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European network operators' market position at the beginning of 2020

Emerging challenges and opportunities driven by changes and trends in a more digitally connected world

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List of abbreviations

ASP – Application Service Providers
ARPU – Average Revenue per Unit/User
BEREC – Body of European Regulators for Electronic Communications
CAPEX – Capital Expenditures
CD – Content Distribution
CDN – Content Distribution Network
CP – Content Providers
CSP – Communication Service Providers
DSM – Digital Single Market
ECS – Electronic Communication Services
ECTA – European Competitive Telecommunications Associations
ETNO – European Telecommunications Network Operators
IaaS – Infrastructure as a Service
ICT – Information and Communication Technology
IoT – Internet of Things
M2M – Machine to Machine
MNO – Mobile Network Operator
MVNO –Mobile Virtual Network Operator
NFV – Network Function Virtualization
NGN – Next Generation Network
OPEX – Operational Expenditures
OTTs – Over-the-top services
PaaS – Platform as a Service
RAN – Radio Access Network
RLAH – Roam-like-at-home
SaaS – Software as a Service
SCQ analysis – Situation-Complication-Key questions
SDN – Software Defined Networking
TSP – Traditional Service Providers
VAS – Value Added Services
VoIP – Voice over Internet Protocol
VRAN – Virtual Radio Access Network

Executive summary

Within a very dynamic industry caused mainly by data traffic growth and adjacent smart-technology evolution supporting the content, the telecom network operators are continuously exploring the ecosystem for new opportunities to create profitability and satisfaction for the stakeholders involved in the telecommunications' value chain. In this sense, certain areas of the world have outperformed others in regional terms of operators' performance due to several factors such as market conditions, regulations and technology evolution, which influenced the sustainability of the business strategies.

Given this context, the European market and its telecom players, seems to have entered into a pronounced sensitive situation with larger data traffic growth and demands determined by technological changes and a disloyal competition which benefits from the market conditions. The escape solutions did not, however, ceased to exist and they may paradoxically come especially from the causes that created the challenging landscape.

Accordingly, the paper attempts to provide a comprehensive overview of the existing challenges and opportunities for the European network operators, with the final purpose of proposing a set of inter-related solutions to tackle the most challenging factors of pressure, while absorbing most of the new business environment. To a certain extent, the outcome of the analysis that includes a major case study, can be considered as a reflection on the European network operators' position in front of the new challenging landscape that integrates emerging tendencies and new business models needs, as well as an understanding over the new opportunities that could consolidate the position on the market.

Finally, the paper will end with discussions based on the analysis findings, conclusions aligned with the formulated problem, and future research recommendations.

Keywords: European Network Operators, Over-the-top Services, Digital Single Market, Cloud Computing, Internet of Things, Infrastructure, New Value Chain, Spectrum

I. INTRODUCTION

The *'European network operators' market position at the beginning of the 2020'* represents a challenging study in its format and content given the complexity of the field, that aims on the one hand at linking the European telecommunications industry with the new ICT landscape' changes and trends while emphasizing the emerging challenges and possibilities for the European operators on a general level, and underline on the other hand the major factor of risk for the European network operators' competitiveness and the potential actions appropriate to reducing it.

With a maintained tendency of natural monopoly due to its direct proportionate relation between value increase and number of users, the telecommunication industry represents probably the fastest growing part of the economy today covering through its sectorial structure the systems, terminals and services for internet service providers and telephone companies (mobile and fixed-line operators). Referring to these two lines of services – internet and telephony, it seems that, for the first time, the data revenues in mobile are about to surpass the voice revenues in larger terms than expected (ETNO, 2016).

First a voice based business, the telephony segment evolved to a mix of voice, text, image and video type of content and it occurs mainly due to the developments within the internet access segment which created the potential to deliver larger contents for the fast emerging mobile network operators, but also for internet based players to enter as substitutes. Consequently, the mobile communications is facing today a strong competition which occurs more and more especially from the internet based multi-sided platforms that, despite their similar-to-network-operators services offering, are involuntary benefiting from a better business environment which further creates a major challenging landscape for the network operators. However, the determinants of this situation have roots in a larger picture of events. Thus, within a European context, the goal of this thesis is to first offer an understanding over network operators' challenges and opportunities' sources, and then build an analysis around the prevalent factor which is considered to influence operators' overall market position the most.

In this sense, starting with chapter II, the paper will propose a theoretical foundation covering an analysis of industry's value chain-based actors with focus on the network operators, and an overview of the European telecom situation including major events, regulatory framework, infrastructure and technology. The chapter will conclude with a set of challenges considered from a PESTEL point of view and Industry-Forces-based Value Chain while creating understanding about the current concepts and build the context for the first addressed research question as well as for the review of the literature which, following a thematic approach, will inform the reader about the current state of research on the topic and inspire for defining the research questions.

Next, the forth chapter occurs due to the need of emphasizing the set of theories and methods used to generate an analysis for the topic being investigated, and for the purpose of limiting the scope of the relevant data, focusing on specific aspects and defining specific viewpoints that will be taken for further consideration. Through its design, the conceptual framework provides a way to investigate the identified gaps of the research topic.

The later chapter will present the methodological aspects of the paper in terms of research approach, data collection methods and data characteristics, while the next two chapters will exemplify and focus on the analysis of the gap through the use of a case study, covering factors which will be defined through a set of three research questions introduced at the end of the literature review.

Finally, through chapter VIII and IX, the paper will emphasize the results of the analysis and related discussions, while concluding on the formulated problem brought into analysis.

Problem formulation

Once among the global leaders in the technologies that comprise the backbone of the digital economy, Europe and its players within the telecommunication sector call for a serious need of a unified approach in the market in order to reconsolidate a top position next to Eastern Asia and Northern America regions which are now leading in ICT cutting edge technology at way better performances than Europe does. In this sense, Li-Fi and 5G are only two of the latest

developments on-course planned to be implemented in the next years, which will most probably reshape the telecommunication system and its business environment, together with the European Commission's Digital Single Market strategy design to create an improved regulatory framework for the European telecommunication business actors.

How the companies got and get involved into these changes, the implications of the emerging developments over their state of business as well as of other variables such as the ascension of the OTTs, the development of Cloud Computing and the M2M communication type, will be further introduced and analyzed in chapters II and VI in correlation with the purpose of this study which intends to address the following matter:

European network operators' market position at the beginning of 2020 - emerging challenges and opportunities driven by changes and trends in a more digitally connected world

Given this context, the author attempts to approach the subject using the SCQ analysis type (situation-complication-key question), by answering three main research questions introduced in chapter III, in order to determine the market position of the European network operators at the beginning of 2020 considering some of the main existing challenges as well as opportunities.

II. BACKGROUND

1. European telecommunication sector

After a period of "industry bleeding" with negative growth rates in the EU28 – a negative 1.7% in 2014 and a negative 1.2% in 2015, the European telecommunication sector has finally recovered to a positive growth rate in terms of about 0.2% in 2016 across the European markets. Accordingly, at a global scale, even though Europe still remains the region with the slowest growth, the gap with other areas, notably Eastern Asia/Asia-Pacific (1.5% in 2016) and Northern America (0.8% in 2016), is being reduced.

Among the users, the Europeans put accent on connectivity and are increasingly demanding for data which outpaces the growth of access lines. In this sense, the estimations show at least a doubled downstream and upstream traffic loads per fixed broadband line until 2020 and an even more significant increase in the mobile network with an associated 7.4 GB per month in downstream traffic and 0.6 GB per month in upstream traffic (ETNO, 2016).

Within the ICT industry, the European telecommunications s remain the main pillar of the value chain with approximately €325 billion total service and network equipment revenue in 2015 as seen in the figure bellow. However, the average revenue per user continues on a downward slope for both fixed and mobile ARPU despite the growing usage, a main cause in this sense being the intense competition in the sector fuelled by non-traditional actors which are leveraging the provisions of the European regulatory framework.

ICT Industry Revenue (€ bn)	2015	2016f
Network equipment	61	62
Telecom services	264	265
IT services	293	300
Audiovisual services	105	107
Online services	75	87
Devices	176	175

Figure 1: Europe's ICT industry revenues. Source: IDATE

While the third and fourth generation networks brought changes in consumers behavior through social digital networking, the last on course of development (5G) is expected create a digitally connected world through a reconceptualization of the telecommunications industry (e.g. facilitating the Internet of Things concept which has already been partially implemented), assigning a major role to the telecom ecosystem. However, the challenges are comparable aligned with the opportunities. The fifth generation network is expected to bring coverage to the needs of smart cities and vertical industries, with massive and ultra-reliable Machine Type Communications (mMTC, uMTC). As a support technology for this need, interference cancellation techniques have been developed as well as massive number of small cells for an extreme densification of the Radio Access Network (RAN) with virtualization possibilities for a Virtual Radio Access Network (VRAN).

Given this context, it is primordial first to understand which are the actors and major changes that inter-connect within the telecom industry, and then to examine which are the challenges and opportunities that occur with the new landscape, in order for companies to be able to develop profitable and sustainable business models. Consequently, the thesis will initially cover the above mentioned aspects using the Industry-Forces-based Value Chain to determine network operators' actual and potential challenges, followed by an analysis which will be conducted to determine, from a Complexity Perspective, how operators can face and adapt to the biggest challenges and even create new opportunities along the process.

1.1 Industry's players

As a starting point, while the telecom services and technology providers will still represent the core of the chain, the advances on interference and densification techniques will open the door for new players in the field, especially in relation with spectrum management, new access technologies, IoT, Cloud Computing and vertical industries, players that will give the new form of the telecommunications industry value chain. For explanatory purposes, the presentation of the value chain will be based on the wireless telecommunication, technology which is rapidly becoming the core medium for data and information transmission.

Value Chain Perspective

In a restrained form of the value chain, the telecom industry presents three layers of actors – the physical infrastructure provider layer (PIP) which owns and maintains the passive infrastructure, the network provider layer (NP) which operates and sometimes owns the active infrastructure, and the service provider layer (SP) which delivers the digital data (European Commission, 2017). Analyzing them separately, Pujol et al (2016) have managed to create a more extended view of the value chain, on which it is important to consider also some of the newest entrants (see Figure 2).

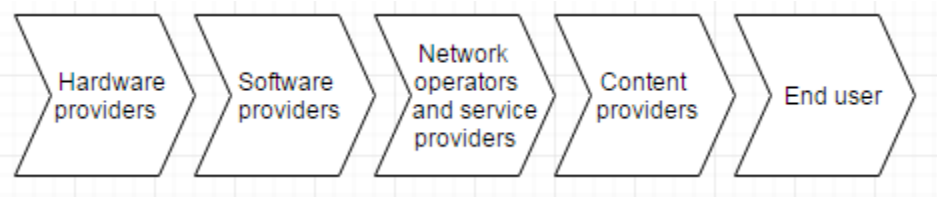


Figure 2: Telecommunications Value Chain. Source: Adapted from Pujol, (2016)

Within the first category there are the equipment (hardware) developers which provide facilities such as base stations, gateways, network controllers (e.g. Ericsson, Nokia, Cisco), as well as equipment that will be further owned by the final entity of the value chain such as smart-devices (e.g. Nokia, Apple). The second category is mainly specialized in developing middleware and applications (software) that enable the functionality of the hardware in terms of operation, monitoring and managing (e.g. iOS - Apple, Android – Google). Further, the third category's core activity following the value chain is represented by operating mobile networks through licenses (e.g. Vodafone, Orange, AT&T) and providing wireless services to the end client such as voice calls and data services such as SMS, and enable access to other services such as e-mailing and video streaming. Finally, the content providers category is, as the name suggests, represented by entities such as Google who providers maps and search engine content, Netflix who providers video content or Facebook with a variety content.

An important mention to make is that within the value chain there can be entities (providers) which are specialized in more than just one category of product/service, as well as intermediary actors (e.g. mobile virtual network operators who partner with the mobile network operators) therefore the presented value chain should be consider mostly for clarification purposes. Given

the multi-specialization of different entities, the appearance of new entrants (e.g. OTTs who provide voice, messaging services and content) and of the new technologies (e.g. 5G on course of implementation, Cloud Computing – SaaP, IaaP, NaaS) as well as of the reconceptualization of the telecommunication system (e.g. Internet of Things), the value chain suffered and will probably still suffer modifications.

1.2 Network operators

Out of the identified players from the telecommunications sector, most of the focus will further be placed on the network operators with both mobile and fixed operations which represent the core element of the research.

At the end of 2015, Europe had around 40 network operators, including the mobile network operators (MNOs) and the fixed line operators, of which only a small number acting in more than a few European countries and across European borders - Vodafone (UK), Deutsche Telekom (DEU), Orange (FRA), BT (UK), Telecom Italy (IT), Telefonica (ESP) or Telenor (Norway), together, these actors serving a large proportion of the European market.

More or less expected from strategic reasons, the number of mobile network operators have been in a continuous change and will probably continue to be given the recent examples of discussed M&A actions – merger of Telia Sonera and Telenor (Denmark), presented more as a joint-venture, the acquisition of O2 by Hutchison (UK) or the merger between Hutchison and Wind (UK & Italy). It is expected that such moves will re-enforce the position of the actors within the European and global market by saving OPEX, CAPEX and creating revenue synergies.

1.3 Regulatory framework

While in the US, the largest broadband market, there has been a shift towards deregulation, and in Asia the two main contributors to the worldwide broadband development are still under radical governmental influence, in Europe the stimulation of competition through access and interconnection regulation on the legacy networks at the national level represented a real success

in the years before 2013, and it is now challenging the EU to keep succeeding with the Next Generation Networks (NGNs) within all the European member states. As an example, Piselli (2014) using a sample of 16 EU countries with data from 1997 to 2011, reveals that the regulatory framework has had small negative impact over telecoms firm's revenues and investments, while on longer time span, the regulations contributed to a better business environment "which make firms more productive for a given level of market power".

During the recent history, regulators have continuously tried to reduce the retail prices and encourage competition, even by determining the largest European network operators to rent their networks at advantageous prices for the rest of the operators that do now own an infrastructure within the country of operation. The result, an increased competitiveness with a large number of mobile network operators still present on the market and covering significant national or cross-border market share, as opposed to the Northern American market which has way fewer operators covering a similar-sized territory and population, and were the level of influence of the industry's giants has poised the regulators to allow them huge profits, which caused on a long run, significant disadvantages for the smaller operators (Nitsche and Wiethaus, 2011).

Digital Single Market Strategy

The latest regulatory framework that will address to almost all the European countries and their operators comes under the name of Digital Single Market Strategy, which will run starting with July 2017. However, its planning and sequential implementation started long time ago with major changes in 2012 and 2015, and it is now ready to support three major pillars of an improved Digital Market: "better access for consumers and businesses to online goods and services across Europe (requires rapid removal of key differences between the online and offline worlds to break down barriers to cross-border online activity); appropriate conditions for digital networks and services to flourish (requires high-speed, secure and trustworthy infrastructures and content services, supported by the right regulatory conditions for innovation, fair competition and a level playing field); and enhanced growth potential for the European Digital Economy (requires investment in ICT infrastructure and technologies such as Cloud Computing and Big

Data, R&I to boost industrial competitiveness, as well as better public services)" (European Commission, 2015).

Out of these three pillars, the most significant previsions that will influence the activity of the network operators refer to "making the telecoms rules fit for purpose" as part of the second pillar. These provisions address optimization issues such as harmonizing the rules for a *net neutrality, elimination of roaming* surcharges through the introduction of "roaming like at home" concept, *managing the radio spectrum* by the member states under a harmonized framework and *creating a level playing field* among network operators and substitutes entrants (e.g. over-the-top service providers), as well as general issues such as covering the inaccessible rural areas and realization of high-capacity connectivity for schools and universities/research hubs. Nevertheless, the new regulatory framework at the time of its implementation will run under certain assumptions of failure to provide an equal treatment for the actors it is addressed to.

Net neutrality and roaming elimination

Considered two of the most important previsions of Digital Single Market's second pillar, the European Commission has finally voted for an open internet and roaming charges elimination. First, within the EU law, the open internet or more commonly net neutrality stands for no blocking, throttling or discrimination of online content, applications and services, and it has been applied since 30 April 2016 (European Commission, 2017). The second initiative is planned to start from June 2017, and it has been design to pay within the entire EU the same prices for telecom services as at home (roam as at home).

First, network neutrality as a particularly important provision of the Digital Single Market, represents a regulatory principle to Internet access pricing by which Internet providers can charge only for connectivity and cannot create discrimination in terms of quality, respectively individuals and businesses such as content and application providers pay a price to connect to the Internet. The paradigm appears however when one must consider the high competition brought by the OTT players to the European telecom operators, OTT businesses which are clearly in advantage with such a policy within the European market by using the "zero rating" practice. Even if it comes on a legal path, this approach violates the principles promoted by the net

neutrality and it has been banned in certain countries (e.g. Chile from June 2014) as it limits the open markets. Extending the discussion, in developing countries with low incomes such a practice puts the regulators to choose between disrupting the competition and offer high-priced internet access, and therefore loose customer segments (BEREC, 2017).

In the run for avoiding blocking and slowing down of any digital service to promote competition, freedom of expression and consumers' privacy, the European Union may risk to create market gaps with certain entities being protected. In this sense, Garcia et al (2016) stated that "a completely unregulated control of data packages may pose risks to competition, freedom of expression and privacy, while only an allowance of prioritized traffic under regulatory control and open internet quality of service requirements will protect these directions and create economic efficiency". The authors also draw a parallel between US and EU, were regulations have been passed to promote network management transparency among Internet access providers and prohibited paid prioritization except special measures such as court ordered blocking of illegal content, prevented malware and services attacks, and congestion related issues from acceptable reasons (Europa.eu).

Within this second implemented initiative – roaming abortion, there are also a certain number of safeguards such as the "fair use" safeguard which prevents the acquisition of SIM cards from EU countries where prices are lower than in the country of use or "permanent roaming" which prohibits European citizens to use roaming services like at home for intentional long periods. It is considered that roam like at home (RLAH) – the motto for roaming elimination, will however led to new challenges for the operators if the Commission will introduce price caps at the wholesale and retail level (measures designed to prevent bill shocks and promote transparency), especially for the operators from low-income countries who can often have smaller prices from home-country to access a host network, but required to pay a fix rate (Papandropoulos, 2007).

Together with the roaming decrease and soon elimination, the domestic mobile prices have been decreased as well since the wholesale cost of operators dropped within the transition period. Moreover, the new rules will significantly promote cross-border use of IoT and increase the evolution of mobile apps.

Necessary to enable competition, the wholesale caps are still kept at high levels in order to force the small operators and the MVNOs to evict the market since their power to negotiate is low. As a consequence, implementing this kind of measures can lead to distortions in domestic markets by increasing prices, therefore the need for a different approach such as roam like a local (RLAL) to stimulate competition in the roaming market (Mariniello, 2015). However, the European body started already at the initiative of MVNO Europe to sequentially reduce the wholesale mobile roaming caps for data (MNVO Europe, 2017).

Further, the European Commission's levers to stimulate cross-border supply are mainly ensuring competition in intra-country mobile markets in order to help operators expand into other jurisdictions, and reduce mobile operators' costs of expansion within EU. Hence, to enforce the European digital industry, the regulatory body finds the mobile telecommunications markets as an important component for the Digital Single Market project completion, whose final goal is to improve end-users' access conditions and stimulate the telecom players to grow.

Radio spectrum

The third top priority of the Digital Single Market's second pillar, the radio spectrum represents a finite natural resource for the digital society. Considered the basis for wireless communications (e.g. Wi-Fi, mobile phones communication) it is largely applicable also in other key areas such as transport, broadcasting etc., which determines a limitation of its spectrum.

Within the EU, all wireless technologies transmit and receive information via the radio spectrum, which is coordinated by regulatory bodies through the allocation of frequency bands in order to ensure harmonization, efficiency and availability for any operations led by players within the field, which represent the main goals of the EU's radio spectrum policy in the attempt of creating a Digital Single Market. In addition, regarding modernization activities on-course, the regulators aim at facilitating spectrum access through flexible usage conditions, managing usage rights such as spectrum trading, and by introducing new technologies that can lead to a more efficient frequency sharing and re-allocation of spectrum within the internal market (European Commission, 2017).

Level playing field

Finally, the last major provision of the Digital Single Market's second pillar refers mainly to how over-the-top service providers should be regulated within the European market in order to ensure a fair treatment for all the actors within the digital sector. In this sense, there have been complains from numerous European operators (e.g. Orange, Deutsche Telekom, Telefonica, KPN) about OTT's incompliance with EU's sector regulation on issues such as user rights, security, antitrust, net neutrality and market obligations, on the basis that OTTs offer similar services as them but benefit from a different regulatory framework.

1.4 Infrastructure

Given the ascension of the mobile services, it becomes indispensable to have a well-defined wireless infrastructure within a pan-European market for mobile services. The later one implies therefore long-term investments to increase the high-speed mobile broadband coverage, but also a unification of the telecom market to reduce the "double mark-up" effects (e.g. termination calls fees). This fragmentation of the EU market has been identified as one of the major factors behind the lower financial results of the European companies compared to the inter-continental competitors from US, Japan, Korea and China if we make abstract of the differences in supply and demand that occurs.

One key resource for the wireless communication services refers to the radio spectrum, which can be divided into allocation to determine the use of bands (e.g. wireless communications, television, radio broadcasting) and assignment which refers to the rights owned to use a portion of a specific spectrum band. In this sense, the DSM project is designed to reduce to issues related to fragmentation in assignment procedures (e.g. auction based assignment at different times and influenced by the country's sovereignty) and contribute towards EU-level assignment of spectrum with an appropriate period of time allocation for transition and a consideration of each country's market features and variables.

Next, while Europe is facing problems regarding the telecommunication infrastructure, the demand for data is exploding for various reasons such as the appearance of multiple content

providers which attract the consumers more and more, as well as the development of smart technology which allows consumers to ask for an increased level of content, factors which have caused serious challenges to the existent infrastructure (e.g. relieving congestion within the network by improving the technologies). The key solution in this context seems to have been the fixed-line for a while, as it is considered that companies who hold the fixed-line technology can face the high demand due to the cables' potential to relieve congested wireless networks.

Looking at the nature of the investment, the study of a consultancy group reveals that operators started to invest massively in backbone and backhaul fiber networks that are of use for both fixed and mobile communication services to end users. The fiber optic cables were seen as a step forward in upgrading the infrastructure by improving the level of coverage required both by the regulators and the market. However, comparative to the two main competitive regions, Europe's fiber access penetration and downstream speed in mbps 1000 penetration was 20 and 35 times lower which shows the drop of the advanced digital networks in Europe (BCG, 2013).

The bandwidth of fiber-optic cables remains hard to be beat, but it presents a major problem for the urban area – high costs driven by labor processes of digging and laying ducts. It might represent however a solution for the rural area, where digging processes area easier and safer to the weather conditions. The solution instead for the urban area is the next generation network (5G) design to solve the issues that previous network generation experienced. Moreover, satellite technologies come to fill the gaps in digital connectivity where fixed or terrestrial mobile technologies experience issues (World Economic Forum, 2017).

Going further with the problem related to the telecommunications infrastructure, a study from McKinsey & Co mentions that this issue affects both operators' profitability and competitiveness and country's economic status since, as an example, the France Telecom (Orange) is perceived first as an entity with employment, infrastructure, tax revenues and overseas political influence for the government deliveries. One step ahead in this direction is about to happen starting with July 2017 when the Digital Single Market project is expected to reconsolidate the European telecoms industry.

In addition, the study emphasizes that the failure to competitively invest in next-generation technology and infrastructure seems to have created a gap between the Asian and North

American telecom overall performance and the European performance. Referring to the public telecommunications investments, Europe accounted around USD 3 billion less than the North America whose investments reached USD 70 billion, leaders in the global telecommunication investments with about 37%. However, according to the OECD data, the European investments were lower than the level from 2008, period in which the European telecom industry lost about the same amount of money they've invested in 2013 in infrastructure from aggregate market capitalization, while the other players on the market such as the digital service providers (OTT), device manufacturers (OEMs) and cable companies gained around € 200 billion, aspects which determined a value migration from Europe to the competitive regions.

In terms of investments barriers, Bock (2014) finds three main inhibitors which refer to the inability of the operators to make fair returns, the mandated inefficiencies in the mobile sector and the lack of a harmonized pan-European approach.

The first impediment is given first by the abundant inconsistent regulation which relates to the lack of local competing infrastructure assessments and the preference for renting instead of building, and second by the uneven playing field in the sector which contributes to the continuous value migration towards the newer entrants – OTT players and non-European device manufactures, and in the end causing unfair returns.

The second places the potential inefficiency of the mobile lines operators. In this sense, it has been argued that, despite the belief that more competitors present will lead to lower prices, the presence of unsustainable mobile operators unable to cover their CAPEX will fragment the overall industry by creating adverse consequences.

Last but not least, the third effects arise from the different customer protection and technical processes rules of the member states create a non-harmonized European market which makes it difficult for the operators to comply with, especially in relation to the IT processes which is considered to be "the main driver of cross-country synergies for telecom operators" (Bock et al, 2014).

Nevertheless, according to the GSMA Association, network operators are expected to invest more aggressively over the next years especially in mobile network infrastructure necessary to support the 5G technology and the upgrades to fiber. Transition to all-IP networks, the expansion and densification of mobile networks or maintenance are also additional requirements of a costly nature which are well reflected into the CAPEX data from 2015 - €25,759 billion capital expenditures for fixed network and €21,263 billion for the mobile.

Finally, despite the slower growth rate from the previous years, CAPEX are expected to rise in the battle for competitive advantage in both the developed and developing countries (GSMA, 2017). In total, the required level of investments for the next generation network (5G) is estimated to cost up to €200 billion with an additional €100 billion for proximity data centers, while for other ultrafast broadband coverage the amount of investments is estimated at €360 billion (ETNO, 2016).

1.5 Technological developments and emerging technologies

Factors of both pressure but mostly solution generation, the technological developments and the way the industry players have managed to keep up with the trends have created the regional differentiation and most importantly, have pushed the operators with financial disposals at the front of the global order among network operators.

In this line, the sub-chapter will discuss the main representative developments and initiatives on course of implementation that will most probably reshape the telecommunication businesses.

5G

Simply put, at the time of its release, the fifth generation of mobile technology (5G) will represent a set of improvements and new developments to the older generations (4G, LTE, 3G, 2G) in terms of better signal strength, fewer interruptions, higher bandwidth as alternative to fixed line access, denser coverage for crowded areas and higher frequencies, as well as new modes of use such as M2M applications for the IoT. However, the advantages will come at a cost and new challenges for the European telecom operators since the 5G PPP between the European

ICT industry and the European Commission aims at reshaping the telecom infrastructure in order to reach better performances.

Moreover, the new infrastructure will bring 1000 times higher wireless area capacity, up to 90% energy save in the mobile networks, time cycle per service creation reduction from 90 h to 1.5 h, 0 perceived downtime for services provision, 7 trillion wireless devices' connections capacity, better network management through sensor-based applications and enhanced user privacy. In addition, 5G network may be also used for the fixed-line services to replace the fixed cable broadband rollout which has been expensive and with unreliable performance in the rural areas, using broadband over radio, either mobile or fixed radio access.

Next, given the high speed potential and minimization of energy consumption, the new generation network 5G promises the appropriate frame for the new content distribution the consumers tend to require. In this sense, telecom operators could position themselves into the global media content distribution and reduce the competitiveness of the OTT players.

Last but not least, another use of the new technology will most probably be seen for the M2M communications within the IoT concept, were telecom operators can extend their influence or even for other similar concepts (Industrial Internet) developed by various companies such as GE.

Looking at the overall landscape, Europe's global competitiveness is tight also on the technology/infrastructure developments segment were many technology suppliers/developers announced field pilot trials within the next two years. On the Asian and North American continents, Verizon announced the release of its proprietary 5G standards (2016), NTT DoCoMo worked with six suppliers to test the possibility of launching 5G in 2020, similarly to Samsung and Huawei who prepare a launch of commercial 5G services in 2018 at the FIFA World Cup in Russia, China Mobile making trials in more than 100 cities and SK Telecom teaming with Nokia to initiate commercially launch for 2020. In Europe, similarly, the initiatives covered in the digitalization strategy were started for debate during the last couple of years, were rooted in the available network infrastructure (4G, satellites, Wi-Fi) and are now planned to be expanded via the adoption of 5G starting with 2018. Nonetheless, according to a GSMA survey from 2016, together with significant benefits brought by the next generation network, there are emerging priorities that might also lead to concerns if not managed properly (see Figure 5).

Assumptions	Priorities
-5G will transform the mobile broadband experience in early deployments and drive new, intelligence automation use cases in later phases;	-Enhance mobile broadband (74%), massive IoT (21%), ultra-reliable communications (5%)
-5G will evolve over time and leverage a variety of spectrum ranges, plus robust security to support new use cases;	-Traditional/new business models in combination with evolutionary/revolutionary technology
-Enterprise services will drive 5G's incremental potential	-Sources of revenues for 5G dependent on B2B
-5G will start as an urban-based tech and integrate 4G to provide boundless connectivity	-Global coverage increase
-Competition and collaboration between operators and other ecosystem players to provide services will intensify in the 5G era	-New roles for network operators as platform provider (44%), digital service provider (41%), pure connectivity provider (10%)
-New models for infrastructure ownership, competition and partnerships will be required	-Network sharing management
-Regulation, licensing and spectrum policy will make or break the 5G opportunity	-Advocate for better regulatory framework
-Fragmentation will reduce the 5G opportunities	- The industry should strive to avoid spectrum and technology fragmentation by collaborating
-Interoperable and interconnected IP services, including M2M, should be supported as default in 5G	

Figure 3: Collective expectations and concerns for 5G era. Source: GSMA, (2017)

Conclusively, the 5G technology seems to facilitate the appearance of a World Wide Wireless Web which refers to the use of the previous World Wide Web through a wireless device and development of formats displayable on any type of device with a Wireless Application Protocol (WAP) that will allow data exchange with almost no limitation. For this, equipment (hardware and software) suppliers must work on improving their offerings as well (Khan, 2015).

Cloud computing

The term "cloud computing" simply refers to the use of IT related services from cloud service providers (e.g. Oracle) which allows consumers of this service to store their data through access to a network connection, without needing an actual physical storage unit but the "cloud" – a virtual storage platform. A more explanatory definition states that the concept is design for "enabling ubiquitous, convenient and on-demand network access to a private, community, public or hybrid based platform of configurable computing resources such as networks, servers, storage,

applications and services, that can be rapidly provisioned and released with minimum management or service providers efforts" (Mell & Grance, 2011).

Most of the cloud computing offerings got the name of "resource as a service" or broadly "anything as a service" – XaaS. Some of the most relevant categories have been presented by Keith and Burkardt (2011) which include: software as a service – SaaS (e.g. Google Docs, CRM) mostly public specific, platform as a service – PaaS (e.g. Google App Engine, Windows Azure) usually community specific, and infrastructure as a service – IaaS (e.g. Amazon S3, SQL Azure), which is usually a private specific category that includes some of the most important tools for the telecommunication sector (Figure 6).

One of the advantages that come along with this new technology refers to companies' possibility to shift from CAPEX to OPEX thus avoiding the physical equipment risks, encouraging cost savings and reducing infrastructure costs. Other said, the cloud computing technology represents a step towards the switch from goods to services, services that become more and more important and predominant in today's business environment.

The risks and challenges of moving towards such service almost equals the balance, as it can lead to hacking, espionage, and operations blockage of proportion in case of a network/energy source drop, as well as data lock-in, transfer bottlenecks, performance unpredictability, scalable storage (Armbrust et al., 2009).

Moving forward to the telecom sector, it is suggested that cloud computing can lead to Network as a Service (NaaS) offerings which refers to the process of renting out a network system or sharing parts of it with a reduce number of entities that can help them build their own ecosystems (Yrjo and Rushil, 2011). In this sense, Ericsson, one of the world's leaders in the network equipment and technology segment, has developed the Network-enabled Cloud (NEC) which includes SaaS offering for the telecom operators; a Mobile Cloud Accelerator (MCA) service mostly for media and content delivery networks which will help operators to cache the content locally, saving round trip time for traffic to and from the Internet, and create radio access network priority which is a key area for the mobile operators; Management Suite as an arrangement and provisioning of clouds services and configuration of the network resources; Service Enablement and Exposure of Network Capabilities tool to help operators build two-sided

business models for increasing revenues; and lastly a Data Center and Optimization program to improve operators' quality and security of the unified communications and enterprise application offerings.

As a bottom line, the telecom operators can benefit from the NEC concept offered by Ericsson through a set of five main incentives, presented as the "5C based NEC", which can lead to new business models of improved quality and reduced costs: unlimited connectivity, efficient operations through integrated management control, compute – embedded capabilities through telecom-grade infrastructure, rapid service creation and customization (Ericsson NEC, 2012).

Similarly, the rest of the system providers in the telecom market (Huawei, Nokia Siemens Networks, French Alcatel Lucent, ZTE Corporation and Cisco) have also created competitive cloud activities and operations.

Internet of Things (IoT)

One realistic scenario for the future platform of digital economic growth has at its core the IoT concept and its applications for entertaining and leisure, health care, transportation, energy, buildings, cities and industries. In terms of connectivity, the IoT will make use, among others, of the daily live known network technologies such as WiFi, and 4G cellular, hence creating new business opportunities for the network operators.

Given its pervasiveness within the home environment and its technical characteristics, WiFi connectivity becomes an obvious choice for many IoT developers, the same way cellular network (4G) becomes a great choice for longer distance IoT applications. However, while both fixed and mobile networks are clearly capable of sending high quality data and therefore to be used within the new opened opportunities, the expense and power consumption will increase for many applications, creating new challenges for the network operators especially in relation with the bandwidth.

By consolidating existing technologies, one response may come from the next generation network also known as 5G which is expected to transform the digital connectivity as we had it until today. Beside its application for regular individuals and their devices across the most inaccessible areas, anticipations point towards "gigabit connectivity for business and consumers

for a range of content, applications and services. It also enables ultra-reliable, low latency M2M communications which will further help reducing congestion" (Vermesan, 2014).

Li-Fi

One of the latest emerging developments - Light Fidelity (Li-Fi), represent a high-speed wireless communication technology design as a complement and potential substitute for the older Wi-Fi and cellular networks due to its increased bandwidth capacity and usage of visible light as opposed to Wi-Fi (radio waves), which will reduce the issues of interference, secure the penetration and create underwater application. Hereafter, such a technology it's becoming a major factor of consideration for the network operators in their attempt of creating the fixed-mobile convergence, as well as for the new business openings such as the M2M communication.

II.2 Sectorial challenges and opportunities

This sub-chapter will follow, based on the above discussed factors, a PESTEL analysis type to emphasize the nature of challenges for the telecommunications sector that, as an initial assumption, are mainly a limited mixed set of an interconnected political, social, technological and legal nature, combined with a set of organizational and business related factors. The overview of the challenges will further create the context for the first addressed research question, after emphasizing how other scholars from the field identified, classified and discussed these aspects.

PESTEL view challenges

Political

In terms of political challenges such as competition policy, business environment prerogatives, trade restrictions, and tariffs, it has been found from the European Commission reports that the European network operators are facing challenges especially in relation with the provisions on spectrum area, net neutrality, roaming elimination and zero rating policy.

Economical

In addition, according to Europe's biggest operators, their activity in multiple countries automatically attracts challenges related to the local economic conditions such as currencies, and in worst case crisis scenario, their possibilities in spending power for customers will be reduced.

Social

This particular dimension has been especially technologically influenced during the 3rd and 4th Next Generation Networks (NGNs), which led to a change in communication habits. If around the year 2000 people were more constrained in financial terms and limited by the offering to virtually communicate, nowadays the technology development and more importantly, the competitive offers allow and encourage them to consume according to everyone' needs in most of the world's regions. Moreover, the variety of channels creates them a wide spectrum of choices and higher experience expectations, point where the most orientated players on the market will benefit.

Technological

Probably the main technological aspect with social impact, even though there have been no reports, is represented by the electromagnetic filed (EMF) with related health risks considering that these signals emitted by the mobile telephone handsets and base stations my pose a negative interaction with the human body.

Some of the other technological challenges have been identified by Ibrahim (2012), and refer on the one hand to the core technology evolution - optical fibers for fixed access and LTE/5G which create wider band availability for both uplink and downlink, and an increased access mobility and flexible consumption. On the other hand, it refers to adjacent technology evolution and customers experiences/expectations - increased demand on non-linear content with increased resolutions such as HDTV and 3D videos; extended mobility requirements since the traffic comes more and more from the mobile devices, such as handling from an application level (for all the concerned content players – CPs, CDN providers and eventually telecoms); customized contents based on user preferences.

In addition, it is important to underline also the challenges raised by content evolution - M2M systems challenges and IoT sensors' challenges, which generate a different type of content with various structures and requirements, as well as the one raised by the so-called "value extraction" evolution - Big Data method with its Cloud-based applications for content storage, processing and distribution. Finally, these new technological evolutions are opening the path for cyber-attacks and failure in maintaining the network infrastructure operational, both representing important areas of focus for the European operators.

Environmental (organizational environment and business related)

Based on the European operators' latest reports, the major concern is represented by the convergence trend and the possibility to fail in delivering it. However, such a challenge occurs mainly in case of compromised access to infrastructure and content or compromised acquisition, renting and build of the right assets.

In addition, Ibrahim (2012) identified an increased complexity among the stakeholders as in case of partnerships, collaboration between stakeholders would be required for clients' authentication, resources allocation, security and privacy etc., which will make the end-to-end monitoring more complex on the one hand, but will also create cost reductions opportunities on the other.

Further, out of a study conducted by a management consulting and advisory company which apply not only on the European level but also globally, it seems that disruptive competition with predominance the OTTs resulted as the main industry challenge according to 75% of the respondents (industry experts from the entire value chain), who have recognized the potential these services have, closely followed by an eventual lack of organizational agility to adapt to the new picture (E&Y, 2015).

Complementary, as presented also by Gent (2017), the "termination calls" comes as another big challenge, usually on two paths. One path has the legislators at the center who are implementing restrictions to the operators in terms of how much can charge for calls arriving from other networks as well as roaming fee reduction and soon complete elimination, two aspects that counted for about 10% of the usual revenues. The other path has the "grey routs" at the center under the more common SIM box fraud syntagm which acts on routing and terminating calls at lower fees that the operators do because of the zero costs they attract.

Moreover, Gent (2017) mentions a second threat for the telecom operators' revenues which occurs on a legit way and it is again related to the relatively new entrants OTTs who compete on both termination calls business part and video, voice & message part. In this sense, with voice over IP (VoIP) as a core element of the business, the new entrants have been perceived as fair competition with manageable impact over telecom operators' businesses. The perception seems to have changed however, when the OTT service providers grew extremely well through their "freemium" policies or inorganic growth moves. Marketing popularity for the OTT businesses has been created also through the possibility they have to offer telecom operators termination calls at more competitive prices than the traditional market, action that occurs within the OTT app under a "receive regular incoming calls" option, which takes the denomination of "OTT hijack" practice.

Further, according to the same 150 telecom operators' global survey, it has been estimated that the considered companies identified a 20% reduction in termination revenues using the OTT hijack practice (Gent, 2017). By doing so, European telecom operators increase their financial potential to invest in new infrastructure that will better support the telecommunication network.

Legal

From a legal point of view, it occurs that the regulatory framework with its provisions on data privacy is one of the most relevant challenges that the European network operators is currently facing.

Conclusively, the identification and managing of such challenges that mostly transfer into risks is an essential business activity on both the operational and strategic level, in order to be responsive to the changing landscape in which actors from domains such as telecommunications operate.

Industry Forces based Value Chain

The Industry Forces Value Chain offers an overview on the network operators' business determinants which, as in any business activity, represent also determinants of potential challenges. To exemplify, one common European network operator has been selected for various reasons.

It can be noticed in the figure bellow that the vertical alignment is making reference to the main actors within the value chain of the industry which make possible MNOs business activity, while the horizontal alignment displays the categories of actors that create an added value for MNOs, stimulates them to improve their offerings and take, on the dark side, parts of their market share.

Further, the purpose of the model is to emphasize, as a conclusion to the formulated problem, the new form that the Industry Forces based Value Chain will most probably take once the changes and trends in the market will begin to have a major impact, the year 2020 being selected in this sense mainly due to the impact criteria.

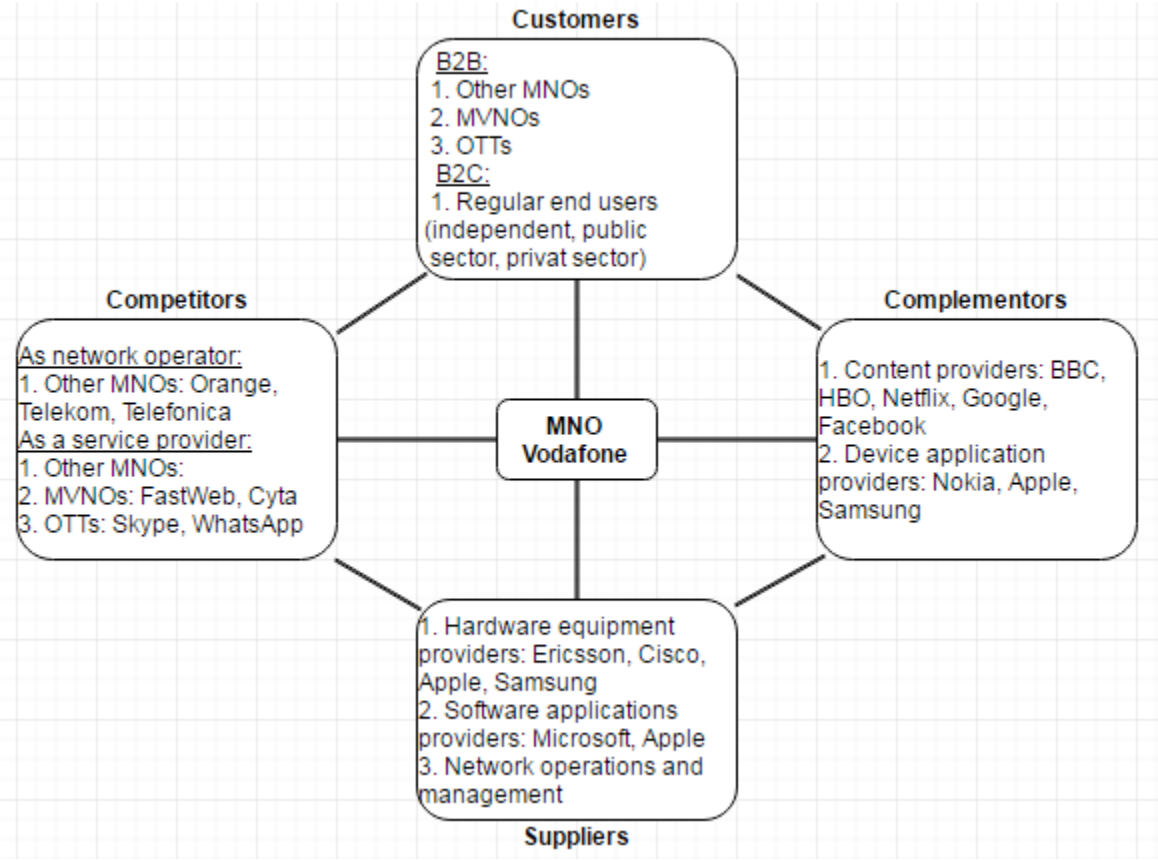


Figure 4: Vodafone's Industry Forces based Value Chain. Source: the author

Considered the first component of the value chain, the categories of suppliers identified create the backbone on which the MNOs business is based on. It includes the hardware equipment such as base stations, network controllers and devices sold through the operators to the end users, the software applications and services which open the access to towers, backhaul or other requirements and lastly, the administration and operational accessories which are used to maintain the functionality and quality of the network. Within this component of the value chain, the suppliers are often multi-specialized with offering from the first to the last category.

On the customers side which represent the last component of the value chain, there have identified the Mobile Network Operators who for example, when entering a new market, don't have access to a network, hence they enter into partnerships with the MNOs already established within that particular market; the Mobile Virtual Network Operators which basically act similarly to the previous scenario. In relation to the OTTs, they have been identified as clients on the broadband Internet access segment, access often gained from the MNOs.

Challenges as opportunities

A 2009 study from A. T. Kearney, a peak-time when the markets were recovering after the financial crisis, reveals that the reshape of the telecom industry post-crisis was attributed to consolidation, external growth, innovation and business models, which can still be reflected in today's main overall picture of the telecom industry development.

National consolidation as a solution for the unsustainable operators through inorganic growth which will allow them to exist long term and contribute to technological innovations; fixed-mobile integration especially for the corporations and as a protection to the mobile operators threatened by the mobile virtual network operator systems (MVNOs) offered by the fixed operators; and multinational expansion/ cross-border growth which will reduce risks, will improve brand equity, product development and extend group's functions. Moreover, while consulting companies come with "integrated carriers of both fixed and mobile networks, a more competitive position on the end customer market, and an increase in successful partnerships" (Detecon Consulting, 2014), others are proposing that, considering the new paradigm shift from

a state of business based on voice to one concentrated on content, the network operators need to identify and take action within the limited critical success factors remained.

One comes from the possibility for telecom operators to enhance their position through Content Distribution (CD) as well as through the creation of Content Distribution Networks (CDN), or simply by renting network to the existing CPs and CDNs providers. Moreover, considering that CDN providers have content providers (CP) as their main clients, a new business model may be possible by selling services either directly to the existing CDNs or to both (Ibrahim, 2012).

In addition, among the solutions for restarting the growth within the European telecom sector among network operators, studies from scholars such as Block (2014) propose deregulating fixed-line wholesale access; leveling the playing field for network operators and OTT service providers especially concerning tax policies, data and privacy protection; consolidation through inorganic growth; sustainable investments and equal treatment for all players no matter the incumbent/new-entrant status; standardizing IT processes between countries and harmonize the rules and procedures for consumer protection (e.g. contract termination) or technical processes (e.g. VAT submission).

Accordingly, these directions and many more, not only emphasize a certain nature of issues, but also present prospective opportunities that might occur once the actions will be taken with probably the only major condition that the market players will have been consolidated their position by the time the changes will happen and will stand from a position of strength, especially from a financial point of view through good monetization strategies, and smart investments in both infrastructure and innovative products that will lead to differentiation.

III. LITERATURE REVIEW

While a large number of authors have discussed the European telecommunication situation such as Bock (2014) and Diehl (2015), each presenting discussions on the gap created between Europe and its inter-continental rivals, and the IT-telecommunications fusion as a determinant of B2B growth, others have developed studies around the situation of the European network operators and the multi-sided cross-sectorial competition – OTTs in order to determine solutions to the existing challenges, mainly from a regulatory and technological point of view. Few however have conducted discussions on how the European network operators can respond to the emerging challenges brought by the OTTs.

Among the most recent academic work to reveal and propose solutions to the existing challenges faced by the European network operators, important papers were written by Curwen and Whalley (2016) who tackled the European regulatory policy in Hutchison-O2 take-over case who procrastinated the decision of allowing such a change in the market. Through a sample of 35 European markets constructions, the authors underlined that even though the European bodies claimed to have made out a waterthight case for the maintenance of the existing structures within the market, the claim should be however perceived with a dose of scepticism considering the history of European M&A activity.

Further, on a theoretical level, Garzaro (2016) also approaches the regulatory part to underline the need for an equal treatment of the Internet actors and network operators that act similarly in order to achieve the highest degree of competition. Using provisions from the competition law, the authors conclude that the higher the neutrality is, the better consumers will be protected, and suggest in a last instance, the possibility operators have to create exploitative business models in order to block the disloyal competition.

Similarly, Benzoni and Dutru (2016) argue for the re-opening of the regulatory tool box in order to approach the new incumbents with own mobile infrastructure and the new entrants with good incentives and prepositions to enter the emerging IoT business sector. To do so, the authors focus their attention on the radio spectrum and how this can be better assigned in order to facilitate a more competitive market, challenge precisely and specifically approached also by Basaure et al

(2015) who found industry openness and spectrum centralization as two key factors that affect the adoption of a dynamic spectrum access in their operator-centric and end-user centric models.

Most recently, Spruytte et al (2017) approached one of the challenges attributed to the roaming elimination policy whose impact on the telecom operators and their clients can be avoided through a set of technical solutions as alternative for roaming. Discussing carrier portability, software-based SIMs, roaming like a local and Wi-Fi offloading, the author emphasizes how these solutions might generate the best possible outcome for the consumers and might ensure the best level playing field for European network operators.

Complementary to the regulatory change initiatives proposed by the above mentioned authors, Cornaglia et al (2015) discussed one of the technological challenges represented by fiber access network infrastructure which attract too much capital for one entity's financial capability to build, therefore the need to form partnerships and joint-ventures in order to share the construction costs and related cross-selling revenues. The authors' Fixed Access Network Sharing concept addresses in this sense the possibility of multiple partnerships that could enable greater product development autonomy and differentiation.

Additionally, Monserrat et al (2016) makes use of the Astellia approach towards the 5G cellular network in an attempt of estimating the performance of quality measurements techniques of the current cellular network as they argue that the operators face a major gap of knowledge in terms of key performance indicators and user experience. By analyzing a list of metrics and attributes, the authors underline the opportunity arising with the next generation network in relation with the users' experience, section were the operators continuously experienced issues.

On the other side, with reference to the multi-sided platforms acting as competitors on the European telecommunication market, most of the studies conducted in the last years are putting in light the challenges brought by the OTTs, but omit however to propose solutions.

Important discussions around the network operators-OTTs situation have been found in the paper of Gorp (2014) who introduced the convergence and divergence trends to emphasize the new forms of electronic communication and the rise of OTT service providers. Similarly, Sujata (2015), Arnold (2016), Garcia (2016) and Gent (2017) emphasized OTTs' competitiveness brought to the network operators in relation with the termination calls and voice & message

business areas, as well as OTTs' emerging success on these segments using "freemium" policies and inorganic growth moves, but also through the facilitating regulatory framework. In line with the regulations, authors such as Karkoski (2011), Cecere (2012), Kekolahti (2015) or Gerpott (2016) have suggested re-evaluating OTTs' substitutable character in order to convince about the need to change the regulatory system, but none have been able to come up with strong indicators.

Nevertheless, some notable proposals come from Bhawan and Marg (2015) who have managed to propose the creation of a framework where OTTs are classified as either Communication Service Providers or Application Service Providers, making them similar to the traditional service providers or at least imply a direct connection between OTTs and operators for different offerings such as licensing authorizations.

However, on the opposite side of Bhawan and Marg (2015) proposal, Shortall (2016) has managed to come up with an explanation on why the OTTs should remain differently treated than the traditional Electronic Communication Services, by referring to their competitive landscape on voice and network operators' still existing major market power, since an extension of obligations to the OTT services would lead to the appearance of entry barrier and undermine the competitive dynamics in the sector. Separately, the same Karkoski (2011), Cecere (2012), Kekolahti (2015) and Gerpott (2016) have tried to empirically find indicators of substitution but none have been able to come up with strong arguments, except Arnold et al (2016) who have managed to extract from a consumers' behavior study led with a sample of 1000 people in Germany that although 78% consumers use OTT services, only about 39% substitute ECS with OTT services, while the others use both complementary.

Last but not least, one of the most recent work to propose solutions for operators' challenges that has already started to be a reality, refers to operators' time to add new value-added-services while implementing strategic moves to reduce costs in order to remain competitive, emphasized by Lahteenmaki (2016) in his Activity-based Costing model as one of the few cost analysis to Cloud based offerings, as well as to the possibility of entering into a partnership. In this sense, considered an appropriate context for MNOs and OTTs, Aidi et al (2012), Sujata et al (2015) and Joshi et al (2016), emphasized the potential synergism to retain more value from the market by entering into a partnership.

Finally, given the limited number of studies approaching the European network operators' emerging challenges and opportunities determined by changes and trends, this paper intends to bring a contribution to the existing literature, combining a variety of factors approached by some of the cited authors but also some of the most recent aspects seen from a PESTEL view.

Literature gap and research questions

Out of an extensive literature review conducted on the European telecommunication industry background, as well as on the limited academic literature on the subject, it appears that a particular gap exists in relation with the network operators' position to the major challenges coming from the sphere of the new PESTEL landscape (see chapter II.2), which are further transferred mainly through the Industry Forces based Value Chain, and eventually creates an influence over network operators' position on the European market.

In this sense, the author proposes an analysis based on a line of three research questions derived from the existing literature gap, questions that are expected to bring a comprehensive contribution to the existing literature. These are:

RQ1: Which is the main landscape that challenges the European network operators' competitiveness the most?
RQ2: Why can the OTTs represent the main challenge for most of the European network operators' competitiveness in line with the new landscape?
RQ3: How can the network operators resist the challenge coming from the OTTs?

Altogether, the addressed research questions stand out differently from the existing literature as it offers clear directions to identify the sources of main challenges that network operators are facing in the new landscape, and as it points towards a set of complex actions that appear as opportunities to react to the changes.

Possibilities for improvements/limitations

Nevertheless, one direction of improvement might come from a more detailed analysis of the other challenging factors which appear to have an impact over the network operators' state of business, as well as from the choice of new theories differently applicable to the phenomenon explained since the existing ones might inadequately fit to new inputs.

IV. THEORETICAL FRAMEWORK

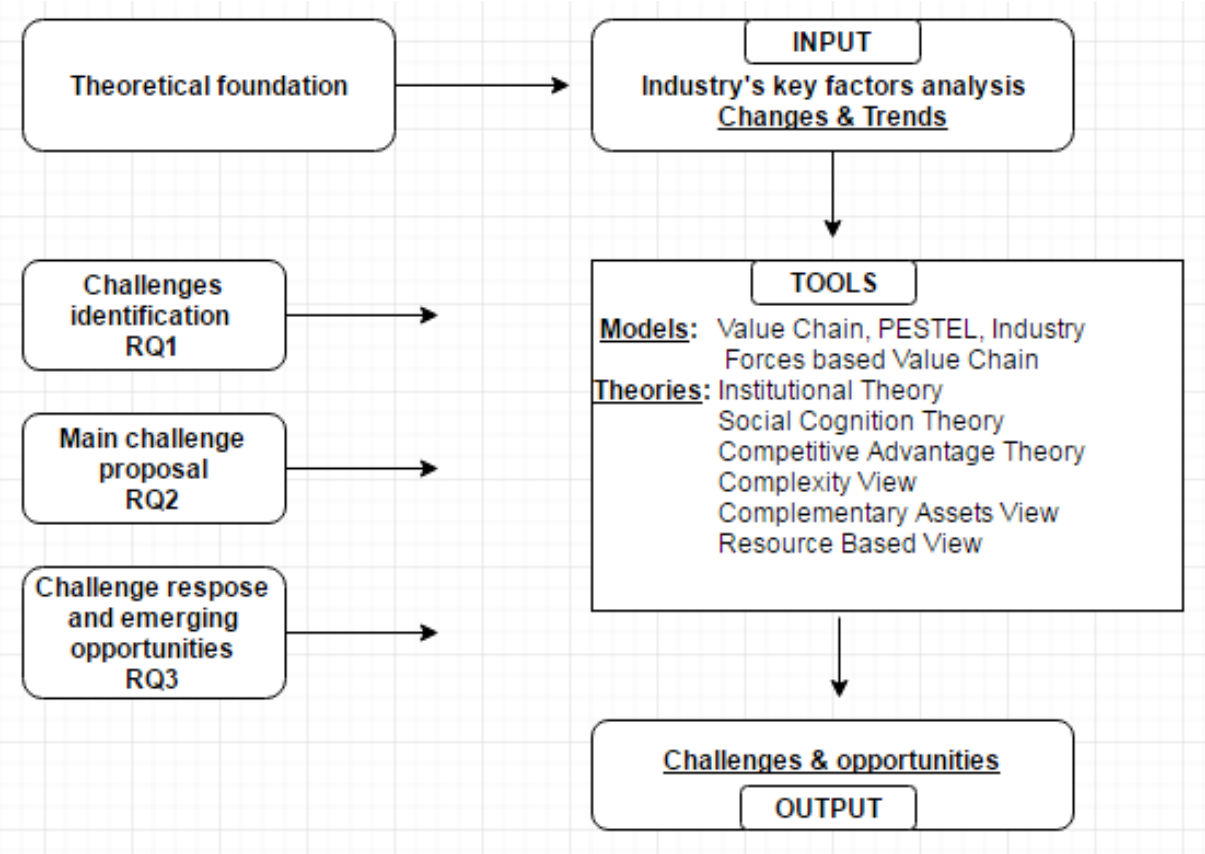
Following an inductive approach from an initial PESTEL analysis and Industry Forces based Value Chain one first answer will be formulated regarding the European network operators' main challenges that occur with the new landscape, by paying particular attention to the Complexity View of the subject area. Several theories have been of great use in this line to cover the theoretical background of the perceived challenges and further explain their predominance. In this sense, the Institutional Theory with its political institutionalism residing mostly from a supra-state level, emphasize the influence of the political actions over the telecommunications sector and its actors, as well as how the regulatory framework creates both differentiation and harmonization within the European market.

Next, the Social Cognition Theory has been studied for its assumptions on how the changes in the surrounding environment determines changes in a person's behavior in certain cases, pointing in the telecommunication case towards users' evolution in consumption terms when factors such as technology and content development have rapidly modified.

Further, the answer to the second research question will align with Sujuta's (2015) perception on the adoption factors of OTT services, who successfully emphasized the cost, convenience, social propensity, content, technological advancement and regulatory nature of OTT success drivers. Hence, the purpose is to create awareness on a main focus area which appears to be encouraged by the new trends and changes in the digital society, as well as by the complementary assets ownership which facilitates the innovation process.

Lastly, through the use of the Resource Based View, the author have managed to produce a good understanding of the competitive advantage creation within the telecommunications sector, and further create proposals of differentiation and sustainability strategies that include a hardware and software focus which are perceived as the most valuable resources, but with a high necessity of good command to avoid complementarity creation by competitors. Therefore the third research question aims at providing clear directions on how the European network operators can position themselves in front of the challenges determined by the OTTs.

Conceptually, the theories chose to explain the meaning and nature of the challenges and opportunities associated with the studied phenomenon can be modeled as in the scheme bellow:



The theoretical framework's conceptual mapping. Source: the author

V. METHODOLOGY

V.1. Ontology and epistemology

On the ontological/paradigmatic level, the methodological approach for this study follows Abnor and Bjerke's Systems Approach which emphasizes the relationships between the components of a system. While the approach promotes, more or less, an objective view on the reality which aligns best with nature of this study, it is also supporting the researcher to create a study based on a combination of static structures, and mechanisms that lead to changes in a system (Kuada, 2010).

Essentially for this study, the Systems Approach represents a great theoretical construct that underlines the presence of various factors of influence over a stable environment, such as the telecommunications sector, that can lead to major and sometimes hard-to-predict changes. In the end, the characteristics of the telecommunications system such as interaction between various industry players and the interlinking of the business-specific resources, explain the business dynamism and the adaptive need of the actors towards the new business environment.

Epistemologically related, this paper takes a more objectivist-orientated view to the formulated problem to which, even though other authors may explain differently the associated research questions, the essence spins around the same core aspects that should not be subject of major interpretivism, as demonstrated in the literature review.

V.2 Research design – sample, methods, data collection, search protocol

The approach to the formulated problem is based on traditional library research as a preliminary step to identify the existing knowledge, which has further represented the basic foundation for the literature gap creation. It falls under the Thematic type of Literature Review through the initial background chapter which informs the reader about the current concepts on the topic in an organized manner, followed by the literature review chapter designed in addition to the previous one in order to emphasize the state of existing research and to present the research questions associated with the literature gap.

This initial research aligns with the overall research design as it creates the path to the first research question, named "*Which is the main landscape that challenges the European network operators' competitiveness the most?"*, and it continues under a qualitative form with a case study-based-action research to build an answer to the subsequent research questions – "*Why can the OTTs represent the main challenge for most of the European network operators' competitiveness in line with the new landscape?"* and "*How can the network operators respond to this main challenges?".*

As method of analysis, the case study sample that addresses the second and third research questions has been selected considering the "market position" of the actor, as well as the access to information, resulting in the choice of Vodafone which appears as one of the leading operators, both regionally and globally. By taking this operator as a point of reference, the answers to the research questions received more relevance and accuracy. Moreover, since research questions address mainly to the smaller network operators, the answers provided through the analysis of one of the leaders on the market can be considered as part of a benchmarking approach.

The main arguments standing for the choice of qualitative research rely first on the nature of the subject under investigation to which a case study based approach fits better, considering the restrained possibilities of individual researchers to create reliable quantitative constructs on such topics. Secondly, systems specific as well as for researchers having no background of the phenomenon, this method is useful to understand the subject and create assumptions for a specific case study, which can later be used to seek empirical support using quantitative methods.

In terms of data collection, in addition to the case study, the study is based on secondary data mainly coming from theoretical and empirical academic papers, and field-specific materials provided by Consultancy Groups, European Bodies and other Research Centers, covering the European telecommunication industry context with recent and relevant data for the subject discussed. The principal argument for the preponderant use of field-specific materials rely on the massive data collection they contain, hence the possibility to extract valuable and reliable information to support the research questions which are by themselves of a holistic nature due to the subject approached.

In this sense, the search protocol integrated a 'bibliometric technique' based on a mix of different field specific keywords typed in several international databases and information centers online platforms (European Bodies, Telecommunication Associations and Companies, Consultancy Groups), following a sequence of materials type criteria such as reports, journals and documents, which provided a significant number of recent publications and up-to-date information to create a solid theoretical foundation and analysis for the formulated problem.

Arranging data, validity and reliability

In relation to the empirical papers used to build the analysis, one of the most relevant studies that fits the purpose of the paper is a 2015 E&Y study used to emphasize the evolving views of business leaders (operators, stakeholders, technology providers and industry experts) across the global telecom industry within 40 companies from Africa, Asia, Europe, Middle East and North America. The study's data collection is based on in-depth interviews with the business leaders, EY professionals' analysis and secondary research sources to extract qualitative and quantitative results in terms of industry dynamics, strategic priorities of operators, and key initiatives such as customer centricity, new service development and attitudes to inorganic growth, which will bring a significant contribution to reach a conclusion for the addressed research questions.

As explained above, this particular study has been chose for its complexity towards the subject under investigation and due to the restrained possibilities of individual researchers to create better collection of data for studies of this nature.

Last but not least, the arrangement of the information to provide clear answers to the research questions has been facilitated through the use of specific theoretical perspectives emphasized in the theoretical framework chapter, which helped analyzing the qualitative content and explain the qualitative research methods.

Finally, the degree of validity comes in tight connection with the analytical approach based on qualitative data and is mostly given by the choice of sources and the relevancy of the materials, which is further placed under author's capacity to evaluate and interpret the findings. Given the use of new information publicly available, reliability can also be perceived in the same line.

VI. CASE STUDY

Originated in Newbury - UK, the Vodafone Group Plc it is now the second largest European network operator and one of the leading telecommunications global actors with operations in 30 countries and network partner in other 20 countries more. Through its networks, especially in Europe, the Middle East, Africa and Asia Pacific, the operator has reached in 2015 a number of 462 m mobile customers, 47 m coming from the 4G network (>55% increase), 13.4 m from the fixed broadband network (>7% increase) and about 38 m customers occurring with the IoT connections (37% increase), which translated into revenues of about 41 billion pounds, in decline however with about 3%.

Historically evolving as a mobile network business type, the operator covers the markets with an impressive 41% of own fiber and cable networks, which is still increasing due to large investments. According to company's 2016 annual report, the total spending in the last three years counted 47 billion pounds across capital expenditure, spectrum licenses and acquisitions. Such ownership gives the operator a good advantage once with the new market trend towards the convergence of fixed and mobile services.

However, it seems that in Europe, the inconsistent industry regulations and spectrum policies, exacerbated by a fragmented market structure, have led to a capital return deterioration. Moreover, with the advent of new technologies that squeeze higher broadband speed from outdated copper infrastructure, one risk of "re-monopolization" is rising, complementary to the new multi-sited incumbents (Vodafone 2016 Annual Report). In this sense, considering that the European market represents about 65% of company's revenue share, it is highly important to respond efficiently and effectively to both challenges and opportunities within this market in order to maintain a high level of performance.

Therefore, in line with the purpose of the paper which intends to discuss the position on the market of the European network operators at the beginning of 2020, Vodafone will be used to make a better parallel between the existing challenges and opportunities driven by changes and trends, by emphasizing their responses to these factors and how can others follow similar paths.

VIV. ANALYSIS

VII.1 RQ1: Which is the main landscape that challenges the European network operators' competitiveness the most?

Based on the preliminary PESTEL identification of factors of pressure, and partially on how various authors have approached the subject, the European network operators seems to generally suffer from a set of three factors of pressure seen from a social, political and organizational & business environment view, which will also be among the primary forces to determine a major change within the landscape of network operators over the next few years. These are the steady growth in data transmission traffic on networks, the success of over-the-top players (OTTs) and the fierce price competition among industry players, influenced by a non-neutral regulatory framework so far.

Accordingly, while on the social part the trends regarding data traffic growth does not represent a surprise considering the variables which caused a change of behavior (e.g. smart devices rise, channels development, content multiplication), the other two factors are challenging especially through the regulatory framework which on the one side creates a heavier impact over operators' revenues through the roaming elimination policy and continues on the other to facilitate a dis-loyal competitiveness brought by the OTTs in network operators' business environment through the lack of a net neutrality and the zero rating policy (BEREC, 2017; ECTA, 2017; ETNO).

Primary at the service level, providers of complete eco-systems (e.g. Google, Apple, Microsoft, Samsung, Facebook) comprising end devices, operating systems, services and applications on the one hand, and telecoms services substitutes applications such as within the areas of voice, messaging and video (e.g. Whatsapp, Facebook Messenger, Skype) on the other hand, offer worldwide services with both scale and scope realized economies which is assumed that limits the success of the telecoms carriers due to their high ascension (e.g. because of high quality products, the networks reached their limits of capacity at faster rates). However, on a partially bright side, there is space for an ambivalent relationship between the telecoms companies and the OTT as the technologically advanced products and services heightened the demand for broadband connectivity, with inevitable investments which, supported by the telecoms carriers,

might put them in danger as it requires a demand of higher connection prices with a competition much too intense in pricing terms.

Nonetheless, it is correct to assume that telecoms companies find themselves in a sensitive position as they are challenged to invest heavily in network infrastructure, while their profits are threatened both by the new entrants on their originally domains of activity in certain rates, and most certainly by the new regulations on roaming practices at an estimated total rate of €4.7 billion starting with June 2017, amount representing the regional roaming annual revenues, plus additional loses from termination calls regulations. Consequently, the European players are even more challenged to monetize from new inevitable investments in order to maintain enough capital for continuous development in research and innovation.

Vodafone's case

In line with the above mentioned set of three factors of pressure for most of the European operators – steady growth in data transmission traffic on networks, the success of over-the-top players (OTTs) and the fierce price competition among industry players, and the regulatory framework, Vodafone is however differently positioned given the scale and size of the company, therefore its potential to respond effectively.

Accordingly, despite its potential to generate revenue, the market growth in terms of users and therefore traffic, would have created in different cases a short-term pressure on the operators' network infrastructure considering the limited spectrum and high quality and speed requirements. Hereafter, since Vodafone has a well-established position through their extended network infrastructure, one might consider the new market structure as an opportunity enabler with expected US$ 1.1 trillion from an estimated 8.5 billion mobile users by 2020, and about US$ 690 billion from an estimated 2.2 billion fixed connections by the same time. Even though in decline for voice, the fixed infrastructure plays an increasing role in the pay TV section, which represents one of the newest opportunities for differentiation for the company since not all the European operators are well positioned to sustained this segment which requires high-speed networks and high-quality services.

On the competitive side however, Vodafone activates into a highly stimulating European environment with a large number of telecom providers that are able to gain extra positioning on

the market by leveraging size and scale. In addition, the OTTs service providers increased the tension within the competitive environment.

Moreover, probably one of the hardest factor of pressure to control, the regulatory framework continue to have a large impact on the performance indicators mainly by lowering the mobile termination rate fees (fees charged for calls received from other companies' networks) and by limiting the amount that operators can charge for mobile roaming services, sources which in Vodafone's case represent about 10% of the revenues. Soon with the roaming elimination policy, the revenues from one of these two segments will drop completely, but it can be subject of interpretation regarding the impact on company's competitiveness since the roaming elimination will affect all the players in the market and maybe even lead to bankruptcy for some, creating this way new opportunities for the better financially positioned operators.

Finally, the company seems to have established a good position in relation with what others still perceive as a challenge, due to the early response advantage and now due to the innovation capabilities, which allow Vodafone to benefit from the opportunities opened by money transfer, video, entertainment and IoT segments, through its increased mobile network (4G), as well as through the soon-to-come 5G network which is expected to increase operator's performance even more by reducing latency and allowing faster connections with better response times.

Nevertheless, even though the telecom giant does not perceive the same landscape as the most challenging one anymore, company's reports emphasize the existence of wider factors of pressure spread and framed into the same PESTEL view. These are cyber-attacks, failure to deliver convergence, adverse political measures, major enterprise contracts disruptions, market disruptions, electromagnetic field related health risks, unstable economic conditions, infrastructure failure, non-compliance with the laws and regulations, and unsatisfactory customer experience (Vodafone 2016 Annual Report). However, one cannot consider all these aspects among the main challenges for most of the smaller scaled and sized European operators since first of all they are still struggling to deal with the big picture and secondly, since these considerations are not necessarily general applicable but more as a portfolio of own desired actions and fears with the associated risks, designed as key components of Vodafone's organizational strategy, except the common regulatory framework and market disruptions (Vodafone, 2015; Vodafone, 2016).

VII.2 RQ2 Why can the OTTs represent the main challenge for most of the European MNOs' competitiveness in line with the new landscape?

Different from the other factors of pressure which can either be controlled to a certain extent both by the market actors and regulators, or perceived in a less influential manner, the challenge coming from the these multi-sided online based actors or the so called over-the-top service providers (OTTs), stands out for their largely gained competitive advantage in terms of technology, access to market, consolidation strategy and even regulatory treatment, aside from the fact that it represents a non-manageable external factors to which traditional network operators can only respond on the market.

Due to an improved broadband connectivity which provides instant global access to online content, applications and web-based services, allowing equipment manufacturers, application providers and customers to create a shift from physical commerce to e-commerce, traditional network operators are strongly challenged by cross-border and multi-sided actors which no-longer act as substitute but more and more as direct competitors.

The VoIP market (e.g. Skype-Microsft), the IP messaging market (e.g. WhatsApp) and parts of the social networking market (e.g. Facebook) form the OTT communication market along with some other actors such as Unified Communications (e.g. Cisco) and Cloud Communications (e.g. Twillio), and enter into the traditional network operators' market through challenging business models. Hereafter, in a final extend of revenues drop among network operators, the response stands again for the classical competitiveness boost factors explained along the next sub-chapter.

One first argument to support the assumption stands for users' adoption of services delivered over the Internet, in most case by OTT service providers, since the use of social networks, online search and e-commerce has become a daily order, leaving the network operators with less voice and messages consumption, but still with a potential to fill the gap through mobile internet data required by OTTs.

In terms of revenues, the decrease that the telecom operators are facing these days are partially caused by the increased competition brought by network convergence and access regulation on the one hand, and network and services divergence through the position established by the OTT players on the other. Convergence in the sense of the new forms of electronic communication

(via Ethernet or IP/VoIP-based broadband) represents the replacement of network technologies (the traditional cooper PSTN-line for voice and terrestrial/satellite/cable networks for video), while divergence stands for rise of the OTT services which are competing with the traditional communication services provided by the telecom operators.

Such trends as convergence and divergence led towards a commoditization of the telecom businesses where, even though operators differentiated themselves through VoIP and IP-TV, OTT providers have countered with higher quality services such as Ultra HD video streams. However, it is considered that the European Commission will be able to help the European players once the net neutrality will be implemented.

According to ETNO (2016), the OTTS are competing with the European telecom operators on numerous layers such as communications services, video or advertising, and are expected to reach about €125 billion in revenues by 2020 within the EU28 market, which even though is still low compared to operators' revenues, their successful business models and the trends on the market led towards a fast increasing growth rate which is still growing at double-digit rates (30.4% in 2015, 22.3% in 2016, ≈13.4% in 2020). In this manner, year by year, a double digit growth rate for the OTTs will inevitably influence the revenues for the network operators which, as opposed to the new entrants, have reached a certain maturity level on the European market (see Figure 5).

	Telecom services revenues (billion €)				**OTT services revenues (billion €)**	
	Fixed voice	Fixed data and internet	Mobile voice	Mobile data	VoIP and IP messages	Others (social, mobile, OTT video, cloud, , e-commerce commission, online games)
2014	49	73	70	57	0.632	59.568
2015	46	74	65	60	0.824	68.28
2016	43	76	63	63	1.008	78.9
2017	N/A	N/A	N/A	N/A	1.374	88.13
2018	N/A	N/A	N/A	N/A	1.1705	100.13
2019	N/A	N/A	N/A	N/A	1.941	110.26
2020	N/A	N/A	N/A	N/A	2.208	122

Figure 5: Network operators and OTTs' revenues in Europe. Source: ETNO (2016)

In addition, a support argument for the threat dimension brought by the OTT services is framed through the regulatory imbalances between telecom businesses and over-the-top businesses treatment. First, in terms of costs the area of regulation exempts the OTTs but not the telecom service providers for spectrum allotment and use, licensing, spectrum related charges or space related charges. Secondly, there are certain requirements applicable again only for the telecom service providers and not for the OTTs such as proper record keeping including methodology, interconnection of the entails costs, quality of service parameters, obligations under various Telegraph Acts, security conditions, emergency and public utilities, monitoring services. Thirdly, due to the type of business OTT providers have, they are exempt from bank guarantees to the government and they also benefit from the infrastructure owned by the telecom players, which however benefits both parts in a certain manner (Bhawan et al, 2015).

A particularly important challenge the telecom operators receive from the OTT services, is related to their applications, which further create separate challenges. Drawing from a study let by the Telecom Regulatory Authority of India (Bhawan et al, 2015), the OTT applications types and the implications they present over the telecom operators can be structured as it follows:

OTT types	**Apps examples**	**Required speed**	**Challenges for the telecom operators**	**Implications for the telecom operators**
Voice & Messaging	Skype WhatsApp Viber etc.	<1 MBps	Substitute for the traditional telecom operators' services	Segmented competition, voice & messaging revenues decrease
Application eco-systems	Facebook LinkedIn Twiter Instagram etc.	< 1 MBps	Substitute places of communication; strong brick & mortar business type	Loss of revenues from traditional services offered
Content	Netflix YouTube HBO Go etc.	>5 MBps	Network infrastructure improvement	Network traffic congestion

Figure 6: OTT services impact over the telecom operators. Source: author's interpretation

Moreover, not largely approached in the literature, the success of the OTT players has been given mostly by a series of consumer behavior related trends as well as through the impact of some regulatory and technology changes. To this extend, Sujuta et al. (2015) confer from their research that the adoption factors of OTT services are of a cost, convenience, social propensity, content, technology & devices advancement, telecom networks and net neutrality nature.

With audio, video and other media type delivery over the internet, the OTT service providers have managed to bypass the telecom operators. Such providers as OTT players, also known as OTT applications due to the fact that they don't make use of direct business/technology affiliations with network operators, have managed to grown and enter into the traditional operators' market through external advantages given by the smart-devices development, fast IP networks, open source platforms, shift in customer preferences towards "freemium" business models and more recently by European digital market policies (e.g. net neutrality, zero rating), but also through own capabilities such as innovative services and cutting edge functionalities (Sujata, 2015).

Complementary to the OTT businesses growth, consumers' new and abundant behavior has also created the environment for profitable business models which gave the context for the OTT service providers to afford "freemium" offerings for certain apps. Some core elements of these business models have been emphasized by Sujata et al (2015) (see Figure 7).

Business model element	**Description**	**Business entity**
Advertising	Services funded by viewing advertisements or collect data to be sold to advertisers	Google, Facebook etc.
Hardware	Services add value to the device and promote market presence within a specific segment by device ownership	Apple, Nokia, Blackberry etc.
In-app purchases	Possibility to purchase fee-based features such as stickers and audio-video content	Tencent – WeChat etc.
Software license	Bundled services with hardware or offered on a whide-label basis	Microsoft – Minecraft etc.
Subscription	Recurring charge either for basic service or additional features	HBO - TV services etc.
Unit pricing	Revenue derived from off-net calls and messages or termination calls	WhatsApp, Skype etc.

Figure 7: OTTs business models elements. Source: Sujata et al (2015)

Currently, the European telecom actors find themselves in a sensitive position where there are high expectations for next generation networks investments and services, while being under high pressure from both a competitive perspective (OTTs ascension) and a regulatory stance (Net neutrality, zero rating, M&A blockages). OTTs have managed to create bigger margin profit year

by year giving them more power to expand, which they have succeeded until now through one of the most recent voice payments extensions to their platforms.

The impact of the OTT services over the telecom businesses has mainly been related to voice and messaging, hence an impact over operators' voice & messaging revenues, and also in terms of mobile data traffic, respectively operators' data revenue. However, the circle of impact does not resume to these aspects only. Even if it can be seen as an advantage, through their subscriptions of data pack at the telecom operators' network, the OTT applications bring contributions to the operators' data revenue on one side, but are enforcing their position in the market as substitute services offerors on the other, hence creating a threat to the operators' overall revenues.

Communication devices have a major role in the competition between the OTTs and network operators considering that the devices that they offer, especially in teleco's case, often define the decision of signing a telecommunication services contract. The OTTs have strengthening their position for distributing devices with fast dissemination through acquisitions of communications arms or under partnership forms (e.g. Motorola mobile communication arm acquired by Google; Facebook and Amazon's plans to lunch own mobile devices; Microsoft partnership with Nokia). In this sense, even though the threat doesn't seem too big, the such partnerships represent powerful weapons through the technological capabilities that could reduce even more operators' revenues. To give an example, the possibility to install a "soft SIM" is already at OTTs' hands, facilitating users' possibility to choose differently in terms of telcos services.

Moreover, referring to the data traffic, OTT services such as Netflix, Skype, WhatsApp, Viber and many others, are creating congestion to the mobile and cable operators' networks, consequently creating a need for an improved infrastructure.

Conclusively, drivers of strength for OTTs competitiveness to the traditional network operators come on the one hand from their large portfolio of services – voice, texting, media (TV, radio, music), and from their revenues structure on the other, which can be structured in four types: pay to download and operate for free, subscriptions (especially for media content), rental (similar to subscriptions) and advertising. However, in addition to these, OTTs strengths come not only from low prices, but also from diversified and advanced services. A few examples in this sense are the applications conceived for multiplatform system, extended limits of offerings or even

limitless (MNO's SMS carry about 160 characters compared to the unlimited provided by OTTs).

Vodafone's case

Even though, as earlier explained, Vodafone established an early positioning in front of the challenges determined by the entrance of the OTTs in the European market, according to the latest insights publicly available, the company still perceives their impact as a potential risk occurring in two specific ways.

Firstly, the advances in offerings provided by the OTTs could reduce the demand for their traditional voice and text services, and therefore impacting the revenues. Secondly, due to new entrants' investment potential as well as due to their consolidation, the European network operator, and not only, might find itself into a price war in key markets. Therefore, the challenge from OTTs becomes increasingly important in all markets since they appear as alternative services commonly available, with another impact on operator's revenues from the service segment.

Moreover, if around the previous years the risks were directed towards the suppliers and how operators were able to manage the key supplier groups, the new few years will probably determine for the traditional network operators a disruption especially in the new and emerging markets.

VII.3 RQ3: How can the network operators resist the challenge coming from the OTTs?

According to the E&Y (2015) global survey, customer experience management (CEM) has been ranked number one direction of action in proportion of 68%, followed by business efficiencies in terms of cost control and greater customer service & personalization (required by CEM), network upgrades and again organizational agility with a rank of 50%, which are expected to boost client's loyalty and spending, raise CAPEX and improve customer centricity. Consolidation, out of which in-market inorganic growth represented the most important type before entering new industry verticals and geographic expansion, was found by the respondents as one of the last priorities before ending the list in proportion of 25% with new services need

such as TV, IoT services and cloud services. The time past as well as the emerging trends and changes, led however to a change in these percentages and not only.

Consequently, while the study creates a reminder on where the operators' should focus their attention at the end of the day i.e. consumer offerings, the recent events in the industry emphasize that main challenges occur also from a data traffic, competitiveness and regulatory point of view. In this sense, it can be deducted that together with the emerging changes, the technological levier will be exploited at its maximum capacity, thus the appearance of new business models. Arguments in this sense come from 5G's mobile network expected capacity to offer equivalent broadband speeds as the fixed lines with a reduced possibility of congestion, and 5G's use as a core infrastructural element for the IoT, where high-speed connectivity is not a requirement, as well as the expected outcomes of the alternative network access technologies.

To this extend, as a main assumption, considering the historical evolution of their business, the European network operators can consider two main aspects to include in their responsive strategy that concerns the online-based multi-sided actors, and these are: keeping their traditional focus on the network access business and engaging in OTTs' playing field. Both strategies will require however an adaptation to the new conditions and emerging changes and trends, which will stand for the success of the business. In this sense, while the network access part is challenged by the new alternatives, some on which the OTT players are already working on, the engagement into OTT's playing field occurs even more challenging especially due to their financial capabilities.

1. Improve the position on access business to boost competitiveness & opportunities for new business elements and cost efficient infrastructure

Primarily and in tight connection with the access infrastructure, hosting, data storage and security services remain the basic components of the access part, which have and are still benefiting the operators with double-digit growth by allowing them to capitalize on their network and retain customers as well as their data and applications.

The growth in smart-devices usage sends signals of opportunities not only for the network equipment/infrastructure companies, but also for the carriers of wireless and fixed networks. In this context, while in the past the network operators were focused mainly on voice and message offerings, the coming years bring a shift of focus towards areas of higher growth such as the content and IoT. According to Joshi (2016), the upsurge of smartphones has affected two sectors in particular in the telecom ecosystem – the network operators as data providers and OTT/Apps players as data consumers.

Small cells and frequency spectrum

In operational terms, opportunities arise from improved and expanded customer services through the use of small cells to improve network densification, fiber spreading for a better infrastructure and through the use of a more efficient spectrum. Accordingly, given the context of rising data traffic, one way to secure profitability by lowering costs and increasing revenues comes from expansion of the bandwidth and frequency bands, which however determines a more complex communication to the end devices hence an increase is expenditures for the end devices. Next, even though emerging cutting-edge technologies such as 5G are design to facilitate the expansion in bandwidth and frequency bands, the increase in data traffic continues and will probably continue to rise even faster than the supporting technologies, creating the need for an improved infrastructure. Moreover, spectrum ranges supplementation with small cells could lead to a better utilization of the radio signal and higher data transmission rates, together with the heterogeneous networks expansion which will allow application running across devices on either one of the existing fixed and mobile networks. OPEX and CAPEX will therefore be enabled by the integrated carriers once the small cell network will connect to optical fiber, as well as the creation of revenues through new price schemes driven by higher data volume (Detecon, 2014).

Cloud computing and M2M communication type

Next, opportunities in terms of customer preferences control and network efficiency and effectiveness management occur with the new software facilitating platforms which can replace network operators' hardware-based network equipment through technologies such as Software Defined Networking (SDN) and Network Function Virtualization (NFV). If network operators will succeed to create opportunities driven by technology changes and trends, by maintaining the

focus, the rewards will most probably be optimized year by year considering the global market growth tendency of technology based business segments such as Cloud computing, M2M and IoT (see Figure 8).

In the context of growing use of cellular data, which increase mobile operators' costs, and revenues drop caused by the internet based services (OTT) which create high competition to the telecommunication services, the telecom operators find themselves in a time to implement value-added-services (VAS) and new strategic moves in order to remain competitive. Considering such factors, the cloud service concept has started to spread into the telecommunications industry as a response to the threats and to the changing market and it is recognized since 2010 under the name of Telco Cloud.

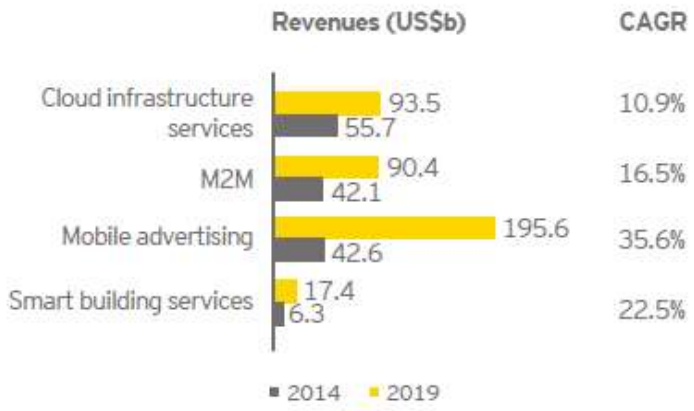


Figure 8: Global market growth tendency of TMT segments. Source: E&Y, 2015

Within the European market, only the large operators are considered capable to offer infrastructure as a service, software as a service and content as a service (IaaS, SaaS, CaaS), in general due to capital possibilities, competing power or addressed marked size. Cloud services offerings however are often based on a fixed connection which cloud services providers sell to the clients packaged with broadband plans, resulting in a need for carriers to integrate themselves both in fixed and mobile. Otherwise, with mobile connection only, the offering will be restricted to storage, sharing and accessing personal content like video, music, documents and email. Hereafter, the telecommunication systems providers can be the initiators of differentiation by enabling combined and innovative solutions such as the cloud computing, and extending afterwards their services to the telecom operators to help them operate more efficiently and keep

up with the multi-specialized competition. The providers themselves should extent their business by entering in strategic partnerships (see Ericsson and Akamai merger).

In terms of benefits, the 'Telco Cloud' is seen as one of the most important emerging infrastructure investments telecom operators should do as it reduces the complexity which further lowers the running costs, increases the efficiency of the resources, reduces the urgency of introducing new services in response to the OTT threat and supports a dynamic ability to respond to the demand amount. Moreover, the promising infrastructure of the cloud platform will bring extra contribution to the robustness, performance, security and interoperability for telecommunication applications, by minimizing the costs as presented by an Ericsson team of analysts (Basilier, 2014).

Bottom line, the above presented opportunities stand for the advantages provided by the up-coming network generation (5G) which will provide boundless, high-speed, reliable and secure connectivity for a plethora of use cases within the society in combination with the existing network technology and infrastructure. It emerging challenges however will stand for finding profitable business models, manage the scarcity of the spectrum resource, keep up with technology and prepare for improvements, avoid fragmentation in terms of spectrum, technology and operator services, and lastly make lobby for a business encouraging regulatory framework (GSMA, 2017).

Lastly, resistance to the existing challenges has at its core network, organization and processes development as it determines higher quality in terms of network coverage and access speed which is the essence for which customers are willing to pay for. In this sense, the current telecom industry situation in terms of network architectures counts four major trends: *fixed and mobile convergence, static and dynamic architecture paradigm, IT and network technologies convergence which further determines the later network layers convergence need.*

Fixed and mobile convergence (FMC) (as network and organization improvement)

In line with the new landscape it occurs that, among the few strategies to survive on highly competitive markets, network operators have the options to divest their network and operate as resellers or mobile virtual network operators (MVNOs), or move towards an integrated heavy assets carrier status (fixed and mobile network convergence). In order to do so however, carriers

should first overcome the emerging challenges related to extra resource gathering and securing long-term profitability through a good customer positioning in order to accomplish one of the two options.

Other than the two options, a company will probably have to consider the exit option, following the example of Vodafone which have left the US market with its mobile network and moved to Germany by acquiring the KDH cable television operator (Bloomberg News, 2013).

Generally, FMC refers to a combination of fixed (usage of wireline or wireless local loop delivery system) and mobile (usage of cellular wireless system) services, networks and commercial practices, and has several categories of drivers such as technology, telecommunications hardware and software providers, users and regulations.

The results of such an eventual fix-mobile network convergence could produce increased efficiency and economies of scale from capital and operational expenditures optimizations (CAPEX, OPEX). The OPEX model would reduce the focus on refinancing of the networks and increase it on achieving the greatest spread between the costs for the advance services of the wholesale carriers providing network capacities and the retail prices which can be realized on the market in conjunction with OTT partnerships. As a sort of opposite, the CAPEX model is based on a long term view with networks as hubs of business decisions and focus on improving efficiency in the allocation of both CAPEX and OPEX for the networks, the full utilization of network capacities and the increase of revenues. Integrated carriers must here justify and quickly refinance all of the investments related to the networks by generating sufficient revenues (Fernandez & Stol, 2015). In addition, a FMC will also determine a reconfiguration of the telecom value chain through a combination of fixed and mobile value chain specificities - flowing backward, dismantling, integrating, eliminating and inserting, of which only backward, integrating and inserting seems to be applicable (Yang et al, 2014). Such an output of the FMC has received little attention and therefore it is highly important to be considered.

In a long run, in order to resist on a competitive market, it is indicated an integrated fixed network with full area coverage and a mobile network infrastructure (heavy assets) in antithesis with a mobile network operator (MNO) only which are seen less and less competitive. Becoming integrated carrier can be reached either by divesting a company’s own mobile network and

utilize one of a third party becoming a virtual network operator (MVNO – light asset) or, depending on the saturation of the market, by building/acquiring a fixed network turning the company into an integrated provider.

Static and dynamic architecture paradigm (as process improvement)

Associated with process automation within the future network, the static and dynamic designs are necessary to drive efficiency by avoiding manual interaction which is generally related to a decrease in operational expenditures. The dynamic type acts on the avoidance of static configuration and data which is dynamically gathered from the network and further determines a re-configuration, while the static type acts in contrast to avoid changes at all (Detecon, 2014).

IT-network technologies convergence & network layers convergence (as network improvement)

According to Detecon (2014) a major impact over network operators' success can come from the convergence of IT and network technologies which stands mostly for the introduction of IT principles in the network domain such as *open source, virtualization, open and standardized interfaces with no vertical integration of hardware, operating systems and applications (e.g. SDN).* The software defined networks (SDN) stand for a three-layer separation of the network architecture into network infrastructure, network control and application layers which, once converged, can determine simpler and cheaper network devices, increased granularity of control of individual traffic flows and a network abstraction which represents the key to handle complex network infrastructure.

2. Engage in OTTs' playing field

2.1 Financial leeway through new business models (a) and strategic partnerships (b) to support sustainable growth and increase competiveness

Considering that not a single European telecom firm appears listed close to the most valuable internet business brands which are strongly entering their market, it becomes essential for the European actors to reinforce their position in order to meet the level of competition. Also, even though at the moment, the percentage of "stolen market share" is still insignificant to be

considered a big threat, the telecos' revenues are dropping, decrease which it is not determined by the OTTs' entrance but also by the regulatory new framework through the termination calls fees limitation and elimination of roaming. Consequently, it appears naturally for the European network operators who have not responded efficiently and effectively, to produce changes in their business models. Therefore, in addition to cost efficient infrastructure and operations, and taking advantage of the new technologies, the changes should revolve around aspects such as personalization of service suites to meet customers' experiences, market consolidation and 'co-opetition', which will stand for better business models and higher revenues implicitly.

On a short term, such an active focus will definitively attract considerable investments leaving the companies financially vulnerable, but on a long term the returns will be on the measure of the efforts in the battle to keep up with the global trends in the sector. There is also the option of spreading the investments over a longer period, which might seem appropriate for the smaller network operators, but for the leading actors, doing so might led to a loose of valuable time in the battle for market shares. In addition, for the smaller operators not facing the competition level, there is also the option of co-opetition or consolidating intelligently.

a. Personalization of service suites to meet customers' experiences and needs

Considering probably one of the most relevant behavioral trends among consumers within the industry i.e. flexible consumption, it is critical for operators to have a good customer experience management in order to create offerings that combine what consumers want at competitive prices with attractive side-offerings. Therefore, to meet the expectations, platforms design for bundling apps, information, entertainment, shopping and communication services might be needed, complemented by a good customer support, as well as suitable for any device and location considering the big steps taken for an European digital single market.

New business models would probably be necessary for the telecom operators to keep up with the investments requirements determined by the growing data consumption. In addition to the above mentioned possibilities, prioritization of the most requested elements (e.g. video content) or other sensitive services with higher prices, while keeping a modest fee for the traditional services to assure fixed revenues might represents successful solutions.

Moreover, since network outsourcing and infrastructure sharing activities became too mainstream among providers in the attempt of reducing the costs, reshaping the business models for a sustained economic growth and improved customer experience appears as a potential solution in network operators' attempt to resist the emerging challenges driven by the ascension of OTTs, next to the opportunities opened by the technological changes and market trends.

In contrast to the tariff model which determines the costs based on the volume and time of utilization, European consumers still face the problem of flat rates which often leaves them with unconsumed but paid services on the one side, but with the insurance that phone calls, Internet usage and data traffic volumes are not billed and speed of data transfer is not reduced.

The existence of flat-rates models has been maintained by the entrance of MVNOs, which left opened an opportunity for the network operators to monetize their services on the retail side.

Emerging business models

The Quad-play integrated business model

In line with the network convergence trend, which has been proved that opens the door for new business opportunities it seems that the mobile operators are increasingly interested in broadband network as it presents potential for a combined fixed–mobile phone calls, internet access and large content channels known as the "quad-play" business type. As explained in The Economist by James Barford from Enders Analysis market-research firm, it is believed that customers of such a bundled model would probably be less likely to switch providers (The Economist, 2014). However, the profitability of such a model is questioned since there are no strong evidences of such a behavior. Nevertheless, in case of new behavioral trends, the possibility to create such a model exists and has started to be framed once with the operators' moves for a converged network. Specifically, since Vodafone's acquisition of Kabel Deutschland cable-television firm in 2013 or SFR' (France's second biggest mobile operator) merger with Numericable Group, the European network operators have started to prepare the frame bundled services which are now quickly arising as strategic moves to keep up with the competition brought by internet-based actors.

Since the fifth generation network is expected to solve the issue of increased data traffic and higher quality demands, the adaptation of the new technology by the network operators leaves nothing more but another reason to enter into a partnership with the OTT service providers due to, as earlier presented, apps' great use for customer acquisition and retention.

Service Bundling collaboration approach

Simply referred as a strategy of marketing products/services in a special priced package (Venkatesh, 2009), a collaboration between OTT service providers and operators might end up with a better establishment of OTTs' presence on a market through faster 'time to market' and visibility, and a generation of increased revenues for operators due to OTT service popularity on which consumers are willing to pay if it comes with improved accessibility.

Sponsored Data collaboration approach

The sponsored data approach transfers sponsoring from the content providers (OTTs) to the data usage providers (operators) in return of priority to qualitative data traffic on free-basis to the OTT service users, which can translate into the following benefits:

Benefits for the OTT service providers	**Benefits for the operators**
Promotion of their services Enhanced consumer engagement Possibility to monetize services through enhanced customer engagement Possibility to create customer loyalty programs Creation of cross-selling opportunities by guaranteeing better quality of services Increase customer stickiness leading to new revenue generation opportunities	Transformation of data delivery channels into revenue generation assets Increased average revenues per user and enhanced perceived consumer value Data charges resulting from direct billing to sponsored OTT players Enhanced engagements translated to subscriber satisfaction and retention Pre-paid to post-post conversion by premium sponsored data offer on post-paid subscription

Figure 9: OTT-operators collaboration through Sponsored Data Model. Source: Joshi (2016)

Platform collaboration approach

The collaboration platform involves resources sharing by both operators and OTT (e.g. monetary resources) to develop applications and services, which are further expected to produce common revenues (Figure 13). Moreover, throughout the common platform, operators can benefit from

OTT services' market, while OTT service providers can access network capabilities to create operational efficiency.

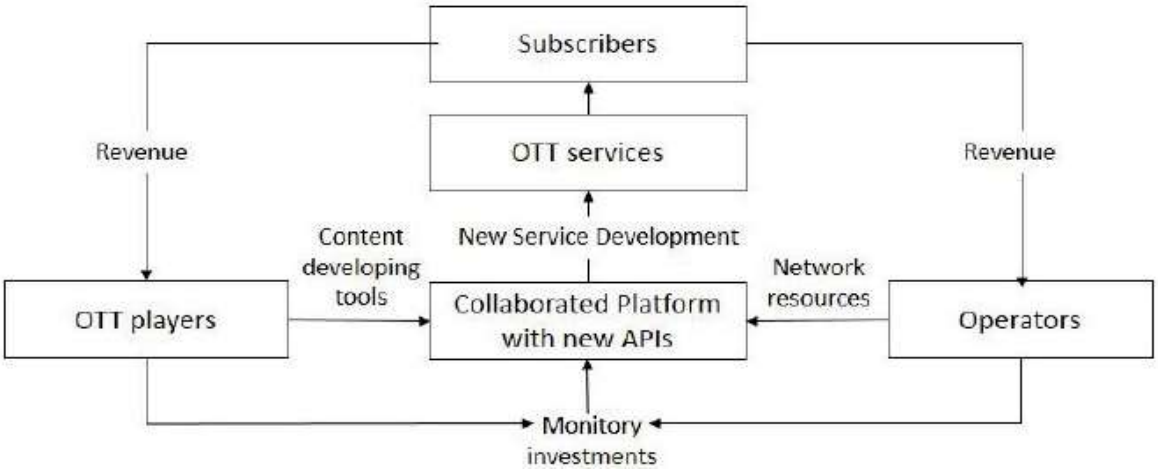


Figure 10: OTT-operators Collaboration Platform Model. Source: Joshi et al (2016)

However, there is also operators' alternative to invest in own OTT applications, which appears at comparable advantages. Through acquisitions or development from scratch, operators could create a multi-sided business model to start competing with the OTT service providers directly on their business segment. In this sense, given the fact that all the European operators are being affected, they could create a fraternity in order to reduce/eliminate the threat to develop similar or improved services and change consumers' behavior. In the end, even if such a move will not be the fastest way to obtain results, it can be a long-term successful plan to enable profitability.

b. Market consolidation and co-opetition

Going back to E&Y's study on global telecommunications, it is important to mention that, while some respondents emphasized the potential of OTTs to change demand scenarios and decrease telecom operators' market share, others have mentioned opportunities are coming from the OTT service providers in terms of video-based partnering and consumers interaction learning, which can further be used for the most important strategic action the operators need to succeed – customer experience management (E&Y, 2015).

Studies of Joshi (2016) and Deloitte (2017) emphasize the still remaining opportunities for M&A once with the deregulation process within the European Union, which can contribute to strengthening actors' resources for upgrades (transition to the fifth generation mobile network

connectivity infrastructure), funding areas of growth potential (IoT, industry verticals, further expansion) and even strategic repositioning to generate new revenue models (network operators-OTT partnerships).

The fusions between the IT sector and the telecoms left a door opened for B2B activities, where the telecom operators can enter and create revenues opportunities shows a McKinsey and company report (Diehl et al, 2015). In this sense, telecom operators have started to acquire and invest in IT companies (e.g. KPN's 2007 acquisition of Getronics) in order to promote growth within the ICT area and related network, leading to a more harmonized cross-sector industry with no boundaries between voice and data, mobile and fixed or telecoms and IT. Accordingly, as presented by the GSMA Association, operators' global investments in venture capital and start-up companies almost tripled between 2014 and 2015, reaching an amount of $3.2 billion in the developing markets and about $5.8 billion in the developed markets, which reflects the ongoing shift in the mobile ecosystem.

Considered not very aggressive but still intelligent moves, the "co-opetition" models such as cooperative ventures and market consolidations, are both seen with potential to create financial leeway. In this sense, following the market events such as Telefonica acquisition of the VoIP provider Jajah or Telekom acquisition of the web hoster Strato and payment provider ClickandBuy, it is highly probable that the number of actors within the ITC sector will be reduced, while the other will enforce even more their position, critical need considering that the OTT players are valued way better that the telcos. Such new positions will free the cash flow to accelerate towards new growth plans for B2B2C platforms or focus the attention even more towards similar offerings as the OTTs have.

In addition, IT-telecom fusion trend lead industry experts to think that B2B offerings will soon have an extensive growth for several reasons which mostly relate to the technological trends which might have some positive implications over the telecom operators in case of partnerships with the IT sector.

First, given the *ubiquitous internet-based connectivity*, growth opportunities might occur from IP-based solutions i.e. managed Internet Protocol (IP), private branch exchange systems and

Voice over IP (VoIP). Moreover, by partnering with IT businesses, telecoms will integrate important future capabilities in the field such as software capabilities.

Second, by extending the offerings portfolio with *unified communications* and cross-platform integration such as desktop videoconferencing, telecom operators can create opportunities to reduce costs and increase the market share by making more complex offers.

Thirdly, maybe one of the most influential factors over the future of telecom industry which is related to the IT sector is the *cloud computing*. This opportunity occurs especially due to cloud's potential to offer a secure and private space of shared infrastructure which can help telecoms operators in relation to incident management, security and disaster recovery.

Lastly, telecoms players can add value to their business by stepping outside their core business and leverage their networks assets, customer base or cross-boundaries field force through strategic partnerships in *a new wave of mobile services* such as Machine to Machine (M2M) applications which represent an important part of the B2B activity.

Among the solutions proposed by various authors for telecom operators to reduce the threat brought by OTT services, there are only a few that can be considered implementable, while the rest come in contradiction with the new European Digital Single Market regulations such as blocking OTT' services (Sujata et al, 2015).

Comparatively, while OTTs are challenged mostly by the quality of services and a need for monetization, the operators are under pressure from OTT ascension and data traffic, which further influenced a decrease in revenues (caused by fierce competition, decline in voice ARPU and regulatory tariff policies) and an increase in costs (determined by investments in network coverage and infrastructure improvement to resist both the growth in connections and data traffic, and to deploy higher speed mobile broadband networks). This represents an appropriate context for both network operators and OTT players to consider entering into a partnership due to the potential synergism to retain more value from the market, as it has also been presented by scholars such as Aidi et al (2012), Sujata et al (2015) and Joshi et al (2016).

Firstly, on the costs side, network operators intend to charge bandwidth hogging (associated with large content "downloading"), highly specific for OTTs applications, will determine cost

pressure on OTT as they might further react through cutting bandwidth costs and hence compromising the quality of their services (e.g. video, music), which will lead to lower customer satisfaction and an increase in churn (customers drop).

Secondly, drawing from Joshi's (2016) work on revenues sharing models, the main areas of consideration for an eventual partnership between operators and over-the-top service providers include *Service Bundling, Sponsored Data and Collaboration Platform (Application Program Interface resource sharing),* design to ensure operators an increase in their average revenues per user (ARPU) rates and subscriber base by acquiring and retaining more customers through the help of OTT services on the one hand, which will further be reflected into faster and qualitative OTT services, hence an increase in revenues for both sides.

Last but not least, apart from costs and revenues modifications, network operators and OTTs can create the path for an increased service innovation by benefiting each other from own capabilities and information portfolio. However, this idealistic scenario is far from happening considering that the OTT groups are already expanding into the infrastructure business through optical fiber networks and satellites.

2.2 Advocate for certain regulatory framework modifications

Among the regulations with the most impact over the telecom operators, over 60% of the respondents from the study conducted by E&Y in 2015 have agreed that spectrum release, data privacy & retention and net neutrality represent by far the areas where sensitive issues occurs, closely followed by wholesale access pricing, mobile roaming and termination rates (Figure 10). In this sense, the industry experts pointed towards the necessity of a level playing field where operators and OTTs are subject of the same regulatory treatment.

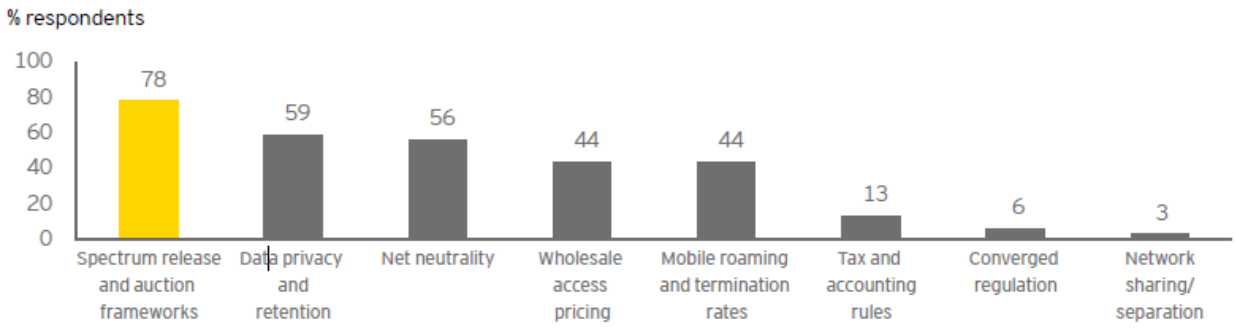


Figure 11: Operators perceptions of evolving regulatory issues. Source: E&Y, 2015

Level playing field

According to the European Parliament Policy Department (2015), the telecom-OTT debate for a level playing field raise important questions around the scope of the sectorial legislation. Specifically, telecom companies are under more stringent rules in relation to consumer protection, privacy and sectorial levies than the OTTs.

In their paper, Bhawan & Marg (2015) discussed the proposal of creating new a regulatory framework for the OTTs which would classify them as either Communication Service Providers (CSPs) or Application Service Providers (ASPs). In such a context, OTTs as CSPs would open them for proper interconnection with other service providers and determine to offer quality of services (QoS) to the end customer. In addition, licensing requirements terms (e.g. lawful interception, security of the network, fee payments) and will also be changed, making the OTT players similar to the traditional service providers (TSPs). Alternatively, OTTs as ASPs will imply a direct connection between the OTTs and the TSPs for different offerings provided through the telecom operators' network under licensing authorizations, and will create a more regulated status quo.

As opposed to Bhawan & Marg (2015), Diane Mullenex (2016) from Pinsent Masons with her expertise within the telecom industry legal frame, stated in an official communicate that the classification of the OTTs with similar treatment as the TSPs would be just wrong as their delivered services are different in many ways. This delimitation has also been emphasized by other filed researchers such as Savin (2015), who classified the structure of the Internet into the bottom layer composed by physical structure (copper, fiber-optic, cable, wireless infrastructure), the middle logical structure layer (domains and protocols) and the top layer which covers all the applications that run on the Internet, each being differently nationally or internationally regulated.

Instead, the law expert Mullenex suggested a three-step approach to regulate the telecom market and its actors – elimination of outdated regulations for the TSPs, introduction of careful crafted updates for both OTTs and TSPs and encouragement of more agreements between the two sides in a legal frame. With these measures, funds raising support would be created for the telecom

operators, increasing their potential to invest in next-generation networks and maintain the willing of rivals to innovate new services.

Finally, the European Commission's position on this matter is reflected in the 2017 Digital Single Market Strategy were better access conditions for consumers and businesses, a level-playing field for digital networks and a maximized growth for the digital economy are given as the main steps the EU's lawmakers want to implement within the next period. Hereafter, while the first step does not present too much relevance for the topic under discussion, the other two directions of action reveal on one side the necessity of a level playing field required mostly by the unfair but legal treatment of the OTT services providers, and the potential of economic growth due to the increased flow of data on the other side. More aspects related to the proposals can be found on the European Commission's Digital Single Market Strategy COM (2015) 627, 634, 635 and COM (2016) 283, 285, 287,288, 289.

Accepting the idea that OTT businesses benefited from a great ascension, many studies have failed however to show whether there is a clear preference for OTT services in front of the traditional electronic communications services (ECS) or not. In this sense, Arnold, Schneider & Hildebrandt extracted from a consumers' behavior study led with a sample of 1000 people in Germany that "although 78% consumers use OTT services, only about 39% substitute ECS with OTT services, while the others use both complementary" (Arnold, 2016).

Beyond their business models' differences, traditional ECS and OTT services diversify also by the nature of compliance with the legal framework, regulations which largely apply for the telecom sector than for OTT businesses with virtually legacy infrastructure and no ex-ante regulations within most of the countries, hereafter, making a re-evaluation of the role of regulations to the OTT services might be necessary if one would convince the substitutable character of the OTT services for ECS. In this sense, authors such as Karkoski (2011), Cecere (2012), Kekolahti (2015) or Gerpott (2016) have tried to empirically find indicators of substitution but none have been able to come up with strong arguments.

To this extend, it is critical to take into account the extent to which OTT services can be considered similar to the traditional services in order to determine whether or not can enter under the same treatment. Moreover, a balance should be considered regarding the feasible and non-

feasible modifications as the EU might not impose obligations to the OTTs which are predominately entering under US jurisdiction.

Vodafone's case

Even though most of the following aspects are not a direct reaction to the challenges brought by the OTTs on operators' activity, especially in Vodafone's case which is a leading player on the market, the end result of such actions represent a way to enforce the overall position on the market and consequently, respond better to the emerging challenges. In this sense, the discussion includes the set of major moves that the company made in the previous years and the plans involved in and made for the following few years that can definitively be considered as a referencing point for the way the European network operators can respond to the challenges brought by the over-the-top service providers (OTTs).

Analyzing company's it occurred that the business model can be split into (i) investments plans that put accent on superior network infrastructure and bread of services; (ii) understanding the marketplace by considering the fast-moving industry generating many new opportunities and adapting the responses by focusing on services that make a difference to the customers, all contributing in the end to a more efficient customer service and personalization, as components of the customer experience management (CEM), mostly in terms of costs and quality which intent to determine a higher customer loyalty and spending, as well as improving customer centricity with final effects on company's key performance indicators.

i. Investment plans

With reference to the superior network infrastructure, during the last couple of years, the company has firstly made a 7.7 bn pounds investment for spectrum and mobile network through 300,000 new base stations sites, acquiring spectrum and licenses to use radio frequencies that deliver mobile services. By increasing the spectrum holdings, the company created a boost in network quality and capacity to carry more data, facing this way the growth in data traffic challenge and also offering customers wide coverage, both indoors and outdoors, with reliable connection and high-speed data transmission.

Secondly, within the same period, 15 bn pounds went for investments in acquisitions, building and rental of fixed network businesses covering cable, fibre and cooper networks, with the purpose of enabling TV, broadband and voice services. Notable consolidation strategic moves include the acquisition of cable companies KDG (in 2013) and Ono (in 2014) to meet the high demand for converged services, resulting in a migration towards company infrastructure of mixed an mobile customers, and combining backhaul and core networks and rationalization of back office functions and procurement. In 2016, Vodafone made a 50% shareholdings joint operation with Cornerstone Telecommunications Infrastructure and a 42% shareholdings JV with Indus Towers, both activating in network infrastructure, as well as a 50% shareholdings JV with the network operator Vodafone Hutchison Australia. The company has also managed to increase the service revenue with 0.6% and obtain a 3.1% growth for the adjusted EBITDA due to the 50% shareholdings Vodafone-Ziggo JV, which strengthened the footprint given the convergence and cost discipline (in Europe); increase service revenue with 7.7% and get a 13.2% growth for the adjusted EBITDA from the Vodacom and Safaricom 40% shareholdings association, which determined simplification due to customer and data usage growth (in Africa); and, as a reaction to the lowered unit price caused by competitive pressure, create a 45.1% shareholding merger with Idea Cellular, leading to the creation of a new digital leader in Asia.

Thirdly, 4.2 bn pounds were directed towards upgrading IT systems through standardization and simplification of the processes, resulting in an enhanced customer services at all touch-points (store, phone, online) and an improved portfolio of services with offerings such as single bills for converged fixed and mobile price plans, and cloud & hosting for enterprises. Company's intentions have to been to make a 65% transfer of IT applications to the Cloud and consequently determine a 40% reduction in data center costs.

Referring to the investments in the breadth of services, Vodafone added to the core mobile business one the one hand, a wider range of communication services including TV, fixed broadband and landline calls, as well as a wider range of services such as mobile money services (e.g. M-Pesa), cloud & hosting, and M2M connections via the IoT service line. On the other hand, the company improved the sales channels such as branded stores, distribution partners, third-party retailers, online for its 92% individual/family clients, as well as the direct sales teams,

indirect partners and telesales channels for the 8% rest of enterprise clients. In addition, the company made available 24/7 contact centers in all European markets to respond their needs.

ii. Understanding the marketplace

In terms of marketplace, the company emphasized the fast-moving industry tendency and associated challenges, but also underlined the emerging opportunities. Accordingly, the data usage from company's customers grew, putting pressure on the infrastructure capabilities; the revenues from fixed voice continued to drop as users switched to using mobile and fixed broadband; the OTTs enabled complementary app-based services that reduce operators' market share; and the regulators have continued to lower the mobile termination rate fees, while getting close to completely eliminate the roaming incomes in Europe.

On the bright side, some of these trends have opened the door for differentiation since not all operators are well-positioned to make the necessary investments. These include business lines such as mobile money transfer, video, entertainment, M2M communications, and possibilities to upgrade the quality and pricing of products and services through the investments in network advancements such as 5G and fibre broadband that facilitates the introduction of the new business lines. Given its positioning, the company expects a number of 8.5 bn mobile users and 2.2 bn fixed connections by 2020, enabling more mobile data usage and adjacent non-core services that will boost company's revenues and returns on investments.

Complementary, by focusing on the services that are expected and occur to make a difference to its customers, Vodafone effectively responded to clients' demands on download speeds, data offerings, converged services and enterprise communication environment, through efforts on developing the next generation network (5G), developments and acquisitions of hardware, spectrum & licenses, and improved service portfolio that are expected to solve both the speed of uploading/downloading and data offerings, as well as enterprises' adoption of digital ways of working such as pre-integrated fixed, mobile and cloud services with simple, predictable and transparent pricing.

Finally, as plans for 2020, beside leading in Net Promoter Score (NPS) perceived as the most important indicator of customer experience, as well as gaining profitable revenue market share in total communications, increase adjusted EBITDA to +4-8%, free more cash flow to about €5 bn

and grow dividends, the company established its attention on 3 main areas. The first one covers core communications (converged in Europe, mobile data leader in emerging markets and enterprise leader internationally), increased digital businesses (enterprise IoT - smart metering, automotive, logistics, started in 2007; data analytics for personalized real time offers launched in 2015; and customer IoT - bike/scooter tracking, family tracker, home security, prepared for launching in 2017), and technology and cost excellence through fibre, 4G+, 5G, and cloud & virtualization.

The second objective is to remain Europe's largest broadband company; improve monetization by offering various packages of benefits with accent on data and on 4G's growth opportunities; accelerate fixed-mobile convergence for digital, analogue and Vodafone Ziggo TV consumers offering live TV, connected screens, content in the Cloud, on demand possibilities, competitive premium content portfolio and partnership model for exclusive ownership; grow the number of enterprise clients for IoT, cloud and hosting and IP-VPN network.

Thirdly and finally, the company aims at leveraging global scale with local flexibility and talent through business process outsourcing (BPO) and shared service centers (SSC) decisions.

Overall, the total re-investments in the business counted about 47 bn pounds in the last three years, through capital expenditure, acquisitions and spectrum & licenses, enhancing the networks and competitive position, resulted in a generation of 11 bn pounds returns to shareholders in normal cash dividends. Out of these investments, about 19 bn pounds were found in the "Project Spring", a program for accelerating mobile and fixed developments, IT systems, products and services, and the retail platform, designed to secure premium position in most of the markets where the company activates, while another significant amount was attributed to the "Customer service excellence program". Accordingly, free cash flow increased to € 4,056 m in FY 16/17 compared to € 1,271 m in FY 15/16, while the returns for shareholders counted almost five times more dividends.

VIII. DISCUSSIONS OF RESEARCH FINDINGS

In light with the main landscape that challenges the European network operators' competitiveness, the factors of pressure identified in the research indicate that the steady growth in data transmission traffic on networks, the success of the OTTs and the fierce price competition among industry players, combined with a non-neutral and severe regulatory framework, represent the top challenges for operators' competitiveness.

Partially, such findings have been pointed out within the existing literature, to provide an analysis of the impact such factors have on the network operators. However, very few have had the core purpose of underling the combination of factors in addition to the main ones affecting network operators' business in a European context, as well as the emerging opportunities determined by the changes and trends in the market. To this extend, this paper differs but supports and is being supported in the same time by previous findings that more or less direct underline the challenges, opportunities and required reactions in a changing market following a set of well-defined trends.

Accordingly, the data traffic increase creates the need for infrastructure improvements, therefore new investments in a time that has seriously affected operators' revenues as a result of OTTs market share "stealing" through much cheaper customer offerings, termination call fees reduction, elimination of roaming monetization possibilities and as a result of the continuous price battle among the top network operators. The strong entrance of OTTs on the voice and messaging market has reduced drastically operators' potential to maintain the level of revenues determined by the two segments that once represented the core business, leading to a switch in network offerings focus and adjacent services. The new focus led to the thought that the network operators are sequentially entering into a core business are where their position might not be so strong as it was on the traditional core business in the previous decades. To top it all, the European regulators, even though are working on the creation of digital single market where the network operators could play major key roles, are challenging operators' monetization models by, in some cases, reducing operators revenues on some practices (e.g. roaming, termination call

fees), with the sole intention of creating a better European communications framework as explained in the official communicates.

Out of these main pressures, the research emphasizes that the challenge coming from the so called over-the-top service providers (OTTs) may be considered the most influential if not responded appropriately, given their largely gained competitive advantage in terms of access to market, consolidation moves and even regulatory framework in the European scenario, as well as their evolution to both substitutes and direct competitors, threatening not only operators' revenues but also services themselves.

Consequently, as a response to the threat brought by the OTTs, improving the position on access business to boost competitiveness, enter strongly on the adjacent industries and OTTs playing field, as well as maintaining a cost efficient network infrastructure, together with the creation of financial leeway through new business models and strategic partnerships to support sustainable growth and increase competitiveness, represent a collection of efficient and effective actions that the network operators took, take and can take, as exemplified through Vodafone's case, in order to reinforce their position on the market no matter the threats, that come in line with what other scholars have considered to be appropriate at the time and in the context of their studies.

The new form of the Value Chain

Moreover, in line with the new value chain and the expected modifications for the next couple of years, the operators will probably be also more involved into the B2B transactional type, increasing the portfolio of clients, hence the financial possibilities. Further, due to own and industry technological advancement, operators can improve performance through the existing fixed and mobile infrastructure which can be used to support the IoT.

Considering the implications of the Next Generation Network (5G), the telecommunications industry's value chain will most certainly suffer modifications that will have at their core the emerging developments such as Cloud Computing, Vertical Industries, Satellite Network Access, but also new players which will enter due to such developments – Bundled Network Access Providers, Cloud Computing platforms providers or Internet of Things actors (see Figure 14).

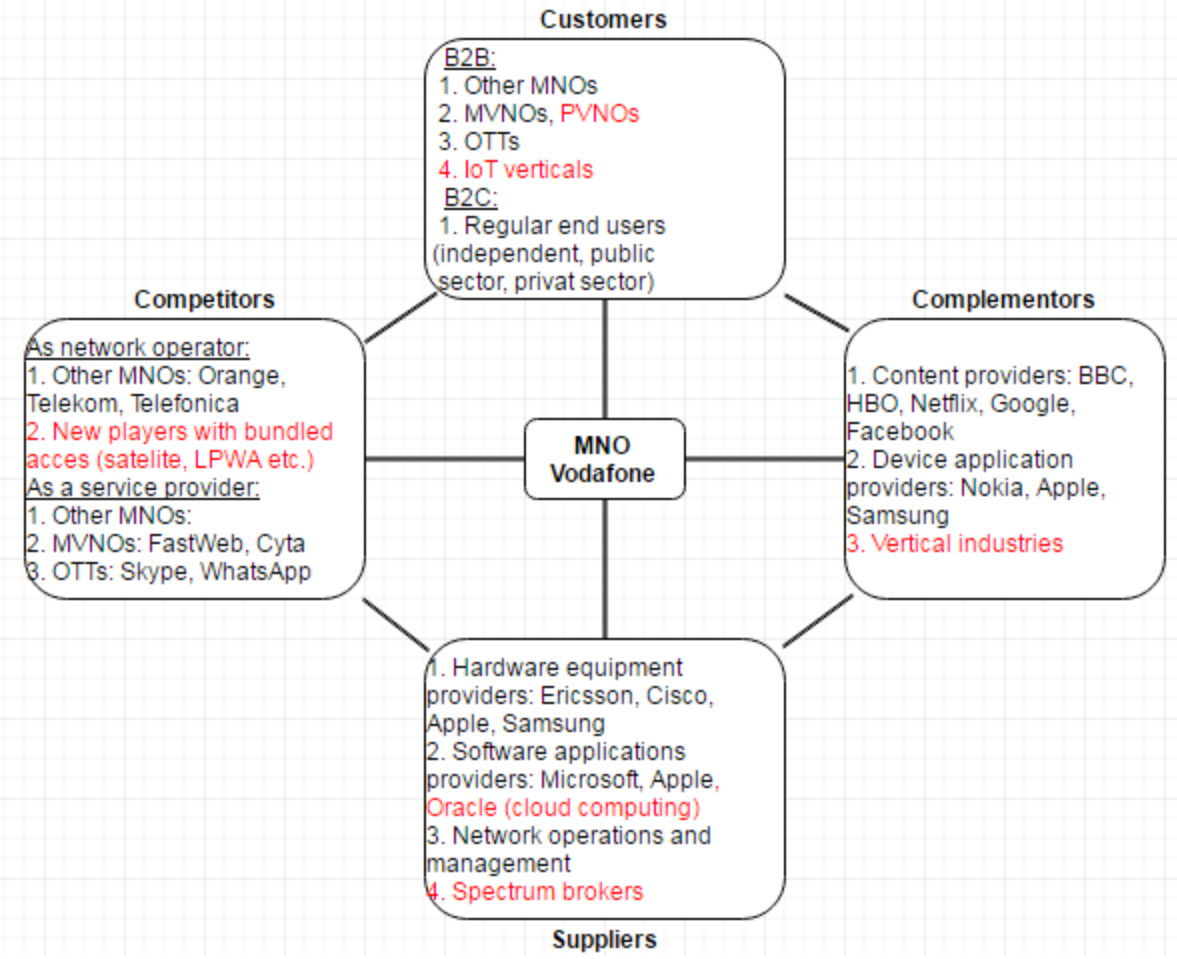


Figure 12: New form of the Industry Forces based Value Chain. Source: the author's interpretation

As presented by the world's first developers (a Dutch utilities company in collaboration with a software company and system integrator) the Private Virtual Network Operators (PVNOs) will address to the M2M type of communication the SIM cards with a Mobile Network Code, which will probably be supplied by the operators or their competition, making the PVNOs potential clients (BMI Research, 2016). Further, the vertical industries which find themselves within the IoT area represent another new potential category of customers for the MNOs as the verticals will need to provide direct connectivity to their customers, making them also complementors to the MNOs.

On MNOs competitive side, the challenges appear from the increased number of space units developed within different countries through private-public partnerships (PPPs) to provide alternative network access, which fortunately for the carriers still represents a costly approach. However, increased competition will probably come from other alternative network access

developments such as the Low Power Wide Area (LPWA) networks which will support the M2M communication type with cellular networks.

Next, within the supplier area, the evolution of spectrum regulation and the allocation of new bands under various schemes might open the door for the so called 'spectrum brokers' within the value chain to facilitate the management of the spectrum on behalf of the MNOs. In addition, the new platforms (Iaas, SaaS, PaaS, XaaS) developed by companies such as Oracle will play an important role on the supply side along with the evolution of the Cloud Computing. ….complete

Europe vs US

Comparatively, while the US saw a healthy growth the mobile network operators, the European ones struggled because of market's fragmentation, the EU policies and regulations which despite the intent of creating a level playing field to satisfy everyone, have brought a serious damage to the operators or the lack of network investments driven also by the above mentioned factors. These are complementary drivers for investments to the estimated growth in data traffic which will reach 6.2 ExaBytes per month by 2020, approximately 8 times more than in 2014 (Ericsson, 2015). However, the market consolidation project soon implemented by the European Union bodies creates hope for an overall recovery of the European telecom industry despite its major gaps, largely emphasized along this project.

Strategic options to secure profitability

In the context of rising data traffic, one way to secure profitability by lowering costs and increasing revenues comes from expansion of the bandwidth and frequency bands, which however determines a more complex communication to the end devices hence an increase is expenditures for the end devices. Next, even though emerging cutting-edge technologies such as 5G are design to facilitate the expansion in bandwidth and frequency bands, the increase in data traffic continues and will probably continue to rise even faster than the supporting technologies, creating the need for an improved infrastructure.

A second direction of securing profitability relies on the Wi-Fi, convergent/heterogeneous networks, small cells and up-coming upgrades (e.g. Li-Fi). In this sense, spectrum ranges supplementation with small cells could lead to a better utilization of the radio signal and higher

data transmission rates, together with the heterogeneous networks expansion which will allow application running across devices on either one of the existing fixed and mobile networks. OPEX and CAPEX will therefore be enabled by the integrated carriers once the small cell network will connect to optical fiber, as well as the creation of revenues through new price schemes driven by higher data volume.

Lastly, differentiation could arise from the implementation of cloud computing which contributes to the improvement of end-to-end quality of services (QoS) therefore a better user experience and to lowering the cost for content delivery through network utilization. In addition, by partnering with the OTTs, (e.g. Microsoft), the telecoms industry can monetize from both OTTs & other content providers and from the traditional customers through the telecom operators.

IX. CONCLUSIONS

In line with the purpose of this study which intended to determine the European network operators' market position, mostly with respect to the OTTs, it might be very likely to see a follow-the-leader approach. Herby, market expansion, inorganic growth, product development and innovation as reactions to the changes in the market, are elements that have been followed to determine the degree of consolidation towards the new business climate.

Follow-the-leader approach has been considered to occur not only as a natural business consequence where the small ones grow slower and on the same line with the big operators, but also due to the leaders' capabilities to sustainably react to the changes and trends in the market, hence an opportunity for the smaller operators to imitate strategies.

With respect to the market potential, the telecommunications sector and related verticals appear to still benefit from a constantly growth in relative terms despite the challenges coming from the steady growth in data transmission traffic on networks, the success of over-the-top players (OTTs) and the fierce price competition among industry players, influenced by a non-neutral regulatory framework. However, the technology evolution and customers demand are creating space for more actors, which further creates new challenges for the actors in the value chain.

Consequently, it is expected that, at the beginning of 2020, the European telecom operators will catch higher orientation towards partnerships in order to resist on the market and eventually create innovation. Starting from in-market consolidation as some of the industry experts explained to be an immediate priority, operators can use the new consolidated position to grow across the borders and continue establishing within the vertical-type of capabilities.

To outline the implications of this research for academic understanding, as pointed out earlier, the paper supports and can be considered to be supported by previous findings, but stands out differently first of all as it brings the European context into analysis. Secondly, it becomes even more relevant as it provides a comprehensive understanding over the new context determined by changes and trends in the market, enabling the author to determine the new challenging

landscape for the European network operators, and further emphasize a set of actions that can be taken as a response, adapted to the new context.

Having taken the case of a top leading player in the European market and not only, Vodafone's reactions to the changes in market as well as their overall strategy can be securely considered as a sort of benchmarking, a strategic model that the smaller network operators in the market can take as a point of reference. Considering the need for adaptability, the operators succeeding to connect their services and products with the dynamic need of the customers will more definitively grow and position better within the market, complementary to the other aspects which refer to the capability of operators to differentiate in the competitive market while reaching the levels of trust as a core requirement to survive in a market.

Lastly, since the advantages are over-promoted, it is necessary to keep an eye on what are the adverse consequences of technological advance, which are not always made public for obvious reasons i.e. cyber-attacks, massive incident of data, threat on personal privacy, as well as on the new implications of the changes and reactions within the market as it can lead for example to the creation of conglomerates able to monopolize markets.

Finally, further discussions can be built around a set of several questions which can represent the subject of new investigations: Is there a gap caused by the discrepancies between Western and Southern Europe when talking about roaming elimination? In the same context, can individuals go to acquire telecoms services much cheaper and use them in their country of residence? Will such a possibility be regulated or will that be a possibility which will lead to a price uniformization in Europe? Debates around these questions already exist within the European bodies but not in a complete form, which leaves us to determine whether new gaps will occur.

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