNOs operate with low margins has brought prices and profit margins down for network operators as well.

In addition, potentially more disruptive news are coming to the telecoms market. Google might soon enter this market first in USA, with a plan "… to create a global network that will cost the same to use for calls, texts and data no matter where a customer is located"[133]. This is an even more ambitious plan than that of the European Digital Single Market and looking at the track record of Europe and Google, Google will possibly make this a reality sooner than the EU, although the regulatory barriers all over the world to overcome will create many obstacles for them.

The way Google plans to achieve this is not to build an entire new network but instead rely on the wholesale market. The idea for the analysts is that Google will "use its network to put pressure on the pricing of America's biggest mobile operators, AT&T and Verizon, who enjoy higher profit margins than their European counterparts"[133].The disruptive part of this idea can come from Google integrating the carrier networks that they get through wholesale deals with existing WiFi networks[133].

4.4 OTTs growth and enablers

The international roaming market was seen as an opportunity, not only by MVNOs; one can even argue that OTTs have been even more successful than MVNOs in this regard. Applications such as Skype, Viber, WhatsApp, Hangouts and Snapchat to name a few, are a part of many people's daily lives and demand for connectivity keeps growing. Their model

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[132] https://gsmaintelligence.com/research/2015/02/the-global-mvno-footprint-a-changing-environment/490/
[133] http://www.telegraph.co.uk/finance/11516189/Google-in-talks-with-mobile-operators-for-cheap-overseas-calls.html

makes it easier for people to communicate no matter where in the world one is, with the only prerequisite being internet access, breaking all the traditional telecom boundaries set by international roaming. These apps are mostly free or operating with a "freemium" model with basic services for free and paid "premium" services.

OTTs are, without doubt, filling the void in a telecoms sector lacking for many years innovative ideas for communication services, especially when talking about roaming. One can even argue that if the international call prices weren't as high as they were in the past, services like Skype may never had come to fruition in the first place or at least not to the extent that they have today. This is reflected in the interviews with operators that noted that services like Skype took away a large piece of the pie when it came to international calls.

The trend created by the OTTs' growth, can also be noticed in the growth of mobile data usage, especially at national level. In the case of Spain, between 2007 and 2011, mobile broadband roaming grew more than 430% (Portela, M.; Ntarzanou, V., pp. 115-123, 2015) (CMT, 2014). This growth is expected to continue at a steady pace in all of the EU as well[120].

At the same time, there are Telecom operators looking at this as an opportunity. One of them is ZeroMobile in Italy that created a service called ChatSim which promises free usage of all messaging apps across, not only Europe, but many more countries in the world, for only 10 Euros per year. This is an indication of how innovative offers can turn into disruptive services and provide operators with new ways to compete to counteract the immense regulatory pressure. Regarding the specific service, though, there can be other obstacles along the way, one of the main ones being net neutrality regulation and the ban of zero-rating that is in effect in countries such as the Netherlands and Slovenia and is discussed all over Europe.

One thing is clear; at this point OTTs are enjoying their golden age. The question is how much time this will last and how many of them will survive in the end.

5. Discussion & Conclusions

The developments in the regulatory field regarding intra-European roaming come at a challenging time for the European Telecom sector and operators. But the EU seems to be determined to make the Single Market of Telecommunications a reality sooner or later and the subject of international roaming is on top of the agenda as a barrier to overcome for the good of European citizens travelling within the Union. The benefits for consumers are many, but the impact on telecom operators can have a negative influence on their prosperity at the expense of network infrastructure and in extension European citizens.

Nevertheless, since 2007 European MNOs are being given time to adjust to the new reality that will include no national borders when it comes to communication services. The wait-and-see approach will not work anymore. Up until now roaming prices remained close to the prices caps and MNOs were trying to hold on to this revenue stream for as long as possible, an approach which is still applied to a certain extent today.

But the market has changed. Competition is rising from both regulation-facilitated players, such as MVNOs and ARPs, and the emergence of OTTs that boosts demand for, not only national, but also cross-border mobile broadband. MNOs have some strategic options to make. Some have already decided to give up part of their roaming revenues, by creating different versions of "Roam like Home" plans for either low or no charges at all, testing the waters and exploring the possibilities of competing with other European operators by trying to hold on to their customers while they are roaming. The goal is to prevent their customers from choosing any alternative providers when roaming, which would fuel competition. This choice though, if it includes mobile data in the roaming plan as well, entails the danger of passing the roaming traffic on to OTTs. Moreover, if the "Roam like Home" offers become the standard in the market border trade and arbitrage regarding SIM cards will be another problem that the EU has to face, possibly with new regulatory measures.

Other plans such as "Roam like a Local" do not seem to have emerged yet, so their success in the market is still debatable. The battle will also include MVNOs that operate across many countries, such as Lyca or Lebara, that have lower costs compared to MNOs but might encounter problems if they are currently operating a roaming-oriented model and MNOs decide to go for "Roam Like Home" offers. This of course will also depend on how favorable access regulation is towards MVNOs and wholesale prices, intended to foster competition.

Another option provided by the EU regulation that both MNOs and MVNOs can follow is that of becoming an alternative provider themselves in other European countries. This could provide additional customers but it also means buying wholesale from local network operators and it is an investment that many small operators might want to follow to compete cross-border. The news about Google investing in an MVNO "project" shows how large OTTs are actually planning to enter the market, this time as operators. This type of strategies though will probably be more implemented after the end of roaming charges.

One last trend that seems to be growing and MNOs strategies are focused and keep an eye on, for reasons that also go beyond roaming, is OTT alternatives. Their growing popularity

creates the dilemma of competition or collaboration for MNOs. Despite the still relatively high roaming prices for data, demand for mobile broadband when roaming is growing, which can be attributed to a great extent to OTTs. It is indeed very hard to compete with them when they are operating on a free platform such as the open internet also benefiting from the lack of regulation. And in a Europe with no roaming charges the demand for mobile broadband will evidently skyrocket. Leveraging the OTT trend is a possible approach that can provide more value to networks and when roaming data usage increases, more revenue for operators that could balance the decline due to the reduction in the ARPU.

The example of ChatSim is another example of an innovative idea that was used by the Italian operator ZeroMobile to adapt to the new roaming conditions. The idea includes partnerships with both MNOs and OTTs to offer access to the most popular OTT services in other countries with a very low fee. The specific approach though, as mentioned in the analysis, is highly dependent upon another regulatory discussion in Europe, the issue of net neutrality and its regulation.

The main challenge that operators face through all of this is to make sure that they manage to recover the revenues to maintain and upgrade their networks to satisfy demand and find a balance between wholesale and retail prices that will allow for the necessary margins to do that. Price regulation from the EU, although beneficial for competition and consumers, puts additional stress on the ability of operators to do that and creates warnings for systemic increases in telecom service prices.

Europe is making slow but decisive steps to a smooth implementation of the Digital Single Market. This will merge a very important part of the national economies at federal level increasing the irreversibility of the EU project only comparable to the Euro currency. In the future it is not impossible that some federal tax will substitute some national taxes in this sector to harmonize prices in the telecoms sector. This can have a good impact in business growth in Europe but that is left to be seen.

The unification of the Telecom market will create new conditions, within which many Telecom operators will not be able to prosper at a European level and so a possible consolidation of operations might occur, as operators that own networks in many European countries are in this case at an advantage against smaller ones. It is also possible that this regulatory development will lead to some companies operating only in some parts of the market, which in the long run will make them a target of this consolidation. These might not be ideal scenarios for the EU so finding ways to mitigate that and create an equilibrium in the European Telecom market that will allow smaller operators and start-ups to prosper in this environment is fundamental. At the same time this can help European start-ups to thrive, as they will be able to "talk" to operators at a continental level and not at country level.

No matter what the strategic choices of telecom operators will be, it is important for telecoms to understand that entering in price wars will only temporarily give them a competitive advantage. In the long run, with roaming eliminated completely by the EU, maintaining a sustainable competitive advantage should be the goal of any company.

Assuming that one can put forward innovative and potentially disruptive ideas, such as the one that Google has announced, facilitated by EU regulation, telecom operators are coming up against new challenges that they have to address with new strategic actions in order to face the dawn of a new era in European Telecoms.

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