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Toward a collaborative use of MBB

A study on opportunities and limitations for MNOs, OTTs and end users to collaborate around MBB

Master of Science Thesis in the Management and Economics of Innovation Programme

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Abstract

The usage of mobile broadband is growing aggressively, both in terms of numbers of users, a 12 times increase since 2007, and the consumption data that have sky-rocketed with a growth rate of 65 percent per year and will be ten folded by the year of 2020 (Ericsson, 2016). Data intensive data traffic, such as video streaming, are growing and represent roughly half of the total data traffic in mobile broadband (Ericsson, 2016). Historically, the success of Internet has been fueled by a collaborative attitude and openness between actors. This growth implies higher demands on the mobile broadband networks and in order to keep up with the increased demands new ways of operating are necessary to deliver best possible performance. In addition, the end users are less patient and are demanding better service. Considering the mobile broadband to exist of mobile network operators (MNO), over-the-top content and service providers (OTTs), and end users, the researchers' pose the question of whether a collaborative approach between the mobile broadband actors would be beneficial to deal with the future challenges ahead. The purpose of this thesis is to investigate if and how MNOs, OTTs and end users would benefit from a more collaborative approach to attain a better working MBB.

The research has been conducted in an inductive manner, drawing upon in-depth qualitative interviews and previous research applied on the empirical findings to guide the analysis. 19 interviews have been conducted with Ericsson, MNOs, OTTs, the Swedish telecommunication authority, a Swedish political party and academic staff that were chosen through a snowball sampling approach. The interviews were conducted in order to gain knowledge about the industry, its trends and to create understanding in actor specific cases.

The study revealed that there exist great values to be realized as well as an openness from OTTs and MNOs respectively to collaborate around improving the use of MBB. Commercial collaborations between MNOs and OTTs have come further than technical collaborations with the aim to improve the service delivery. Involving end users in collaborations is possible, however the leeway is limited. Establishing end-end quality chains to align the configurations of MBB networks and OTT-application in order to deliver the best possible end user experience during adverse conditions was found to be an area which interest both MNOs and OTTs. Several obstacles and prerequisites to engage in inter-actor collaborations were however identified which pose great challenges for especially technical collaborations to form, e.g. valid business case, scattered ecosystem, uncertainty about value and net neutrality regulations. If the actors can overcome the prevalent obstacles and meet the prerequisites, there is opportunity to collaborate for a better use of mobile broadband.

Keywords: *Mobile broadband, Industry collaborations, ICT, Mobile data growth, Telecommunications, Net neutrality.*

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First of all, we would like to thank everyone that have contributed to completing this master thesis. We would like to direct special thanks to our supervisors Professor Erik Bohlin, Chalmers University of Technology, and Aldo Bolle, Ericsson AB, for the great support throughout the process. Moreover, we would like to thank our Ericsson-reference group consisting of Per M Johnsson, Åsa Larsen, Ulf Mattsson, Hans Mattsson, Lars Egeland & Szilveszter Nadas; all the interviewees from Ericsson AB; the interviewed representatives from Spotify, SVT, Viaplay, Tele2, Telia, Post- och Telestyrelsen and Piratpartiet; as well as Associate professor Christian Sandström at Chalmers University of Technology.

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Gabrielle Persson and Jacob Thordson

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List of Abbreviations

2G: Second-Generation (Mobile Network)

3G: Third-Generation (Mobile Network)

4G: Fourth-Generation (Mobile Network)

5G: Fifth-Generation (Mobile Network)

B2B: Business-to-Business

B2C: Business-to-Consumer

CDN: Content Distribution Network

FBB: Fixed Broadband

ICT: Information and Communications Technology

IoT: Internet of Things

IP: Internet Protocol

ISP: Internet Service Provider

IT: Information Technology

MBB: Mobile Broadband

MNO: Mobile Network Operator

NEP: Network Element Provider

OTT: Over-the-top content

QoE: Quality of Experience

QoS: Quality of Service

1 Introduction

This aim for this chapter is to put the thesis into context and to explain the underlying problem definition. The chapter will also explain the purpose of the thesis as well as the thesis scope and delimitation.

1.1 Empirical context and problem definition

The ICT industry has grown rapidly the last couple years (Ericsson, 2016) and in the emergence of a network society the technological progress is both steered by society and its needs as it is radically transforming the same (Castells, 2005). New possibilities open up thanks to the technological advancements in the ICT industry, which fundamentally transform how people communicate, business operate and societies are structured (Castells, 2005). The evolution has resulted in more subscribers consuming more data. According to International Telecommunication Union (ITU, 2015), 47 percent of the global population now have a mobile broadband subscription, an increase by 12 times since 2007. Similarly, Ericsson's latest mobility report show a boom in the amount of data traffic sent of mobile networks (Ericsson, 2016). Data traffic have grown with sensational 65 per cent year-on-year last year and is continuing to grow further – by 2020 data traffic is estimated to amount to 10 times the current level (Ericsson AB, 2015).

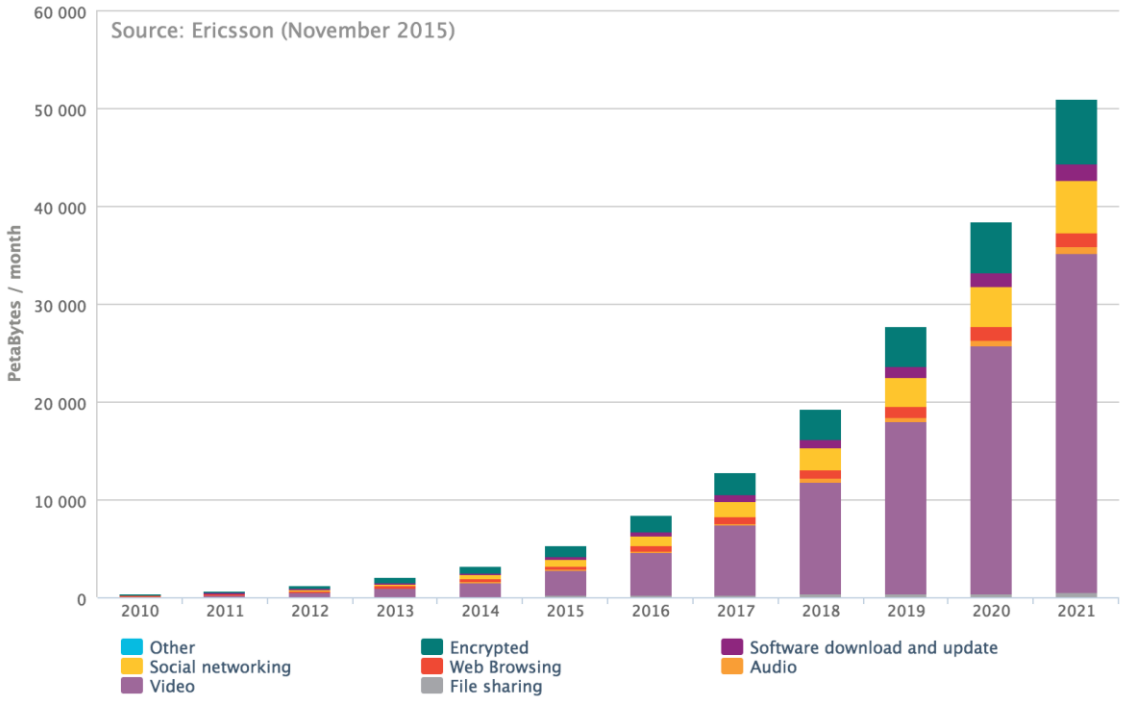


Figure 1. World consumption of data traffic in petabytes per month divided per application type (Ericsson, 2015).

This explosive growth in data consumption implicate high demands on the networks and their performance as it is, with the risk of congestion and inadequate quality of experience (QoE) to the end users. The demands have however increased even further, as with the trend of increased data consumption there is also a trend of end users to having less and

less patience for delays and increased demands on low time-to-content (Ericsson, 2016; Rydberg, 2016).

The latter years' emergence of over-the-top content and service providers (OTTs), such as Facebook and YouTube, have played a vital part in changing the industry. Not only have they disrupted existing services and challenged e.g. mobile networks operators (MNOs) business models (Behar et al., 2014). Many of the services, especially video, is very data demanding (Bohrarper & Gustavsson, 2016) and thus boost data consumption further. As seen in figure1 most of the data sent over mobile networks, 48 per cent, is currently attributed to video content, with social networking, web browsing, software updates and downloads, and video content each taking a larger share of the remaining 52 per cent (Ericsson, 2015). Concerning growth in video streaming, it is in most geographies primarily driven by only a few actors. In fact, in many mobile networks YouTube alone stand for 50-70 of the video traffic (Ericsson, 2016). End users determining the current future needs, MNOs operating the access networks and OTTs creating services and applications are all vital actors in the forthcoming evolution of MBB.

Historically, the success of Internet has been fueled by a collaborative attitude and openness between actors (Berners-Lee, 2015). Thus, a question that arises is whether a collaborative approach between the MBB actors would be beneficial also to deal with the future challenges the MBB faces. While some trends point to increased secrecy and reluctance to share certain types of information; e.g. the trend of increased encryption of data traffic (Finley, 2014), others show an increased willingness to cooperate; a report from Mobile Squared (Mobile Squared, 2014) show that a majority of the MNOs now have left the view of considering OTTs as threats and opened up for potential partnerships.

However, as Fransman (2007) and Basole and Rouse (2008) point out, the ICT industry ecosystem is highly influenced by external actors, and its activities directed by policies and regulations. The ongoing debate about network neutrality, affecting in what ways the operators are allowed to manage the data traffic in the access networks, are therefore of high interest. Moreover, it shows that whether future collaboration between MBB actors is a good way to approach current and forthcoming challenges not only concerns anticipated cost and benefits for involved actors, but also about contextual circumstances and external influencers.

1.2 Theoretical context and problem definition

The research on when industry actors benefit from collaborative approach and vice versa is not new. Powell (1990) introduced the concept on networks as an alternative to markets and hierarchies and argued for its superiority under certain circumstances, and Jacobsson and Bergek (2004) underlined its benefits especially with regards to shifts into new technological systems. Gadde et al. (2003) described the prerequisites for a well-managed and well-functioning network, and furthermore mentioned potential disadvantages in the form of lock-in situations and inabilities to change.

Fransman (2007) and Basole and Rouse (2008) describes the ICT industry, its actors, and how the actors are interrelated. Furthermore, they explain certain trends and how the ICT industry has gone from pre-internet state with network element providers (e.g. Ericsson and Cisco), network operators (e.g. AT&T and Telefonica) and end users, to a post-internet state which also include content and service provides.

The ICT industry is however constantly evolving and is changing rapidly (Rydberg, 2016), and there is little research on how actors collaborate today, to what extent they would benefit from collaborating in the future, and the conditions and likelihood for it to happen. Furthermore, even less research treats this subject with regards to differences in fixed and mobile broadband.

1.3 Purpose and research questions

The purpose of the thesis is to investigate if and how MNOs, OTTs and end users would benefit from a more collaborative approach to attain a better working MBB. Furthermore, the purpose is to map prerequisites and obstacles to establishing such collaborations, as well as how they are likely to impact the opportunities to establish collaborations in the MBB industry.

To meet above stated purpose the thesis will answer following research questions:

RQ1: What does each actor consider their main values and/or challenges related to MBB?
RQ2: Are the actors willing and interested in engaging in collaborations?
RQ3: What opportunities exist to collaborate toward improved use of MBB?
RQ4: What are the prerequisites for and obstacles in establishing collaborations?
RQ5: What is the impact and implications of found prerequisites and obstacles on interesting collaborations?

1.4 Scope and delimitation

From an actor point of view, the thesis includes MNOs, OTTs offering music and/or video streaming services, and B2C end users. Only collaborations between the actor types are investigated, thus not collaborations between for example two MNOs. Actors and collaborations that are based primarily on FBB are described only to contrast or to provide examples of potential collaborations around MBB. End users have not been interviewed. Instead the opinions and perceptions of end users needs and demands are derived from the conducted interviews with Ericsson employees, MNOs and OTTs.

As the largest OTTs operate on a global level, we have chosen not to limit the thesis to a single geographical area but to take all types of markets into account. It should be noted however that due to difficulties in getting interviews with OTTs and MNOs with basis outside Sweden, the findings are better substantiated for the European and especially the Nordic market.

Collaborations are included if they aim to attract or retain customers, or if they aim to improve the service delivery. Collaborations with other aims, e.g. facilitating product

development and creation of new functionalities, are not included. What is categorized as a collaboration is interpreted liberally, and where there is ambiguity it has been included rather than excluded. More on what is defined as a collaboration is found in section 1.4.1. It should be noted that the interviewees work primarily with technology improvement rather than on the commercial side.

As our competence lie in business aspects, not on a detailed technical level, and due to the fact that many of the suggested collaborations are just in fact suggestions or early attempts, the idea for the thesis is not to provide an exhaustive list and detailed description of current and likely future collaboration. Rather, the aim is to state and describe collaborations on a conceptual level.

1.4.1 Our definition of collaboration

A collaboration can be described and differ according to what is exchanged between the parties, the reason for entering the collaborations, and with regards to the characteristics of the collaborations, as seen in figure 2. Another way to look at a collaboration is that there is a scale from pure transactions to highly collaborative collaborations, as seen in figure 3. Pure transactions are when financial assets are exchanged for a finished good, while a highly collaborative collaboration could be a joint venture. Somewhere on this scale there is an infliction point where the activity goes from being called a transaction to a collaboration. Exactly where the infliction point is placed is however debatable: if an end user allows a service access to personal information used to develop the service in exchange for being able to use it – is that a transaction or a collaboration?

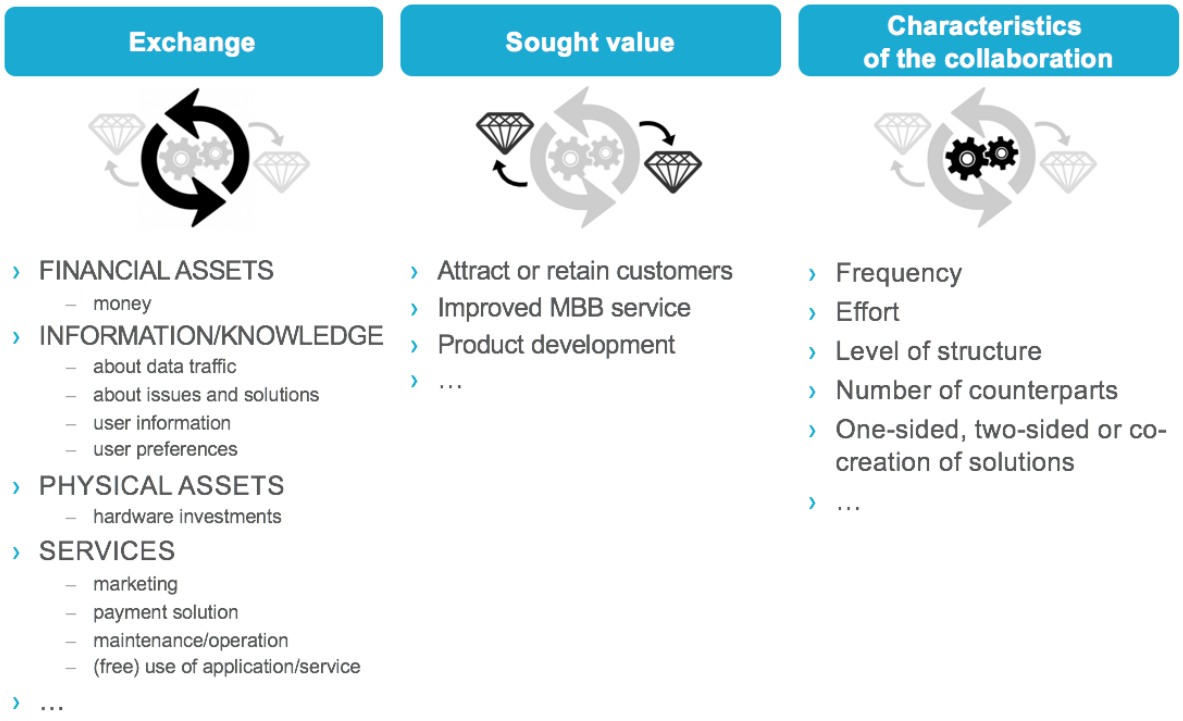


Figure 2. Different aspects of a collaboration.

Our definition of a collaboration, and thus what is included is an exchange between two or more parties, where the exchange shall enable or make easier the creation of a product or service and/or its performance. The collaboration can include financial transactions, but not solely. As mentioned in scope and delimitation, if there is an ambiguity the researchers have included the activity rather than excluded it.

Figure 3. Conceptual representation of what can and cannot be counted as a collaboration.

While the researchers have been liberal in terms of what is allowed to be exchanged and the characteristics of the collaboration, the thesis only include certain types of sought value. In this study, the researchers make a distinction between commercial and technical dimensions of collaborations. *Commercial collaborations* are those that aim to attract or retain new subscribers through offerings, marketing, branding etc. *Technical collaborations* are instead defined, in this study, as collaborations that aim to develop the service in quality speed, reliability control, etc.

2 Methodology

In the following section, the methods used for this study will be described. The choice of research strategy and design will be described and motivated, along with the choices regarding methods for data collection and data analysis. Research process and research quality will also be presented in this chapter.

2.1 Research strategy and design

In conducting research, one of the most important features are to align the research's design and methods appropriately in order to properly address the research questions (Easterby-Smith et al. 2015). The design of the research is fundamental in achieving high-quality research. A research may be either quantitative or qualitative, each with certain advantages and drawbacks (Bryman & Bell, 2007). A quantitative research strategy involves either data collection techniques, e.g. questionnaires, or data analysis procedures that generate or use numerical data. While, a qualitative research strategy refers to either data collection techniques, e.g. interviews, or data analysis procedures that generate or uses non-numerical data (Saunders et al., 2012). A quantitative research strategy has its benefits in being fast, provide with wide coverage of situations and may be interpreted effectively with statistical methods (Easterby-Smith et al., 2015). However, it has some drawbacks in flexibility, insufficient to generate theories and not very effective in understanding processes. Qualitative research strategy on the other hand has its strengths in the ability to understand people's meanings, to adjust to new issues and ideas that emerge and to contribute to the evolution of new theories. Whereas, the drawbacks may be that data collection absorb a lot of time and resources, difficulties in interpreting the data and may appear untidy due to difficulties in controlling the pace and progress.

The research strategy chosen for this study is evidence-based practice research, where practitioner knowledge and previous research are combined with the researchers' own understanding in interpreting the results of empirical findings (Easterby-Smith et al., 2015). In this study a qualitative research strategy was found appropriate since the study aimed to gain understanding of the MBB industry and the MBB actors objectives rather through interviews with individuals than drawing conclusions from numerical or aggregated data.

An inductive research approach refer to observations from reality that is combined with theory to obtain general conclusions (Eriksson & Wiedersheim-Paul, 2014). The contrast would be a hypothetic-deductive approach, where formulated hypothesis founded in theory are tested by observing reality. An inductive research approach is in general associated with qualitative research and a hypothetic-deductive approach with quantitative research. In this study an inductive research approach has been used to gather empirical data and theory applied to interpret the results. The inductive approach was chosen since this study is exploratory by nature and the empirical findings guide the direction and result of the study, rather than testing a formulated hypothesis.

2.2 Research process

The study was broken into phases in a stepwise sequence in order to facilitate planning and give structure, see figure 4. Despite being ordered into phases the study comprises an iterative character, where phases overlap and modifications to previous phases from gained insights was encouraged.

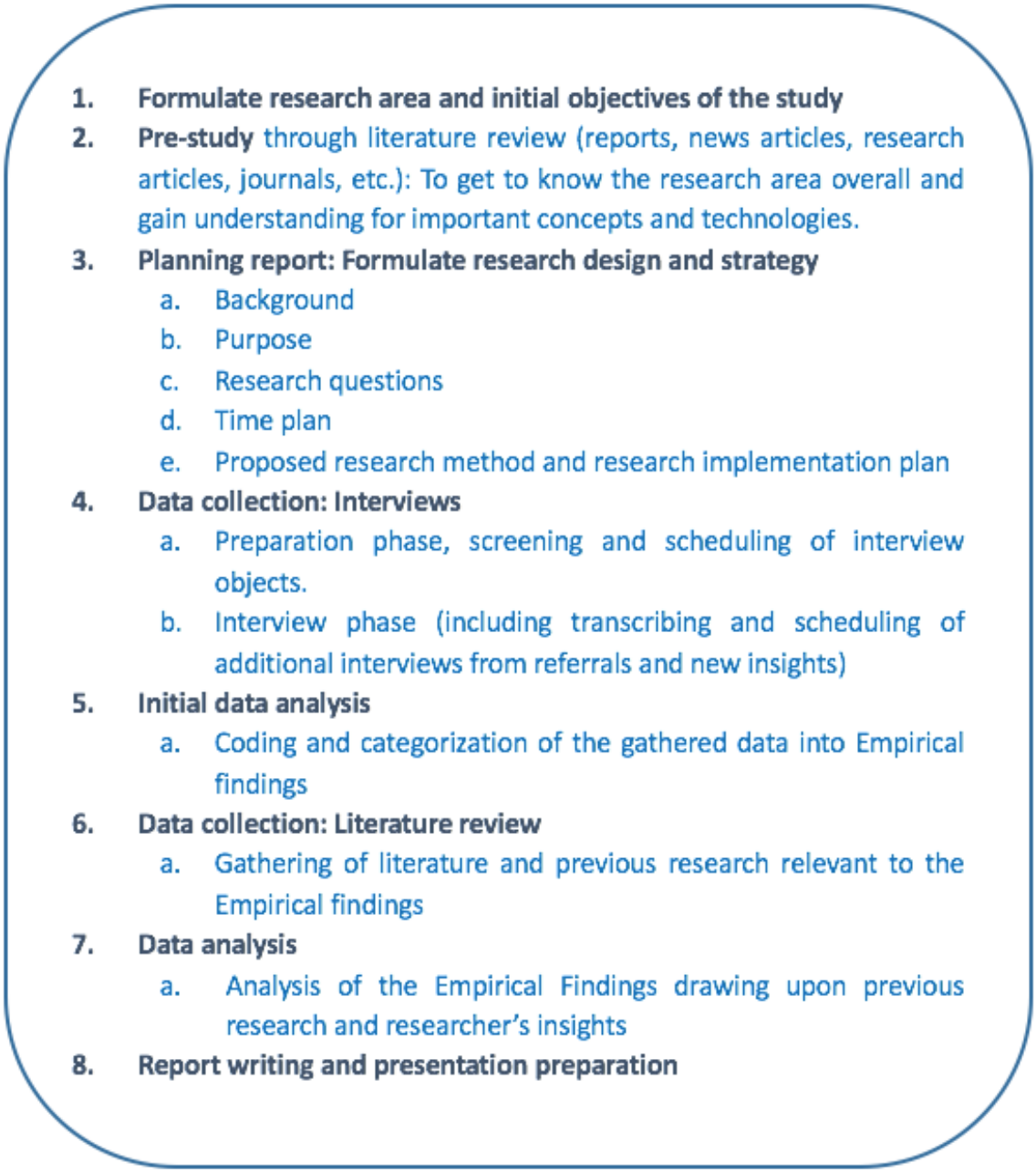


Figure 4. Illustration of the research process.

Initially the research area and the study's initial objectives were formulated in consultation between the researchers, Ericsson and the supervisor at Chalmers University of Technology. In order to familiarize with the research area and getting acquainted with key concepts and technologies a literature review was conducted, and followed by the creation of a planning

report including the background, purpose, research questions, time plan and proposed research method implementation of the study. However, in accordance with an inductive research approach the purpose and research questions were left open to modification to reflect the development of the study.

Thereafter, the first phase of data collection phase was initiated by initial screening and scheduling of interview objects. Since the study utilized a snowball sampling approach screening and scheduling of interviews took place during the majority of the interview data collection phase. Transcribing the interviews was a part of the data collection phase. In total, 19 interviews were conducted with interviewees from Ericsson, MNOs, OTTs (video and music streaming), the Swedish Post and Telecommunications authority, Chalmers University of Technology and Piratpartiet (former member of the European parliament).

The following step was an initial data analysis through coding and categorizing the gathered data to create an overview by using matrices illustrating respondents in rows and their corresponding opinions in columns. The MBB actors were categorized and presented in separate matrices to facilitate the data analysis. From the matrices the researchers identified factors to further facilitate or obstruct collaborations within the MBB ecosystem.

The second phase of data collection through a literature review was founded on the initial data analysis in order to guide the researchers toward relevant previous research to be applied on the gathered data. This second literature review was done in order to create a theoretical framework to be applied on the results from the data gathering. From the literature review, the second phase of data analysis was conducted by applying previous research and the researchers understanding of the gathered data to draw parallels on how to overcome obstacles and identified potential areas of interest to stimulate in order to obtain further collaborations within in the MBB ecosystem.

The study was finalized by writing an academic report and orally presented to both Ericsson and Chalmers University of Technology.

2.3 Data collection

Data may be of either primary or secondary character (Easterby-Smith et al., 2015). Primary data is new information collected by the researchers for the purpose of the study, and may generate new insights and confidence in the outcomes of the research. Primary data is often created by the researcher by conducting interviews and observations. Secondary data refers to data that already exists and not collected by the researchers, and may be used to explore new relationships and patterns within existing data.

In this study, the empirical findings rely heavily on primary data gathered through qualitative interviews with elements of secondary data. Whereas, the theory to support the analysis is drawn upon from secondary data through a literature review.

2.3.1 Primary data

Qualitative in-depth interviews are directed conversations evolving around questions and answers about a certain topic (Lofland & Lofland, 1984). Interviews, as noted by Tracy (2013:13) "provide opportunities for mutual discovery, understanding, reflection and explanation", and enable the interviewer to access information in context. Moreover, interviews may be conducted with varying levels of structure. Easterby-Smith et al. (2015) list three levels of interviews: highly structured appropriate for market research with questions in predefined order, semi-structured to cover a selection of topics and unstructured without interview schedule or guide. Interviews may be face-to-face or remotely through, for example, telephone, video calls or chat (Easterby-Smith et al., 2015). Remote interviewing has advantages in flexibility and independence of geographical distance, however its drawbacks relate to limiting the social interaction with respect to depth and non-verbal communication. Moreover, interviews may be conducted on individual or group basis. Individual does not involve the risk that social pressures in group interviews might suppress some individuals that are not willing to express their opinions publicly (Easterby-Smith et al., 2015).

The primary data in this study has been collected through individual in-depth semi-structured interviews with representatives from Ericsson, regulatory authorities, mobile network operators and over-the-top content providers. The researchers have chosen to not interview end users per se, but rather to summon the answers from Ericsson, mobile network operators and over-the-top content providers and their opinion about end users. This because the interviewed actors are believed to have a sufficient understanding of the end user's situation. A semi-structured interview approach has its advantages in allowing the interviewee to speak freely while securing that answers are given to key areas of interest and to allow the interviewer to ask questions not listed in the interview guide (Bryman & Bell, 2011). The interviews were held either face-to-face or remotely dependent on the geographical locations of the interviewees. Interviews were held face-to-face in Gothenburg and Stockholm, and all international and some Stockholm interviews were held through voice call. Moreover, an interview guide was provided to the interviewees in advance of the in-depth interview in order to allow the interviewee to prepare and thoroughly reason about topics to be discussed in the interview. All interviews were recorded and transcribed in order to fully utilize information gathered in the interview.

2.3.1.1 Sampling

A sampling strategy is important since it informs the selection of participants for data collection (Easterby-Smith et al., 2015) and the type of sampling should reflect the research questions of the study (Bryman & Bell, 2015). Probability sampling, mainly used for quantitative research, may also be used in qualitative research, however its main application is when the researcher is able to generalize to a wider population. In qualitative research purposive sampling is most frequently used, and it is a non-probability sampling strategy, where the researcher does not seek out participants on a random basis rather

chooses the participants strategically to be relevant to the research questions. Another non-probability sampling strategy is snowball sampling, where selected participants recommend other participants to the study (Easterby-Smith et al., 2015). Snowball sampling is a type of purposive sampling and may be used to broaden the number of participants from the initial selection (Bryman & Bell, 2015).

In this study an initial purposive sampling approach was deployed entailed by snowball sampling. Snowball sampling deemed appropriate to add in order to guide the researchers to recruit interesting participants outside of the initial selection. Given the exploratory nature of the study snowball sampling was found appropriate for the researchers to be flexible and allow the study to adjust direction along the research process based on the empirical findings. Snowball sampling give the possibility to include interview objects discovered in the process to be interesting for the study, but that were not considered in the initial criteria to direct the purposive sampling.

2.3.2 Secondary data

The secondary data has been collected through review of journals, reports and other electronic sources to build on theory to explain the empirical findings. In some cases, secondary data is used to further support certain statements in the conducted interviews during the data collection phase.

2.3.2.1 Literature review

During the study a literature review was conducted twice, to gain understanding of the research area and later on to analyze the gathered data. A literature review is an analytical summary of an existing body of research and help researchers to learn from previous research related to the research area of interest (Easterby-Smith et al., 2015). Reviewing of literature previous to designing the research facilitate improved understanding of the research topic. However, literature reviews may be continued throughout all phases of the study. There is a distinction between traditional and systematic literature reviews, where the former aims to summarize a body of literature and draws conclusions about the research topic (Jesson et al., 2011). The traditional approach allows the researcher to select the most interesting and relevant sources.

The literature reviews in this study were conducted in a traditional approach utilizing journal articles, news articles, consultant-, organization- and company reports, books and other printed or electronic source deemed to be trustworthy by the researchers.

2.4 Data analysis

Qualitative research implies an issue in how to condense large amounts of text to create an easily comprehensible result to others (Easterby-Smith et al., 2015). Clear explanations of how the analysis was undertaken and how the raw data were transformed into meaningful conclusions is therefore of importance to ensure transparency. Before the data can be analyzed it needs to be organized systematically into appropriate formats. Bailey (2008)

argue that the process of preparing the data for analysis may be considered as the first step in analysis of qualitative data. Content analysis is an approach that is suitable for both hypothesis testing and building new theories (Easterby-Smith et al., 2015), where the data is examined for presence, meanings and relationships of ideas that are derived from previous research, the research questions or the data itself.

The analytical framework used in this study builds upon the logic of content analysis. The gathered data are organized and categorized after criteria derived from the research questions of the study. Areas of interest are divided into columns with the corresponding answers from the respondents ordered in rows. According to Easterby-Smith et al. (2015) organizing the data in matrices, as described above, are particularly useful when a new area is explored. Hence, content analysis was deemed appropriate in this exploratory study since it allows to explore patterns and relationships between factors derived from the gathered data itself. Another advantage of displaying the gathered data in matrices is that it brings structure to the analysis (Easterby-Smith et al., 2015). Furthermore, data gathered from interviews with different actors were categorized in separate matrices to open up for comparisons between the various actors of the MBB. This first analysis aims to answer research questions 1-4:

RQ1: What does each actor consider their main values and/or challenges related to MBB?
RQ2: Are the actors willing and interested in engaging in collaborations?
RQ3: What opportunities exist to collaborate toward improved use of MBB?
RQ4: What are the prerequisites for and obstacles in establishing collaborations?

In accordance with an inductive approach, the content analysis of the gathered data is thereafter used as a guide to the selection of the second literature review. The purpose of the second literature review is to explore links from the gathered data with previous research. Drawing upon cases from previous research the researchers aim to explain and create recommendations on how to take advantage or overcome factors to stimulate increased collaboration among the actors in the MBB industry. Hence, the second analysis aim to answer research question 5:

RQ5: What is the impact and implications of the found prerequisites and obstacles on interesting collaborations?

2.5 Research quality

In addition to a relevant and attractive topic, research quality concerns the credibility of the research findings (Easterby-Smith et al., 2015). Since the end quality is affected by all stages in the research process, many aspects have already been mentioned in connection to the stages in which they occur. The aim for this section is thus to provide a better overview on how quality has been assured. Reliability and validity is the two main criteria for assuring and assessing research quality, where the latter is divided into internal and external validity (Saunders, et al. 2009). Bryman (2012), Tracy (2010) and Easterby-Smith et al. (2015) also

advocate objectivity as corner stone, which will here due to its close relationship with reliability be treated thereunder.

2.5.1 Primary data

2.5.1.1 Reliability

Reliability concerns consistency in results, i.e. whether replication of the data collection techniques and analysis procedures by other researchers or other occasions would produce the same results (Saunders et al., 2009). As Easterby-Smith et al. (2015) and Saunders et al. (2009) mention, there is an inevitable issue with replicability for qualitative research due to the fact that the researchers engage with a particular context in a certain point in time. These circumstances certainly are true for this project, and to assure reliability thorough documentation of both data gathering (interview guides, dates and information about the interviewees) and the results (interview recordings and transcripts) have been undertaken and transparency about the data, process and research design decisions have marked the report. By doing this reliability can be assured also for qualitative research as peers are enabled to understand the process and reanalyze the data collected (Easterby-Smith et al., 2015; Saunders et al., 2009).

According to Saunders et al. (2009) participant and observer error, and participant ant observer bias are four threats to reliability. Objectivity, i.e. to what extent researchers own values and reference frames have been allowed to interfere (Bryman, 2012), is closely linked to these threats and is according to Tracy (2010), Bryman (2012) and Easterby-Smith et al. (2015) for this type of research impossible to obtain entirely. To minimize the threats mentioned by Saunders et al. (2009) and let the researchers' own values and references frames impact as little as possible, measures advocated by Saunders et al. (2009) and Easterby-Smith et al. (2015) have been followed. The interviewers have been well informed about best practice for interview techniques before conducting them, the interviewees have been provided a copy of the interview guide line and interview purpose in advance to have time to reflect, both interviewers have been present at every interview to attain the information first handedly and to ask questions, full transcripts have been used to minimize misinterpretation of the interviewees replies and open questions have been used to avoid leading the interviewee and probes to sharpen up the interviewee's response without causing bias. Finally, the interviewees have been offered the possibility to read the results to establish trust.

Throughout the entire process, the affiliation with Ericsson has been clear and since Ericsson is not a competitor to any of the interviewed organizations, the researchers do not find any concern for the answers to be unreliable. What can be debated however is whether the interviewees have been able to disclose all aspects of their collaborations and strategies, as no non-disclosure agreements (NDA) have been signed and the research will be published publically. The researchers' conclusion is, however, that a breach of the ethical aspects of openness about the project purpose would only do harm and that openness as Easterby-

Smith et al. (2015) state instead establish trust which makes the data collected more reliable.

2.5.1.2 Validity

Turning from consistency of the results, to integrity and trustworthiness of the conclusions, validity comes into focus (Bryman, 2012). Internal validity concerns causality and the ability to measure what you actually set out to measure (Saunders et al., 2009). Thus, one important aspect for internal validity is the selection of interviewees. The combination of snowball sampling, where interviewees were asked about what type of actor would be most valuable for us to talk to, and purposive sampling, interviewees chosen by the researchers, allowed the study utilize both knowledge from industry experts in deciding interviewees, while still retaining control of the selection. To assure that we spoke to the right person, a description of the project and its purpose was provided to the interviewed organization, and asked the organization could suggest a suitable candidate. In order not to miss any imperative information, at the end of every interview, the interviewee was asked whether he or she though there was something more that should be said with the regards to the project purpose.

Yet another measure suggested by Bryman (2012) and Easterby-Smith et al. (2015) to ensure validity is triangulation. This has been incorporated in the way that every actor group is represented by more than one organization, that different kinds of organizations were represented and that the interviewees were active in different countries.

In contrast to internal validity, external validity concerns to what extent the results are generalizable beyond the research context (Bryman, 2012). According to Tracy (2010), Bryman (2012) and Easterby-Smith et al. (2015) most often qualitative researcher cannot know whether their results can be generalized to other context, and thus the researcher can only state tentative hypothesis. What Tracy (2010) and Bryman (2012) suggest instead, and what has been done, is to provide thick description and transparency about the context and circumstantiality of the data. The reader is thereby enabled to assess whether their case is similar and determine generalizability or not.

2.5.2 Secondary data

The reliability and validity for secondary data is on a high level dependent on the same criteria as primary data, i.e. from where the data was collected and the collection methods (Saunders et al., 2009). Saunders et al. (2009) argue that established and well recognized survey organizations are trustworthy as their reputation is dependent on data. Concerning the theoretical framework, peer reviewed and published articles have been used, and are considered trustworthy for the same reasons as mentioned by Saunders et al. (2009) for recognized survey organizations. To strengthen the results in empirical findings, reports and articles have been used that are published by established and well known organizations and news sites. One should however note that some of these organizations could have incentives to only publish information that favor their business. Furthermore, as Bryman

and Bell (2007) note, secondary data have been collected for a different purpose, and moreover, reports and articles that are not research articles rarely convey the methods used. To assure reliability and validity, we have followed the advice of Tracy (2010), Saunders et al. (2009) and Easterby-Smith et al. (2015) and aimed for triangulation as far as possible and chosen data from sources that complement each other.

3 Practical framework

This chapter aims to bring clarity to certain important ICT-related concepts to give a basic understanding of the studied industry.

3.1 ICT industry actors and structure

The width of actor types involved in providing high performing ICT functionality and providing content delivered through the ICT channels are vast. To simplify the ecosystem, several actors have described their view on the ecosystem structure, the main type of actors present and their interrelationships.

3.1.1 Actors and influencers

A simplified model of the ICT ecosystem is provided by Fransman (2008) who categorize the actors into a hierarchical layered model as shown in figure 2. In the first layer we find network element providers (NEPs), such as Ericsson and Cisco (Fransman, 2008). A NEP is the actor that provides the individual elements of the network such as routers, switches and computers. The next layer consists of network operators (NOs) such as Vodafone, Orange and Telia, that utilize the network elements to form converged networks, e.g. telecom, broadcasting and satellite networks. The third layer, consists of content and application providers (e.g., Google, YouTube, etc.) whereas final consumers constitute the final layer. Content providers that deliver content (e.g., messaging, video, music, social media, e-commerce, etc.) over the open Internet is called an over-the-top (OTT) content provider (Balis, 2015).

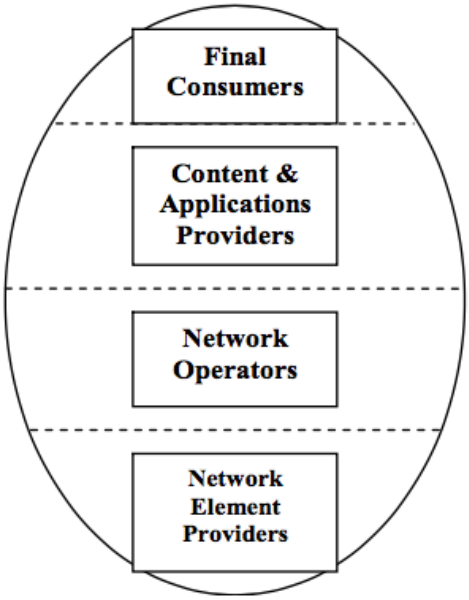


Figure 5. Depiction of the simplified ICT ecosystem (Fransman, 2008).

In addition to the model developed by Fransman (2008), he also highlights six symbiotic relationships between the actors; each consisting of financial, information and material flows. Three of the relationships are categorized as “old” or “pre-Internet” relationships that is the relationships between the NEPs and the NOs, the NEPs and the final consumers, and the NOs and the Final Consumers. Thus the “new” or “post-Internet” relationships consist of the once between the platform, content and application providers and each of the three other layers (Fransman, 2008). The main difference between these relationships is that where the old relationships are characterized by being a closed innovation system, the new once often imply an open innovation system with low cost barriers for actors to enter.

In addition to describing the actors and their relationships, Fransman (2008) mention four types of influencers that affect the relationships between the actors, especially the relationship between a network element provider and a network operator. The influencers are competition, regulation and competition law, financial institutions and other institutions, e.g. legal standardization universities.

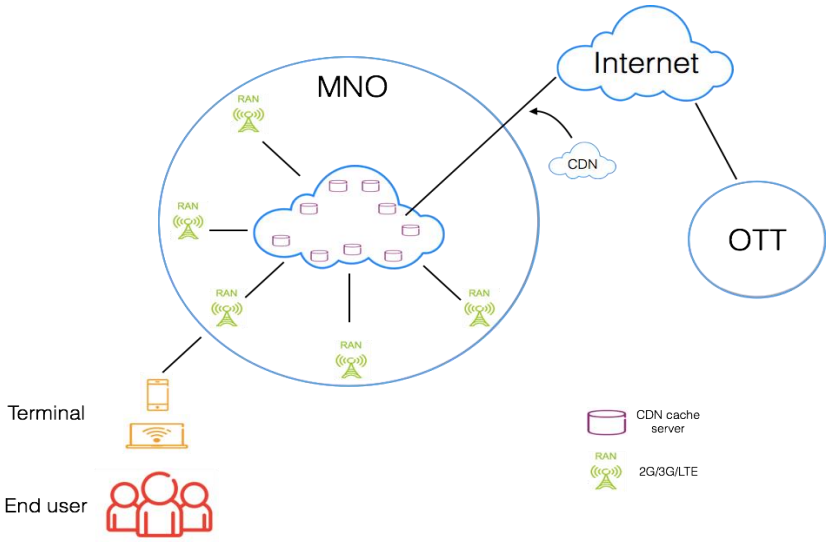


Figure 6. Illustration of the ICT ecosystem and the connections between the actors.

The MBB ecosystem is a sub-system of the ICT-ecosystem, see figure 6, where the MBB networks, controlled by the MNOs, function as a content delivery chain intermediary linking end users and content providers.

3.1.2 Digital content delivery

Data traffic comprises of information is sent in packets, i.e. the data is divided into smaller units (Cisco, 2015). The packets travel through the network as pulses of light or as radio signals and goes through routers, and switches, that reads and sorts the packets to their intended destination. The intended destination is decided by the IP address, a unique numerical address for every connected device on the Internet. The internet is a global system of interconnected regional and local computer networks that use Internet protocol suite to link devices worldwide (Nationalencyklopedin, 2016). The packets then travel through a larger or smaller part of the Internet in order to reach its final destination. Upon

arriving the packets must be reassembled at the right time and order otherwise the application/service will not work properly. Since there are millions of Internet-user's worldwide congestion at the routers might occur, and the router traffic becomes like a junction, where packets wait for their turn to go through causing a delay. The Internet is served by a best effort principle, striving to deliver the data packets as efficiently as possible through the networks (Welzl 2005). Excess packets can either be put to buffer or dropped. Buffering implies that the packets are queued, while dropped packets refer occurs when the queue is full. In some cases, like e-mail, it is not a problem with latency, but in other cases that require real-time traffic it is crucial that the packets arrive at the same time and in correct position. In the case of delay, long latency, there will be significant negative impact on the service, i.e. video chat, self-driving cars, real-time stock trading, payment services, etc. In the case of video chat or online gaming the image may become blurred, delayed and/or freeze causing a reduced service experience (Cisco, 2015).

This study concerns data traffic that is routed from the content provider to the end user through either FBB or MBB. Utilizing FBB the data packets travel from the Internet through DSL, fiber or cable as pulses of light passing through core networks and the regional ISPs access network before reaching the users connected device (Körner, 2016). MBB connects to the Internet through its mobile core network, comprised of one or several networks, further wirelessly connected with a radio access network (RAN). The RAN is accessed through a radio base station and it is where the connection between the mobile device and the Internet occur.

3.1.3 Quality of service and quality of experience

Quality of service (QoS) is defined by ITU (2009: p5) as the "*the totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service".* QoS depends both on network performance, e.g. bit error rate, latency, etc., and on non-related network performance, e.g. provision time, repair time, etc. (ITU, 2009). QoS can be described in four dimensions, see figure 7, where understanding of QoS Perceived by the customer (QoSP or QoSE) are highly relevant to any service provider that seeks to optimize revenue and resources. QoSE is a statement of the experienced level of quality of the end user and can be expressed in both qualitative (e.g., user expectations, ambient conditions, application context, etc.) and quantitative (e.g., end-end system effects) levels. QoS relies on all contributing components in an end-end connection, see figure 8, and in order to maintain high QoS the service provider needs to be concerned with the various performance of terminal equipment, the performance of access network (e.g., wireless, ADSL, cable, etc.) and the performance of the core network (e.g., transmission media, technology, etc.). The requirements on QoS can vary between particular services dependent on the type of service and segment of the customer population.

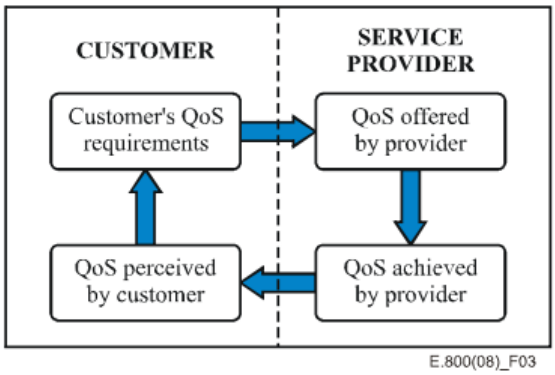


Figure 7. Four viewpoints of QoS (ITU, 2009).

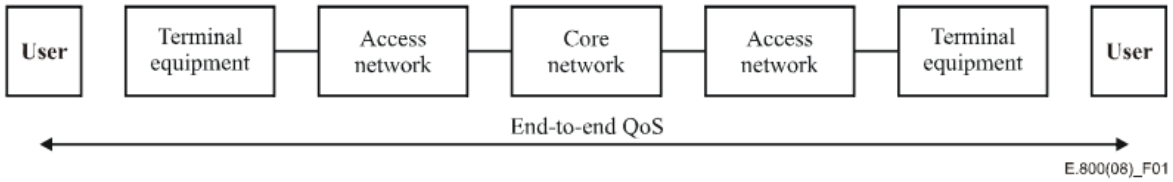


Figure 8. Schematic depiction of contributions to end-end QoS (ITU, 2009).

A closely related term is quality of experience (QoE), which by the ITU (2006: p1) was defined as "*The overall acceptability of an application or service, as perceived subjectively by the end-user.*" QoE is just like QoS influenced by all components in an end-end system (client, terminal, network, service infrastructure, etc.) (ITU, 2006). QoE will be the concept used in this thesis to represent end user experience.

3.1.4 Content delivery network

A content delivery network (CDN) is a network of servers used to store content distributed closer to the end user (Akamai, 2016). The idea with CDNs are to cache content closer to the end user in order to speed up page load times and content fetching, since the content can be retrieved at the CDNs cache server rather than travelling all the way back to the server of the content provider and back again (see figure 6). CDNs can effectively be deployed on the edges of ISPs', e.g. MNOs', network close to end users and therefore improve user experience and reduce load on the core network to avoid global network bottlenecks. CDNs can be operated by content providers, i.e. Netflix, Amazon and Google, MNOs, Telia, Verizon, Telenor, etc., or provided by third-party actors such as Akamai, Cloudflare or CacheFly (Telia, 2016; Akamai, 2016; Amazon, 2016; Google, 2016; CDN Reviews, 2016)

3.1.5 Data traffic scheduling

In order to avoid congestion and improve resource utilization the data packets could be labeled for the router or switch and sorted appropriately dependent on type of data packet and the requirement for fast delivery (Welzl, 2005). The ultimate goal with congestion control is to avoid delay, caused either by queues or loss of packets. Labeling of data packets enables scheduling, or prioritization, of internet traffic and can enhance the overall experience for all users, i.e. packets for real-time applications can be handled first and other

packets that allow longer latency can be sent through at a later stage (Cisco, 2015). The logic of scheduling of internet traffic is to divide the data traffic into classes based upon different parameters, and assign every class an individual priority in the network. Examples of parameters may be source address, destination address or traffic type (i.e. email, website, image, audio, video, etc.)

3.1.6 Net neutrality

Net neutrality is a widely debated topic of great importance to the ICT-industry and the MBB-ecosystem in particular. The net neutrality principle can be regarded to establish boundaries for what network operators are allowed to do concerning data traffic management. It was initially introduced by professor Tim Wu at Colombia University in 2003 and have since sparked an intensive debate and formed regulations to protect the content delivery on the open Internet. Many voices have been heard and several definitions exists, such as:

“An Open Internet means consumers can go where they want, when they want. This principle is often referred to as Net Neutrality. It means innovators can develop products and services without asking for permission. It means consumers will demand more and better broadband as they enjoy new lawful Internet services, applications and content, and broadband providers cannot block, throttle, or create special "fast lanes" for that content.” – the American Federal Communications Commission (FCC, 2016)

“An open Internet is essential to the American economy, and increasingly to our very way of life. By lowering the cost of launching a new idea, igniting new political movements, and bringing communities closer together, it has been one of the most significant democratizing influences the world has ever known. Net neutrality has been built into the fabric of the Internet since its creation — but it is also a principle that we cannot take for granted. We cannot allow Internet service providers (ISPs) to restrict the best access or to pick winners and losers in the online marketplace for services and ideas.” – Barack Obama, president of the United States (White House, 2014)

“Net neutrality is founded on the principle that all Internet-traffic should be treated equally regardless of sender, receiver, platform or content.” - the Swedish Post and Telecom Authority (PTS, 2016)

“Net neutrality guarantees equal Internet access free from blocking or intentional slowing down by interventions from Internet service providers.” – European Commission (European Commission, 2015)

4 Literature review

This chapter contains a compilation of literature body introducing relevant theory for the analysis to be applied on the empirical findings in this study. The literature review lies as a foundation for the creation of the theoretical framework applied on the empirical findings in the analysis chapter of this thesis, see figure 9.

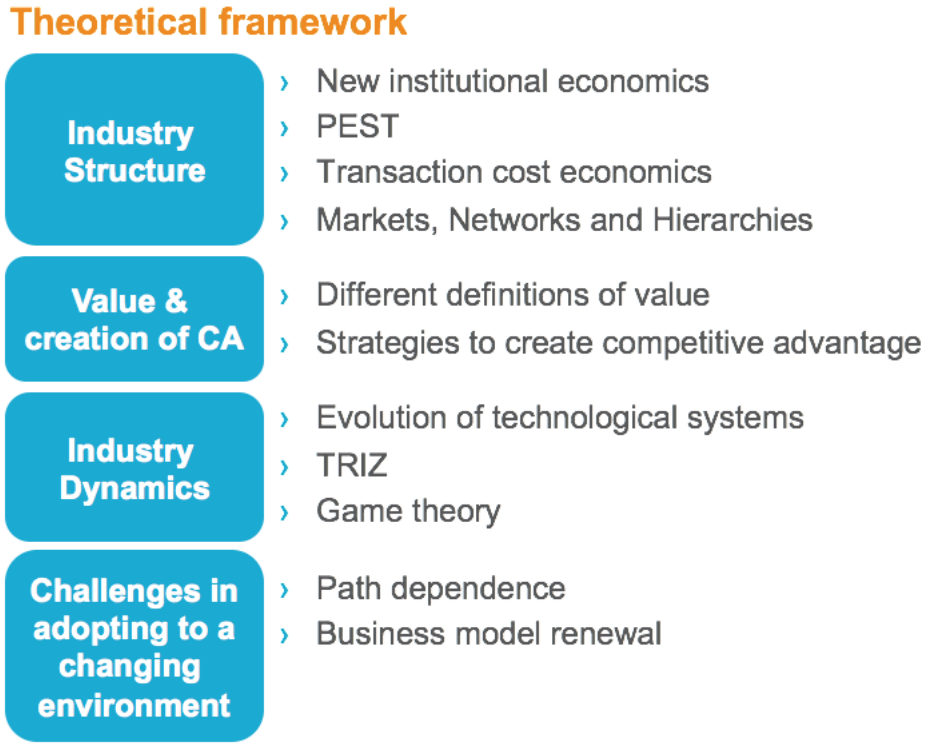


Figure 9. Illustration of the theoretical framework created from the literature review used to analyze the empirical findings.

4.1 Value and creation of competitive advantage

4.1.1 Resource based view of the firm

Resources and capabilities look to the internal environment of a firm, and decides what a firm create and how it can offer greater value to its customers relative the market competitors (Grant, 2010). In contrast to adopting a resource-based view of the firm, an alternative business strategy is to seek out opportunities to target attractive markets in order to obtain competitive positions in the market.

Resources and capabilities form the base for a firm's strategy and how a company competes on a market by aligning internal and external environment of the firm. Resources are assets owned by a firm, and capabilities can be described as what firm can do. Grant (2010) argue that competitive advantage is the primary source for superior profitability. Competitive advantage may be defined as "*when two or more firms compete within the same market, one firm possess a competitive advantage over its rivals when it earns (or has the possibility to) a persistently better rate of profit"* (Grant, 2010: p211). By successfully assessing its resources and capabilities a firm can build a more secure foundation for long-term strategy

than relying on external market factors, and a firm should focus on exploiting its unique strengths rather than doing the same as its competitors (Wernerfelt, 1995). Competitive advantage can also be derived from a firm's ability to respond to change in the external environment, where key capabilities are the firm's responsiveness and speed in which it tackles external changes.

Competitive advantage is created by a set of resources deployed together into organizational capabilities (Grant, 2010). Organizational capabilities are what a firm can do particularly well relative to its competitors, thus fundamental for a firm's strategy. For a firm to sustain its competitive advantage over time, Grant (2010) propose that it depends on whether the resources and capabilities are durable, transferable and replicable. Durable relates to the life span of resources and capabilities and how easy they are replaced or becomes obsolete. For example, in fast-moving technology industries the lifespan of certain resources and proprietary technology might be short. A resource or capability are transferable if it is easy to move from one firm to another and replicability is to what extent it can be built and developed by another firm. Lindmark (2006) emphasize on the concept of utility as the value gained by the customers from a certain product or service provided by a firm, and where customers always aim to maximize utility. Moreover, a firm can sustain its value proposition toward its customers based on the standalone value of the service or product, the complementary goods available and its installed base of users (Lindmark, 2006). He further argues that these three aspects can explain why incumbent firms can outperform new entrants, despite the new entrants having superior performance, i.e. standalone value. Hence, sustaining its competitive advantage.

Competitive advantage can be achieved either through a cost or differentiation advantage (Grant, 2010). Cost advantage implies that the firm supplies the market with an identical product or service at a lower cost than its competitors, hence appropriating better margins or providing the product or service at a lower price. A differentiation advantage occurs when a firm manages to supply a product or service that the customers are willing to pay a premium price for. The premium price covers the additional costs incurred with providing the differentiated product or service, examples of differentiation are quality, features, service, design, etc. A firm cannot pursue both cost and differentiation advantage mutually and have to choose in order not to be "stuck in the middle". A business strategy to pursue both mutually will guarantee low profitability (Porter, 1998).

4.1.2 The concept of value

The discourse of value have been centered around the two concepts of value-in-exchange and value-in-use, where the former often is considered to be synonymous with price and the latter emphasize on a mulit-dimensional view of value (Rashid, Varey, & Costley, 2013). In other words, value-in-use can be described as utility, or the usefulness of a product or service (Lindmark, 2006). Utility can be defined as the pleasure or satisfaction derived by an individual from being in a particular situation or from consuming goods or services (Lindmark, 2006: p24). In economic theory individuals strive to maximize utility and the

perception of utility is different among actors. Recently, the view on value in literature has shifted toward value-in-use, where value is believed to incorporate a wide range of factors apart from economic factors (Rashid, Varey, & Costley, 2013). This implies that in the concept of value focus has developed from only transactions to include relationships as well, consistent with the shift from goods to a more service intensive economy. Value can be regarded to be created jointly among actors through reciprocally interactions, where value is co-created by multiple actors and sustainable business models should focus on relationships and interactions.

4.2 Challenges in adopting to changing environment

4.2.1 Path dependence

Path dependence is a concept to explain organizational inflexibility derived from historical behavior and decisions (Sydow et al, 2009). In path dependency, past events are deemed important for future action and to a large extent informs or impacts decisions for current and future decision-making. An organization under influence of path dependency is at risk to end up in a lock-in situation, where sub-optimal decisions are taken as a consequence of previous resource allocation (Northcraft & Gerrit, 1984). Self-reinforcing processes are likely to act as drivers into a specific path of action eventually ending up in a state of lock-in and organizational inflexibility to adapt to external changes (Sydow et al, 2009). Self-reinforcing processes are to a large extent created from increasing returns (Arthur, 1989; 1994) and creates positive feedback processes. Increasing returns may lead to a repetitive pattern to appropriate these increasing rents (Sydow et al, 2009). Once a dominant pattern is established from this repetitive behavior the self-reinforcing process becomes increasingly irreversible, especially in cases of large investments and high fixed costs. A full lock-in situation imply that the firm, or organization, has no longer any options to choose from and are totally dependent on the set course of action. Path dependence develop in three distinct phases, as described by (Sydow et al, 2009); preformation, formation and lock-in phase (see figure 10).

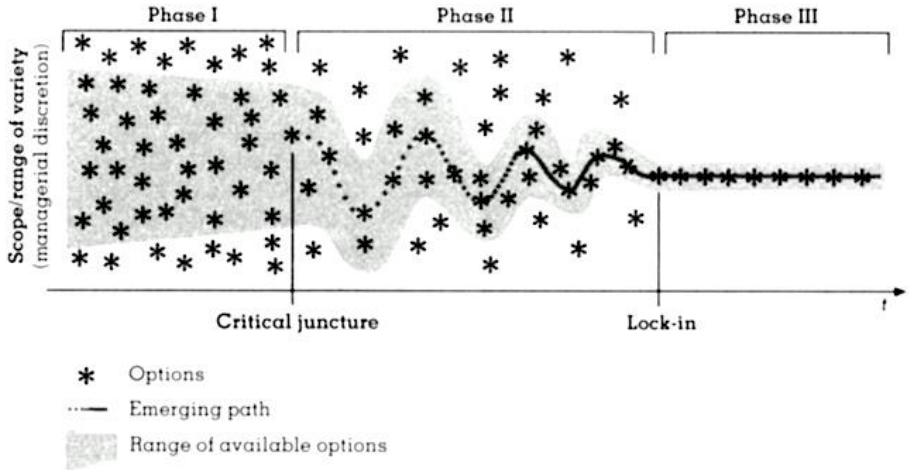


Figure 10. Illustration of the emergence of path dependence in an organization (Sydow et al, 2009).

In the preformation process, the scope for choice of action are broad and the decisions cannot be predicted, however once a decision is made it sets of the self-reinforcing processes (Sydow et al, 2009). Entering the formation phase, a dominant pattern of action is emerging and the range of options narrows while it becomes increasingly difficult to reverse the choice of action. Hence, a path is emerging. An organization transformed into the lock-in phase, are characterized by deterministic decision-making and a particular choice of action has become dominant resulting in loss of flexibility. Even in the light of new and better options divergent from the path, the organization lack the ability break out of predominant decision-making structures and continue in the established direction which in the end leads to a potentially inefficient system.

4.2.2 Business model renewal

It is an established notion that firms encounter difficulties in technological shifts, especially when it comes to adopting new business models (Sandström & Osborne, 2011). The difficulties can be derived from the fact that a firm's business model is based on interdependence on other actors and changing business model involves aligning the incentives of the concerned actors.

The concept of business models includes the ways of how value is created and captured both inside and outside of the boundaries of the firm. The need to adopt new business models corresponds to appropriating returns from new products and to compete in mature markets. Chesbrough (2010) argue that firms struggle to renew business models, despite understanding the importance in doing so. The difficulties may have several explanations, however (Sandström & Osborne, 2011) point out that there tends to be a conflict between the existing business model and business model innovation. Moreover, it is argued that elements of the new business model tend to be incompatible with a firm's existing resources and capabilities. In particular, established firms may suffer from a structural inertia, an internal resistance to change (Hannan & Freeman, 1984). The structural inertia is the product of several factors such as internal politics, sunk costs in personnel, equipment or plants and organizational structures. Routinizing and institutionalizing activities within a firm is considered a prerequisite for creating effective organization, but paradoxically also the cause of inertia that may result in an inability to adapt to a changing environment (Sydow et al, 2009). The evolution of inertia is closely linked to the concept of core rigidities, where organizational capabilities inhibit a firm's ability to develop new capabilities (Grant, 2010). Eventually, structural inertia can threaten the survival of the firm. Attempts to engage in business model innovation may therefore meet resistance from within the firm (Sandström & Osborne, 2011). Incumbent firms depend largely on their dynamic capabilities in their ability to adapt to changing circumstances in the external environment (Tucci & King, 2002). Dynamic capabilities can be defined as *"the ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"* (Teece, Pisano, & Shuen, 1997, s. 516) *and relates to a firm's ability to reconfigure its resources to respond to change* (Grant, 2010).

The above mentioned arguments are also applicable to situations where new technologies threaten to make existing competencies and organizational structures obsolete (Sandström & Osborne, 2011). In addition to the internal constraints to engage in business model renewal, it is of great importance to consider the external actors concerned and how relations to other actors are handled. Hence, Sandström and Osborne (2011) propose that in order to successfully adopt a new business model the interdependent actors in a network needs to be identified and the actors' incentives need to be mapped and aligned throughout the network. In order to understanding the actors' incentives, the values created throughout the network needs to be identified. Moreover, barriers and enablers needs to be identified in the entire network.

4.3 Industry structure and dynamics

4.3.1 Transaction costs economics

In the article *The Economics of Organization: The Transaction Cost Approach* (Williamson, 1981) describes two types of costs associated with organizations; internal and external transaction costs. External transaction costs are described as the costs to carry out market transactions, while internal transactions costs are the corresponding costs if the task is performed within the organizational boundaries. Coase (1960) elucidates the concept of external transaction costs, by stating the following:

"In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on."

Later on (Williamson, 1995) categories Coase's explanation into three subparts of external transaction costs consistent with the different phases of the exchange process: search and information costs, bargaining and decision costs, as well as policing an enforcement costs.

The existence of transactions cost, (Williamson, 1995) states, have several impacts on organizations. Firstly, high transaction costs prevent organizations to undertake transactions if they are predicted to be larger than the expected benefit. Furthermore, the relation between internal and external transaction costs determine the organizational boundaries (Williamson, 1995; Coase, 1960). If the internal transaction costs are lower than the external, the task will be undertaken within the firm, and vice versa in the case of lower external transaction costs the tasks will be carried out on the market. Transaction costs are by no means absolute, but can be altered. In fact, the sole reason for an actor's existence in the market can be its ability to create value by lowering external transaction costs for others (Pihl & Sandström, 2013).

When the term transaction costs are used without "internal" or "external", scholars usually refer to external transaction costs. From now on, if nothing else is specified, the usage of the term transaction costs refer to external transaction costs.

4.3.2 Networks as an alternative structure

While transaction cost economists propose markets and hierarchies as ways to organize the same activity, networks is a concept introduced by (Powell, 1990) which is used instead of markets where there is reason to underline the mutual dependence among suppliers and customers (Sandström & Osborne, 2011). The concept of networks relates to transactional economy, but differ from hierarchies and markets, and is dependent on relationships between actors and not solely on transaction costs (Powell, 1990). By engaging in collaborations the boundaries of firms become blurry and networks form rather than traditional market or vertical integration, i.e. inside the firm. The firms within a network may be regarded as actors with different aims and scale. However, no single actor commands all resources throughout the network, so the actors are therefore interdependent and the network is held together by mutual benefits or interests (Sandström & Osborne, 2011).

	Markets	Networks	Hierarchy
Power	None	Some	A lot
Flexibility	A lot	Some	None
Scalability	A lot	Some	None
Knowledge transfer	None	Some	A lot

Table 1. Tradeoffs between different ways of organizing industries (Sandström, 2015).

As shown in table 1, the different ways of organizing activities have different characteristics. According to (Powell, 1990), networks are favorable when there is a demand for speed, when resources are variable and the environment uncertain. Moreover, markets are poorly equipped for transfer of technological know-how, making networks favorable when the aim is utilization and enhancement of tacit knowledge and technological innovation, as the structure incentivize information sharing and thus allows rapid transformation of ideas into action.

Industrial networks consisting of firms can be considered to comprise three dimensions that needs to be addressed in terms of maintaining relationships and a well-functioning network; actors, activities and resources (Gadde et al, 2003). Firstly, a network comprises of actors that coordinate the other two dimensions, resources and activities. The individual actors influence each other and the greater that influence is, the greater the potential for development is. However, it is important to balance the level of influence so that a single actor does not control the whole network. In relation, activities are interdependent of those of the other actors and it is important for a firm to consider the activities of others in order to enhance the individual firms and the network's performance. Similarly, to activities,

resources are also interdependent and tied to other actors where increased involvement enhance the potential value of the network (ibid). However, an appropriate level of involvement must be established, where the value is balanced against cost, level of dependence in order to avoid a lock-in situation.

In addition to contextual circumstances in place for networks to be the most beneficial industry structure, and an appropriate strategy for all three dimensions mentioned by (Gadde et al. (2003), a prerequisite for a well-functioning network is trust (Powell, 1990). According to Powell (1990), repeated interaction between actors not only increases the likelihood of cooperation, but also of punishment to those who do not cooperate. Reputation becomes of large importance in networks as it is most detectable signal for reliably. Moreover, Powell (1990) states that networks are most likely to take place in settings where participants share common ground – ethnic, geographic, ideological, professional, or yet something else – as the more the groups are alike, the greater the trust.

4.3.3 New institutional economics and PEST-analysis

New institutional economics is a theory developed by Williamson (1998) which go beyond transaction costs economics (TCE) and neo-classical economics (NCE) by adding institutions, i.e. social and legal rules - thus both formal and informal rues, to impact economic activity. Williamson (1998) argues that these factors; resource allocation and employment (NCE), how actors interact (TCE), formal legal rules, and informal social norms, are four layers of factors that impact the economic activity and where the frequency of how often they change vary, from resource allocation and employment that is changed continuously, up to social norms that can take up to hundreds of years to change.

Yet another model that speaks to factors impacting a firm's value creation opportunities, its strategy, and thus by extension its activities, is the PEST framework (ALoA, 2004). The framework consists of four factors in the external environment that are usually beyond the firm's control. First, Political and legal factors impact the firm through e.g. regulations, tax policies, consumer protection etc. The second factor, the economic environment, concern economic growth, inflation rates, stage of business cycle and so on. Third, the social environment involves income distribution, demographics, education, lifestyle changes, welfare etc. Finally, the technological factors include new inventions and development, life cycle and speed of technological obsolescence as well as changes in IT, internet use, and mobile technology use and cost.

4.3.4 The evolution of technological systems

In their article from 2004, Jacobsson and Bergek, use the concepts of actors, networks and institutions, by declaring the support from all three dimensions a necessity for a shift to a new technological system. A technological system is defined as "*network(s) of agents interacting in a specific technology area under a particular intuitional infrastructure for the purpose of generating, diffusing and utilizing technology*", and is made up of actors, networks and institutions (Jacobsson & Bergek, 2004). Two types of actors as mentioned as

especially important: first, there is prime movers, which are actors that are so powerful, financially, politically and/or technically, that they have a particularly large impact on the development and diffusion of technologies. Second, there is non-commercial organizations advocating certain technologies. Networks, are important as they facilitate knowledge transfer, identification of problems and the development of technical solutions thereof. Finally, institution provide, as previously stated by Williamson (1998), the rules for interfirm interaction (Jacobsson & Bergek, 2004).

According to Johnson and Jacobsson (2001) there are five main functions that need to be attended for in technological systems:

- The creation and diffusion of new knowledge
- The guidance of the direction of search among users and suppliers of technology.
- The supply of resources such as capital and competencies
- The creation of positive external economies, both markets and non-market mediated.
- The formation of markets.

In technological systems, Jacobsson and Bergek (2004) point out the existence of inducement as well as blocking mechanisms to these functions. Inducement mechanisms include market formation, entry of firms and organizations, institutional change and coalitions promoting specific technologies. Blocking mechanisms on the other hand comprise inability for institutions of alignment to the new technology, difficulties for markets to form due to for example technological lock in, lack of firm entrance due to their path dependency, or networks' inability to support the new technology due to low connectivity between actors.

According Jacobsson and Bergek (2004), many scholars divide the development of a product or industry into two phase, first a formative period followed by market. The formative period is often characterized by small markets, many different actors with competing designs, and high uncertainty in regards to markets, technology and regulations. The investments are large under the early stage, and often seemingly fruitless. Breshanan et al. (2001) argues however that these investments are a necessary step to build a base on with investments in the new technological system that do show success can build on.

Furthermore, Jacobsson and Bergek (2004) mention niche markets as critical in the formative phase in order to form new markets. Niche markets are generally small markets where the technology is superior in one or several dimensions, often due to special needs in that market or due to government subsidies. Actors enter these niche markets, which allow a learning process where the technology develops according to customer needs and the ratio price/performance decreases. Jacobsson and Bergek (2004) also state that to transition from the formative period to market expansion, bridging markets are important as they provide volume of production and necessary secondary innovations.

Fey and Revins (2005) offer a complementary perspective of how technological systems develop by introducing nine laws:

1. Increasing degree of ideality
2. Non-uniform evolution of subsystems
3. Transition to a higher-level system
4. Increasing dynamism (flexibility)
5. Transition to micro level
6. Completeness
7. Shortening of energy flow
8. Increasing controllability
9. Harmonization of rhythms

For this thesis, the first law is particularly interesting. More specifically what it means is that the technological system either becomes less costly or complicated, or it becomes better in performing its current functions or perform more functions (Fey & Revin, 2005).

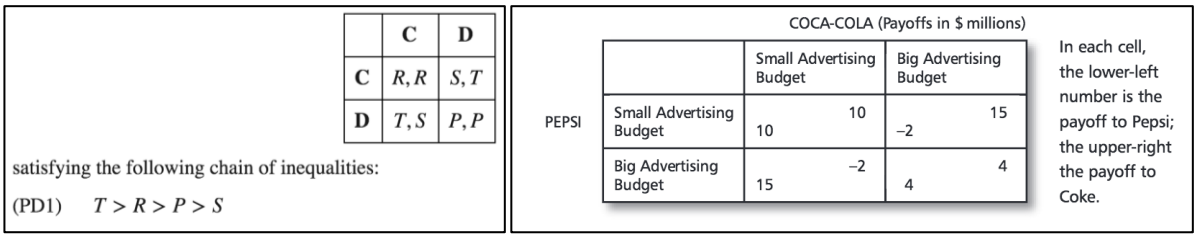
The nine laws are part of a model called TRIZ, which is developed by Genrich Altshuller (Fey & Revin, 2005). The model is well suited for looking at long-term evolution of technologies, however less appropriate for understanding why a certain technology have failed, or to understand the market and its environment (Sandström, 2014).

4.3.5 Game theory and the prisoner's dilemma

Game theory is defined by Myerson (1997) as "the study of mathematical models of conflict and cooperation between intelligent rational decision-makers", who points out that while it can be applied on a several of situations, it have especially been proven a powerful model in economics. According to Grant (2010), game theory have two main use cases in strategic management: First, it allows an enhanced understanding of the strategic decision at hand as it describes the situation in terms of identifying the players, their options, the results from each combination of option and the progression of decisions. Furthermore, it can be used as a prediction tool of a competitive situation and thus help identify what strategic decisions return optimal outcome.

One classical example of game situation is the Prisoner's dilemma (Stanford Encyclopedia of Philosophy, 1997). The situation is that two prisoners are arrested and interrogated separately. If both remain silent both will get a convicted for a minor charge, if one confesses that person will go free while the other get convicted for a serious charge, and if both confess both will get convicted for the serious charge. Due to that fact that regardless of what the other prisoner does, the best option for both prisoners is to confess. The end result is thus that both will end up in a suboptimal situation, as shown in figure 11. Grant (2010) provides a version of the Prisoner's dilemma applied on a business situation. Coca-Cola and Pepsi-Cola each have an option to go for a big or small advertising budget. As in the case with the prisoners, both will choose a big advertising budget and thus receive suboptimal proceeds. The state two the lower right in both cases are called a Nash-

equilibrium, as no actor can improve their result by changing their strategy unilaterally. Furthermore, Grant (2010) states that even if they parties would be able to return to the upper left corner, the state would be unstable as the incentives to cheat and break the agreement would be strong.



	C	D
C	R, R	S, T
D	T, S	P, P

satisfying the following chain of inequalities:

(PD1) $T > R > P > S$

COCA-COLA (Payoffs in $ millions)

PEPSI	Small Advertising Budget	Big Advertising Budget
Small Advertising Budget	10 10	15 –2
Big Advertising Budget	–2 15	4 4

In each cell, the lower-left number is the payoff to Pepsi; the upper-right the payoff to Coke.

Figure 11. The left figure show the prisoner's dilemma visualized (Stanford Encyclopedia of Philosophy, 1997). The right figure show Grant (2010) version of the prisoner's dilemma applied to a business situation.

Game theory have been used both in attempts to predict the future, and to explain the past. As Grant (2010) point out however, it has proved more accurate in latter case than the first.

5 Empirical findings

This section aims to portray the findings from the interviews in six different subsections: challenges and values for the actors, current collaborations, actors' attitudes toward collaborating, potential collaborations, prerequisites and obstacles to create MNO/OTT collaborations as well as end user collaborations, and finally the importance of MBB from an OTT perspective. Initially a brief description of all interviewed parties will be provided. To facilitate the reading of this chapter, executive summaries are provided before each sub chapter.

5.1 Interviewee descriptions

Industry	Company	Interviewee, Title	Date
Mobile network operators	Tele2	Joacim Rask, Head of Group Product Management Residential	2016-04-07
	Telia	Anders Lenman, Global Product Manager Enrichment of Voice & Messaging	2016-04-19
OTT-Music streaming	Spotify	Pär Bohrarper, Software Engineer and Team Leader	2016-04-12
		Niklas Gustavsson, Back-End Development and Content Distribution	
OTT-Video streaming	SVT Play	David Karlsson, Head of Development Streaming	2016-05-02
		Thomas Porsaeus, Strategist	
	Viaplay	Jens Köpsén, Head of Content Delivery	2016-05-18
Regulatory authority	PTS	Johan Rydberg, Senior Legal Advisor	2016-04-15
	The Pirate Party of Sweden	Amelia Andersdotter, Former member of the EU parliament	2016-03-09 2016-03-13

Table 2. Details for the conducted interviews with representatives for MNOs, OTTs and regulatory authorities.

Tele2

Tele2 is a Swedish telecommunications operator founded in 1986, and are included in the Kinnevik-sphere (30% stake), offering mobile voice, messaging and data, MBB, fixed voice and broadband, IoT-solutions and B2B communication solutions. Tele2 AB is present in Sweden, Kazakhstan, Central Europe and the Baltics providing with 2G, 3G and 4G networks. Their main market is in Sweden, where Tele2 have 4 million customers and net sales of 12,6 billion SEK in 2015. Tele2 strive to be cost-efficient in all their operations, and strive to be profitable from increased data consumption driven by larger data buckets and new attractive offerings. (Tele2, 2016; Kinnevik, 2016)

Telia

Telia is a Nordic telecommunications operator founded in 1853, owned partly by the Swedish and Finnish government, with headquarters in Stockholm, Sweden. Telia is today present in 14 countries in Europe, Russia and Eurasia. Telia operates in mobile and fixed broadband, TV and fixed voice. Telia's main market is Sweden, where they are the largest telecommunications operator with 6 million mobile subscriptions and net sales of 37 billion SEK in 2015. Telia aim to be the New Generation Telco by providing superior network connectivity, a seamless experience across technologies, services and channels, cost efficiency and by exploring opportunities in adjacent areas to their core business. (Telia, 2016)

Spotify

Spotify is a music, podcast and video streaming service founded in 2006, and in June 2016 Spotify had over 100 million users (Larsson, 2016). Spotify is a Swedish company with its headquarters in Stockholm, Sweden. Currently the streaming service has over 1500 employees over 26 offices worldwide, and is available in 59 countries (Spotify, 2016).

Spotify's main area of operation lies in music streaming, but the company added during the spring 2016 video streaming functionalities (Bohrarper & Gustavsson, 2016). The majority of Spotify's customers use the applications from mobile devices, however it may be through either MBB or FBB through Wi-Fi. As the interviewees from Spotify, Bohrarper and Gustavsson, work with audio playback, consequently the focus in their answers lies within the same area.

SVT Play

SVT Play is a part of SVT (Sveriges Television), the Swedish public service television company. SVT was founded in 1956 and have since then been an independent media company operating in Sweden. On SVT Play all programs shown on SVT (SVT1, SVT2, SVT World and SVT24) can be viewed 30 days after the first broadcast. Moreover, SVT1 is the biggest channel in Sweden (SVT, 2016).

SVT-play is a public service corporation with roughly 95 percent of its data traffic within Sweden. Even though the usage of mobile devices is increasing amongst end users, a very small fraction of the data traffic is currently delivered over MBB. Due to an overall increase in data traffic consumed, the amount of data sent over MBB are increasing slightly. This is however only in absolute terms, subsequently leaving the percentages unchanged. During the interview Karlsson and Porsaeus (2016) point out that SVT-play does not separate between FBB and MBB, but treat them as one entity.

Viaplay

Viaplay is an online on-demand pay-tv service, owned by the international entertainment group Modern Times Group (MTG). Viaplay provide streamed TV-series, movies, sport and other entertainment. Viaplay is available on multiple devices, e.g. smartphones, tablets and computers (MTG, 2016).

Viaplay distribute video content in video-on-demand (VoD) and live sports, and are exclusively active in the Nordic countries (Denmark, Finland, Norway and Sweden) over both fixed and mobile broadband. However, Viaplay cannot tell how much of the content that is delivered in MBB networks, but approximately 50 percent of the data traffic goes to smart phones connected through MBB or Wi-Fi (Köpsén, 2016).

The Swedish Post and Telecom Authority (PTS)

PTS monitors the electronic communications and postal sectors in Sweden. The term "electronic communications" includes telephony, the Internet and radio. PTS's vision is that everyone should have access to good telephony, broadband and postal services. The authority works with consumer and competition issues, efficient utilization of resources and secure communications (PTS, 2016).

Piratpartiet

Piratpartiet is a Swedish political party advocating for everyone's equal rights and integrity on the Internet and in everyday life. Piratpartiet had seats in the European Commission during 2009-2014. One of Piratpartiets key issues are surveillance and all individuals right to online privacy from governments and companies (Piratpartiet, 2016). The interviewee, Amelia Andersdotter, held one of the seats of Piratpartiet in the European Commission from 2011-2104, where she actively engaged in issues regarding the role of Internet in society (Andersdotter, 2016).

Ericsson

Ericsson is a Swedish company founded in 1876 that operates in the telecommunications industry. Ericsson provide equipment, software and services to enable transformation through mobility. According to Ericsson figures, some 40 percent of all global data traffic runs through networks supplied by Ericsson. Currently, Ericsson regard itself to be the leader in the development and deployment of LTE systems and provider mobile broadband modules to connect a growing range of devices and systems to the Internet. Besides mobile networks, Ericsson are also engaged in business in core networks, microwave transport, IP networks and fixed-access solutions. In 2015, Ericsson had net sales of 247 billion SEK and more than 115,000 employees worldwide. (Ericsson, 2016)

Interviewee, Title	Date
Fransisco Alcoba, Head of Product Management	2016-03-31
Greger Blennerud, Market Category Driver MBB	2016-04-04
Reiner Ludwig, Director Business Development	2016-03-31
Michael Martinsson, Market Category Driver FBC	2016-04-07
Daniel McGillivray, Solution System Manager	2016-03-10
Masniza Mokhtar, Senior Solution Architect	2016-04-06
Vittorio Orsini, Head of Marketing & Bus Innovation	2016-04-01
Franscesco Pompa Pacchi, Head of Technology KA H3G	2016-04-01
Filiberto Pagani, FBC Engagement Manager	2016-04-08

Table 3. Details for the conducted interviews with Ericsson employees.

Executive summary

Challenges and values for actors

- End users' values are services and applications with functionalities meeting their needs, that are possible to use whenever they want to, with as high QoE as possible, to as low cost as possible.

- Interviewed video and music streaming services mention assuring high QoE as one important challenge to solve. Video streaming services point out live streaming to be especially tricky. Both video and music streaming services mention end-to-end quality chains as valuable to establish to improve end user QoE.

- Another important challenge for OTTs to solve is avoid eroding customers' data plans. While music streaming is less data intensive than video, Spotify send a fair share of their data over MBB and is active in markets where data plans are small and expensive. While Viaplay and SVT-play are active only in markets where data plans are relatively large and cheap, the companies still risk eroding end users' data plans if end users need to stream over MBB.

- The main challenge for MNOs is currently to find new revenue streams and capitalize on mobile data. Even though data consumption is increasing rapidly, price wars eliminate a corresponding revenue growth. Other challenges and values exist, but pale in comparison. Interviewed MNOs take different strategies to deal with the challenge; Telia aim to be a service creator, and Tele2 aim to be cost-efficient and compete on price.

5.2 Challenges and values for the actors

This section gives an overview of various challenges and values related to MBB for the concerned actors in this study. It aims to bring understanding of what challenges and values that the actors regard to be most important.

5.2.1 End users

End users want applications and services meeting their needs, be able to use them when they need, with as high QoE as possible and to as low cost as possible. Concerning what service and application functionalities end users asked for, the specific details are outside the scope for this thesis. Instead availability and QoE will be discussed below.

Ability to use the services and applications when needed

According to Spotify, one issue that OTTs with data intensive applications, for example Netflix, are trying to solve is for their customers to be able to use their application throughout the entire month (Bohrarper & Gustavsson, 2016). Today, end users with small data plans and/or data intensive applications risk of burning through their data buckets (Pagani, 2016; Orsini & Pompa Pacchi, 2016; Alcoba, 2016). This issue is especially present in markets where data plans are generally small and expensive, which results in the end users being careful of how they use their mobile phones (Bohrarper & Gustavsson, 2016).

As high QoE as possible

Better QoS is a demand from the end users (Ludwig, 2016), a need that is acknowledged by both Spotify as an OTT (Bohrarper & Gustavsson, 2016) and Telia as a MNO (Lenman, 2016). The demand is however present only where it also can be linked to an increased QoE (Rask, 2016; Bohrarper & Gustavsson, 2016). This imply higher demands on real time and data intensive services (Alcoba, 2016) such as VoLTE, voice, online gaming (Blennerud, 2016) and video streaming (Rask, 2016; Alcoba, 2016), whereas a constant bit rate is substantially less important for assuring a good QoE when it comes to services such as e-mail or downloading documents (Rask, 2016). Yet another example of QoE being the actual value to end users, and not QoS per se, can be seen in the fact that improved video quality can only improve the user experience to a certain point as the human eye cannot observe quality improvements beyond a certain point (Rask, 2016). Spotify has a similar example related to music streaming and why it does not make sense to lower latency beyond the level of 100 ms (Bohrarper & Gustavsson, 2016).

Current level of QoS vary vastly between different regions in the world (Ludwig, 2016), as do the reasons behind the poor experience (Bohrarper & Gustavsson, 2016). Congestion during peak times (Alcoba, 2016; Rask, 2016) or due to overall lack of bandwidth, and poor or varying coverage are two salient reasons. In some areas this might be due to an overall poor national ICT infrastructure (Bohrarper & Gustavsson, 2016), whereas in other areas it is an issue in a more limited area such as the subway or a thronged radio cell a certain point in time (Rask, 2016; Bohrarper & Gustavsson, 2016).

5.2.2 OTT content and service providers

Overall, the objectives for OTTs are to satisfy their customers and to do it in a financially advantageous way (Ludwig, 2016). Improved QoS during congestion is a quest brought up by several interviewees (Alcoba, 2016; Ludwig, 2016; Mokhtar, 2016; Blennerud, 2016), with a possibility for the OTT to have an end-to-end control over the QoS, including the segment that is under the control of the operator (Orsini & Pompa Pacchi, 2016). A second challenge, is the limited end user data plans and the risk for OTTs to use the end users' data plans and thus leave them unable to use their application (Pagani, 2016; Orsini & Pompa Pacchi, 2016; Rask, 2016; Bohrarper & Gustavsson, 2016).

OTT content and service providers with high throughput and latency demands are more dependent on the performance of the MBB networks. Video- and music streaming are mentioned as examples dependent on throughput (Alcoba, 2016; Orsini & Pompa Pacchi, 2016; Bohrarper & Gustavsson, 2016), where video streaming is by far the most data demanding service (Bohrarper & Gustavsson, 2016; Karlsson & Porsaeus, 2016). High latency demands are associated with real-time services such as VoLTE and online gaming (Blennerud, 2016). Moreover, there is also a difference between the services when it comes to how much they are used via MBB versus FBB, where more data intensive services, e.g. video streaming, are used to a lesser extent on MBB since they quickly burn through the end users' data plans (Köpsén, 2016).

5.2.2.1 The Spotify case

During the interview with Spotify two focus areas stood out as particularly valuable for Spotify to improve; assuring good QoE for their customers even during adverse conditions, and enable utilization also for customers with small and expensive data plans who currently face the risk of data intensive applications burning through their data buckets.

Assuring high QoE for their customers

Since many of Spotify's customers uses MBB to utilize the application, Spotify is extremely dependent on the network capacity and performance, where throughput and latency are the two most important metrics (Bohrarper & Gustavsson, 2016). As the networks cannot always support utilization of the Spotify application without complications, improving how it operates under adverse conditions is vital to good user experience, and thus a primary focus for Spotify. There are several ways in which they treat these issues, but it mainly comes down to prefetching, i.e. preloading, and optimizing batching of data.

The focus for Spotify to resolve operational issues over MBB lies on markets where the conditions are the worst and thus the improvements would imply the largest increase in QoE for the end users. Bohrarper and Gustavsson (2016) say that these markets are the same for Spotify as for most other OTTs, and mentions USA, South American and APAC as examples of problematic regions. The variations within the regions are however large, both between countries and within a single country. Moreover, they mention that even cities and countries with a generally adequate network infrastructure experience similar problems in

areas such as the subway. Reason for poor user experience is partly caused by poor or changing coverage. Latency, is as mentioned an important metric. Due to a focus on improving latency for a long time, the situations is however fairly good in most markets. Instead interrupts in playback and difficulties in handling changes in bandwidth currently pose a greater problem to Spotify. Another issue affecting Spotify's possibility to assure high QoE is traffic shaping, that is when operators give lower priority to certain types of traffic. It does not happen on a large scale, but do occur in countries where internet capacity is expensive.

In addition to resolving the issues with poor QoE, two equally important challenges for Spotify is for one to understand the source of the problem and secondly to understand with minimal delay when it happens. Bohrarper and Gustavsson (2016) refer to the last mile networks as a blind spot for Spotify. They know well how the clients behave and use different metrics to measure their performance. They know and to a large extent have control over how their back-end and CDNs behave. When it comes to intermediary section per contra, especially the last mile, there are many question marks. This poses a problem as while they can measure or estimate symptom metrics such as the networks' resulting throughput and latency, they do not know the reason behind it; thronged radio cells, misdirected antennas, issues with the operators backhaul, or yet something else. This inability to link a resulting issue to its source makes it difficult for Spotify to address the problem appropriately.

Regarding the delayed information about issues, the current way Spotify learn about poor QoE for customers is that they acknowledge it and let Spotify know. Spotify can track the users' behavior, but they have limited possibilities to track over time when and where certain problems arise. Gaining a better understanding of when these problems occur would according to Bohrarper and Gustavsson (2016) prove valuable, since they to a larger extent would be able to act proactively.

Avoid eroding their customers' data plans

The fact that some markets have small and expensive data plans, is something that Bohrarper and Gustavsson (2016) states as a challenge. The Spotify application use a fairly large amount of data traffic, and there is a risk present in burning through the customer's data plan leaving the customer unable to use the application the rest of the month. This challenge is linked to the issue mentioned in the previous section seeing that there is a tradeoff between QoE, attained through the use of prefetching or higher quality content as two examples, and the amount of data used.

Today Spotify know very little about their customers' data plans, both on the individual level and on an aggregated per country and operator level, and it is according to Bohrarper and Gustavsson (2016) difficult to estimate. If they could choose freely, this would be a metric they would want to know. Still, even with an understanding of how the data plans look like, there is the issue with understanding how the customers' usage of the Spotify application

affects their data buckets. For some users, Spotify might be the main application they want to use their data buckets for, while for others Spotify might just be one of many data demanding applications.

5.2.2.2 The SVT-Play case

The main values and challenges centers around improving QoS and QoE for end users, handling the shift from linear to on-demand TV cost efficiently, and doing so while still assuring national security and a reliable public service during national crisis situations.

Assuring high QoE for their customers

Improving QoS and QoE for the end user is of high priority to SVT-Play. The ongoing challenge lies in peak times; that is scaling when there is a high amount of traffic in the networks. SVT-Play has no control over neither when the end users utilize their service, nor when certain popular events take place. Karlsson and Porsaeus (2016) mentions Olympic Games and World Championships as two recurring causes for peak times. Moreover, they point out that live streaming is more sensitive and more difficult to assure high QoE as the buffering opportunities are limited and thus less time to act.

Scalable distribution to low cost and adequate security

To handle the shift from linear to on-demand TV is a challenge for SVT-Play according to Karlsson and Porsaeus (2016). The traditional linear TV is based on agreements where the number of viewers on certain program do not affect the cost for distributing it. With on-demand TV, more viewers imply higher costs, which is not feasible business model in the long term. A current focus for SVT-play is therefore to find a satisfying distribution model that allow scaling to a larger extent than today to a supportable cost. Moreover, Karlsson and Porsaeus (2016) adds that being a public service corporation also implies duties in having secure distribution model also in the event of crisis situations such as during a war. This implies different evaluation criteria from many other TV media corporations when constructing a distribution model.

5.2.2.3 The Viaplay case

Assuring high QoE for their customers

Viaplay focus on delivering a fast and reliable service to as high quality as possible (Köpsén, 2016). Previously, end users were lenient with buffering and lower quality when watching video over Internet, but nowadays end users expect the same or better quality than traditional TV broadcast. This implies low latency, no buffering and high quality, which becomes a challenge especially in MBB networks. End users in Scandinavia enjoy among the best connectivity in the world, and their expectations on video content over Internet are therefore consistently high.

Köpsén (2016) argues that the difficulties to assure high QoE might be explained by the fact that Viaplay only can control the delivery until the last mile and within the application at the end user. Viaplay has no control of the content delivery over what happens in MBB- or Wi-Fi

networks. Of the services provided by Viaplay, live sports streaming is the one most affected by this challenge. A good live sports streaming is very dependent on latency, e.g. end users watching live sports and getting event notifications on their smartphone before the event appears on the stream will result in a poor end user experience. End users seldom understand the reason for issues with live streaming quality and tend to believe that streaming video and live sports require the same amount of resources. Hence, end users with poor MBB- or Wi-Fi connection believe that Viaplay is to blame for a poor live streaming experience because video streaming, e.g. YouTube or Netflix, is working properly and Viaplay encounter difficulties in communicating the reason for problems that the end users are experiencing.

Delivering video content to end users with limited data plans

Probably the most prominent problem related to MBB is that the end users have limited data plans (Köpsén, 2016). This makes it difficult for video content providers in general, including Viaplay, to serve end users connected through MBB on a regular basis, since streaming video in high quality erodes small and limited data plans quickly. Köpsén (2016) compares MBB with FBB and concludes that in FBB end users are not charged per MB and that it is surprising that MNOs have managed to get away with charging per MB in MBB networks. Previously, unlimited data subscriptions existed also in the MBB and hopefully, Köpsén (2016) says, it will move in that direction in the future.

5.2.3 Mobile network operators

5.2.3.1 Finding new revenue streams and Capitalizing on mobile data

One of the most urgent challenges in the operators- and telecom industry is to obtain growth in revenue since the industry growth rate is around 0-1 percent, and have been like that for some years now (Blennerud, 2016). The operators face difficulties in monetizing on data, at the same time as voice and messaging revenues are declining, see figure 12. In the Ericsson Mobility Report, released twice a year, it is obvious that the trend of data consumption is growing and by 2020 it will be 10 fold that of today, but still the majority of the Western operators are not growing (Ericsson AB ,2015; Blennerud, 2016; Martinsson, 2016; Orsini & Pompa Pacchi, 2016). Subscribers want to use their smartphone more, consuming more data intensive services like video streaming and according to Martinsson (2016) the competitive situation and pricing models in the industry result in that roughly the same amount of money is generated despite increasing data consumption. The reason for this may be that significant revenue streams from the generated data ends up in California, US, in the pockets of major OTT-players (Blennerud, 2016). Operators are therefore faced with the challenge of figuring out how to capitalize on data in the long-term and need to come up with business models to increase revenue from the growth in data consumption (Blennerud, 2016; Martinsson, 2016; Mokhtar, 2016). Data revenues are growing significantly but from an initially low level and are not enough to cover up for the declining revenues from voice services (Blennerud, 2016).

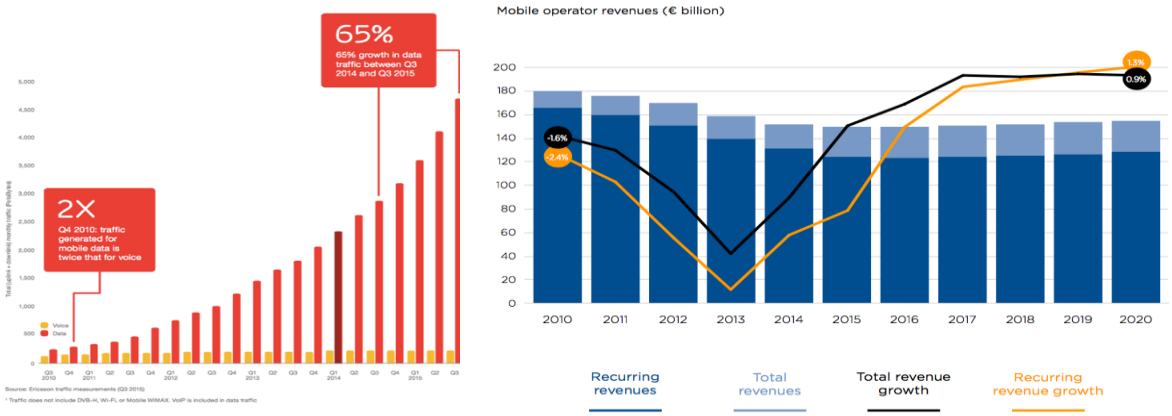


Figure 12. Graph (left) illustrating the data traffic growth compared with voice traffic between Q3 2010-Q3 2015 (Ericsson AB, 2015). Graph (right) showing European mobile operators revenues 2010-2020 (GSMA, 2015)

According to Blennerud (2016) there is a correlation between revenue growth for the MNOs and an increased end-user data consumption. Data intensive OTT-applications such as video- and music streaming drives the data growth and the more mobile data consumed the more revenue for the MNOs (Blennerud, 2016). The underlying logic is that with a larger data pipe accessible to the end user, the more data will be consumed, which implies that the MNOs could offer larger and more expensive subscriptions. However, in the highly competitive telecom industry the MNOs are undercutting in price each other with wars and bundles in order to attract new subscribers and gain market share (Blennerud, 2016; Martinsson, 2016; Mokhtar, 2016; Pagani, 2016; Alcoba, 2016; Orsini & Pompa Pacchi, 2016). According to Blennerud (2016) a misalignment between data subscriptions and end-user data consumption have occurred as a result from some MNOs introducing too large data plans. Previously the subscriptions were balanced against the end users' data consumption and in the case of increased data consumption the subscriber would need to do a, so called, top-up in order to get more data. This proved to be profitable for the MNOs and ARPU began to increase (Blennerud, 2016). In the case of reoccurring top-ups, the MNOs could offer the subscriber to upgrade to a larger data plan, hence increasing revenues, and since the data consumption per user increased over time this could be done over again keeping a balance between packaging and data consumption.

The result of introducing misaligned and excess data plans was that end users now had an excess of data, therefore eliminating the need for top-ups and upgrading to larger data plans gradually. One result of the introduction of excess data plans is the fact that the end user get more data, but still pays the same or less money (Blennerud, 2016).These kind of data plans, so called flat-rates and *all-you-can-eat* bundles, exist globally (Blennerud, 2016; Mokhtar, 2016) and encourage MNOs to get involved in cost competition rather than acting in innovative a manner (Martinsson, 2016). The operators pursuing this strategy seek to force down prices, which makes it hard see significant revenue growth in the consumer segment of MBB in the future (Martinsson, 2016).

The OTTs competes with the MNOs core business in communication services and have gained an advantage toward the MNOs (Pagani, 2016). The OTTs pose a threat directly toward the MNOs revenues from communication services (Blennerud, 2016). The

dominance can be seen to derive from several factors, but the main reason according to Pagani (2016) is the flexibility and speed in which OTTs can create and introduce new services at low operational expenditure. The reason for this technology gap between the MNOs and the OTTs derives the fact that the OTTs from the beginning had a need to manage their services from a central point in a way that enabled scaling and flexible introduction of new services (Pagani, 2016). The consequences, of the technological gap, are that the OTTs can be more agile when trying out new services and updates because the time required to introduce the new services are actually shorter than for MNOs.

Moreover, the applications are under total control from the OTTs and allows them to further shut out the MNO by encrypting the data traffic which makes it difficult for the MNO to scrutinize traffic and obtain valuable information about end users (Pagani, 2016). The end user information is related to the OTTs main assets and can be leveraged for developing of new services or other business purposes (Alcoba, 2016). Historically MNOs have had access to a lot of end user information but have been reluctant to do something with it, and now the OTTs reap significant revenues from leveraging their access to end user information (Blennerud, 2016).

5.2.3.2 The Tele2 case

Uncertainty about future connectivity solutions

Depending on how the industry evolves the connectivity might be incorporated into the device, making MNOs a supplier of connectivity to the actor, i.e. Apple, Samsung, etc., that will be in charge of offerings toward the end users. This is just one scenario of how the industry can evolve, but the development is going in that direction, and in this scenario MNOs would probably be even more driven toward cost competition (Rask, 2016).

The networks today are fairly under-utilized and (Rask, 2016) anticipate no problem with increased data consumption and a growing number of devices requiring connectivity. According to Rask (2016) it is rather the coverage that is the main headache, especially in rural areas where there are low coverage spots. A problem might emerge with QoS if end users choose to replace FBB with MBB, and in that case the networks would need expensive upgrades.

Finding new revenue streams and capitalizing on mobile data

Tele2 have already made the transition from business based on revenues from voice- and messaging to revenues generated from data traffic (Rask, 2016). There is still income from voice, but the focus is on data traffic. The more end-user data consumption, the more data Tele2 deliver and the more revenue is obtained. Along with the introduction of mobile internet and the emergence of OTT-communication services, Tele2 have changed charging scheme from voice and messaging toward charging for data consumption. According to Rask (2016) Tele2 does not recognize the OTT-communication services as a threat, rather they see these services as drivers of data consumption.

According to Rask (2016) data is a commodity, just like voice service, electricity and water. Data is the same everywhere, "*a MB is a MB*". Since it is very easy imitate between the MNOs, the possibilities are to differentiate with certain bundles, size of data plans and potentially speed. Subscriptions are easy for end users to compare and therefore MNOs are forced into pure price competition. Tele2's strategy is to be effective and maintain the lowest operational cost in order to obtain better ARPU or offering a lower price to the end-user. There is also additional value that can be added by e.g. differentiating data and that is something that Tele2 have been looking into for a long time, but in most cases it results in increased complexity for both the end-user and Tele2. Rask (2016) argues that it is difficult to compete on quality on the Swedish market since the MNOs either share networks or have equally sophisticated networks. Moreover, there is the problem that the end users do not have a detailed interest in the core product, connectivity, and therefore it becomes difficult to communicate the value added from differentiating data. MNOs need to focus both on effective operations and develop strategies for adding value to the product in order to avoid being commoditized.

5.2.3.3 The Telia case

Finding new revenue streams and capitalizing on mobile data

MNOs are coming from a monopoly on communication services, and lately going more toward offering data as their core product, hence focusing less on the communication part (Lenman, 2016). Although this is only a part of the development of MNOs business, and if you look at Telia in particular, the strategic vision has changed from aiming to be the best bit pipe toward being the *New Generation Telco Provider* and a role as service creator. Telia is now active in several businesses, e.g. TV, cloud, IoT, industry solutions, etc., and aim to provide end users with attractive bundles of services on top of connectivity. These services may be a product from partnerships with other actors or in-house, but according to Lenman (2016) the trends goes toward more and more partnerships. Telia and Spotify is an example of such collaboration, where the companies collaborate in commercial, operational and technical aspects.

The MBB industry is highly competitive on price, and are increasingly going toward a similar charging scheme as for FBB (Lenman, 2016). Telia as a premium MNO always aim to deliver the best quality toward users, and are actively working on creating value-adding services to develop their value proposition toward end users. In the cost competitive landscape, the MNOs compete with creating bundles of services on top of connectivity, and recently Telia launched a campaign zero-rating the use of certain social media applications. According to Lenman (2016) this is part of the MNO positioning war and means to attract new subscribers, although zero-rating implies giving away data for free.

There is a challenge related to growing data consumption and increasingly data intensive applications, and with 5G the networks will offer new ways to ensure QoS and preemptive measures toward congestion (Lenman, 2016). 5G offer the possibility for dedicated QoS and data differentiation, but net neutrality regulations pose a significant barrier. Telia would like

to be able to offer differentiated services and further regards it to be a way to financially motivate further investments in network infrastructure. The major OTT-players are in support of strong net neutrality-regulation, however Lenman (2016) mention that Telia frequently receive requests from OTT-players to install edge cache servers for effective content delivery. According to Lenman (2016) the MNOs would be strengthening their position in the value chain if they were allowed offer cache- and data differentiating solutions for faster access to OTTs. Potentially there will be opportunities with 5G to charge for quality, but according to Lenman (2016) that kind of offerings will primarily be directed toward B2B-end-user rather than the consumer market.

Competition from OTTs

The OTTs competes with the Telia's core business in communication services and have gained an advantage toward the MNOs (Lenman, 2016). The relationship between MNOs and OTTs have been a menace for some time now, especially concerning communication services. Lenman (2016) further argues that OTTs have an advantage toward in creating and introducing new services toward MNOs, especially in flexibility, speed and lower operational costs and derive this advantage from the fact that an OTT control the complete value chain in delivering services to the end users. When introducing or for updating services OTTs, e.g. WhatsApp, specify the features, immediately deploy and in 2 weeks all their millions of users have the new or updated service. This stands in stark contrast to when MNOs are to create a new service. For example, in the case where MNOs want to introduce a new, improved version of SMS. First all MNOs need to agree on all the specific features, exactly how the service will function and discuss with the suppliers (e.g. Ericsson). There is a long chain of stakeholders and various actors that all need to agree, and if there are any complications it starts all over again. An update of a service for the OTT takes 2 weeks in comparison to roughly 2 years for MNOs. There is simply no way to compete with the OTTs in speed when it comes to delivering new services.

Even though the MNOs might not be able to compete on flexibility, cost and speed there are opportunities to leverage existing capabilities and assets in delivering the most reliable communication services. According to Lenman (2016) the core offering in communication has not changed much during the last 10 years, and the features available then are still present today. The MNOs have an opportunity to leverage the fact that the OTT-services are divided over several silos (application specific), highly competitive and are dependent on data traffic, while a service like SMS is universal and independent of application, terminal and data traffic. Lenman (2016) also stresses the fact that even if an OTT-service like Facebook Messenger appear to have momentum at the moment it can change fast and that there is no sense is game over for the MNOs. According to Lenman (2016) Windows Live Messenger is a proof of this, since the service was totally dominant 10 years ago and vanished only 5 years later.

Executive summary

Current collaborations and actors' attitude toward collaborating

- Commercial collaborations between OTTs and MNOs have come the furthest in terms of being structured, official and widely spread. They often include bundling, zero-rating of services or unique co-created campains.

- Technical collaborations between OTTs and MNOs are less structured and often on an ad hoc basis. Dialogues occur, but few in depth collaborations exist.

- Collaborations with end users are structured and official, but on a highly superficial level demanding only minimal end user effort. For the purposes in scope for this thesis, they are not widely used. T-mobile's BingeOn offer and TIM's agent are two MNO-end user collaborations mentioned.

- MNOs and OTTs are generally open toward collaborating with each other, but do not actively seek technical collaborations to the same extent as commercial ones. The reason for this is several prerequisites and obstacles in creating B2B collaborations, see chapter 5.6.

- MNOs and OTTs are reluctant to initiate collaborations regarding the purposes in scope for this thesis due to a perceived passivity from end users. End users are not against collaborating per se, but have demands on the collaboration, e.g. minimal effort, which heavily limits the leeway for creating collaborations. Some actors have tried, but failed due to these demands, see chapter 5.7.

- Actors stance on the net neutrality grey zone, e.g. zero-rating of services, impact what collaborations actors are and are not willing to engage in. The larger the incentives, the less strict stance. OTTs are generally less willing to risk bad publicity than MNOs.

5.3 Current collaborations

Comparing different types of collaborations, there is a difference in how far they have come with regards to how developed they are, see figure 13. Commercial collaborations between OTTs and MNOs, i.e. collaborations with the purpose to attract or retain customers, have come by far the furthest. They are widely spread and often highly structured with official agreements between the different parties. Technical collaborations between OTTs and MNOs, i.e. collaborations with the purpose of improving the service delivery, are less developed in the sense that while they do exist between actors, they are usually ad hoc dialogues without official agreements between the actors. While collaborations with end users are common where the purpose is product development and improved customer service, they are less common if the purpose is an improved service delivery.

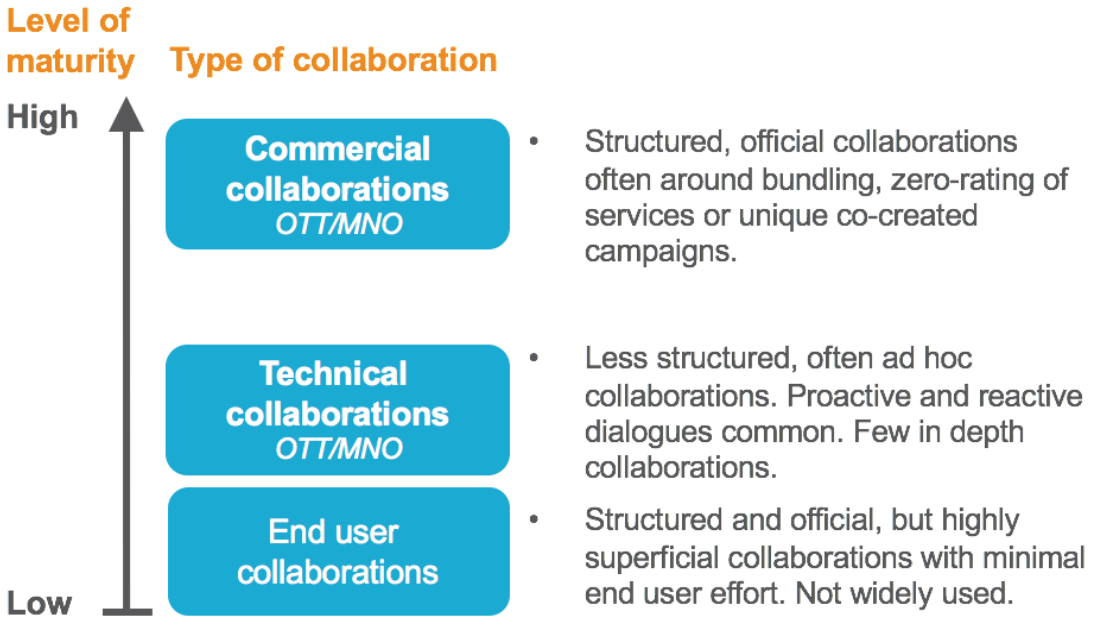


Figure 13. Level maturity of different types of collaborations with regards to how structured, official and widely used each type is by MNOs, OTTs and end users.

5.3.1 Collaborations with end users

Collaborations between MNOs and end user are rare (Alcoba, 2016). Usually, MNOs acquire the information needed about the end users either directly through monitoring their own networks, or from OTTs. There are exceptions, however. One example brought up by Alcoba (2016), Blennerud (2016) and Ludwig (2016) is T-Mobile's service Binge On. The service, which as default includes all subscribers, which subscribers can turn on and off according to their own wishes and to which OTTs can "opt out" or "opt in", down-grade the quality of video traffic detectable by DPI (van Schewick, 2016; T-Mobile, 2016) The logic is that video quality over 480p is rarely noticed on the screens of mobile devices, and consequently both waste of bandwidth for the MNO and unnecessary consumption of the end user's data plan (Alcoba, 2016; Blennerud, 2016). The value offered to the end user is, depending on the end users form of subscription, either the possibility to consume an increased number of

minutes of video or getting the video traffic sponsored entirely by T-Mobile. Yet another example is shown by TIM in Italy (Pagani, 2016). Through an agent installed by the subscribers, TIM acquire active measurements about the network QoS, which allow the MNO to tune in the network properly. In exchange the subscribers receive discounts on their data plan, and potentially better QoS.

A common way of collaboration between OTTs and end users, are OTTs asking end users for access to information in return for access to a specific service (Ludwig, 2016). As for collaborations that are more closely linked to QoS, some OTTs offer the end user the possibility to set the level of quality sent after their own preferences, e.g. Spotify and Netflix (Bohrarper & Gustavsson, 2016). In the case of Spotify few users ever change the default settings of receiving maximum quality.

5.3.2 Commercial collaborations between MNOs and OTTs

Between MNOs and OTTs collaborations have started to take form, where the vast majority are of commercial character to attract new subscribers (Pagani, 2016; Orsini & Pompa Pacchi, 2016). Bundling of services are common, where two separate solutions are offered together, often to a discounted price (Orsini & Pompa Pacchi, 2016). Orsini and Pompa Pacchi (2016) mention Fastweb and Sky as one example, but acknowledge that there are considerable number of similar partnerships. A growing form of bundling services is sponsored data or zero-rating, that is not only to offer the specific service or services to a discounted price but providing the without charge (Pagani, 2016; Blennerud 2016; Mokhtar, 2016; Ludwig, Ericsson, 2016; Orsini & Pompa Pacchi, 2016; Martinsson, 2016). Sponsored data can be enabled by information sharing where the OTT disclose information about IP addresses and URIs, but do not require collaboration to be established (Pagani, 2016). An alternative way is for MNOs to use DPI, a technique that is not 100 percent accurate, that is complex during certain circumstances (Mokhtar, 2016) and often imply high operation expenditure to keep the DPI technique updated (Pagani, 2016), but that hold the benefit of no requirements of partnering with OTTs. Pagani (2016) states that these kinds of collaborations mainly are a way for the MNOs to stay competitive relative other MNOs, which Orsini and Pompa Pacchi (2016) agrees by stating that the OTTs under those circumstances enjoy for free the benefit of knowing that their customers will have access to their service without the need to pay attention to their data plan usage. Blennerud (2016) adds however that the circumstances vary vastly between different regions, and consequently also the balance of bargaining power between operators and OTTs. In mobile first-markets, i.e. mobile technology represents the first communicational infrastructure rather than FBB. OTTs are highly dependent on operators for growth in customer base. Both Google and Facebook have had collaborations in for example Russia and Asia with the purpose of acquiring new customers through the operators and where the operator get kickbacks as compensation. In brief, OTTs can use the operators' existing customer base to reach new subscribers, and operators can boost their brand by collaborating with certain OTTs.

5.3.3 Technical collaborations between MNOs and OTTs

Technical collaborations, with the purpose of improving the service delivery and offering better quality to the end user, are not seen to the same extent as commercial collaborations (Orsini & Pompa Pacchi, 2016). Cooperation between the parties do exist, however. Blennerud (2016) mentions Spotify and Telia as a partnership that was initially created due to commercial interests, but later on developed into also including discussions about technical issues. Orsini and Pompa Pacchi (2016) further on refer to cooperations between OTTs and operators where skill sharing is core. OTTs such as Amazon and Google work in interorganizational project teams with operators to help them deploy best of breed telecommunication networks and cloud environment. The OTTs know that their possibility to offer high-end services depend of the operators' ability to enhance the capability of the networks. Collaborating in this way, Orsini and Pompa Pacchi (2016) says, the OTTs can help develop the network that will ultimately benefit them and their service, and at the same time the operators receive more value from the OTTs that they would be able to charge any party for it they would have decided to do corresponding improvements singlehandedly.

Another form of collaboration is when large OTTs install cache servers into operator's network, Netflix-Comcast being one example (Ludwig, 2016). With the content delivered directly from the cache servers instead of over peering or transit links, Comcast reduce their costs and Netflix get better user experience for their subscribers.

Regarding collaborations around service data differentiation they are to their knowledge non-existent (Blennerud, Ericsson, 2016; Mokhtar, 2016; Alcoba, 2016; Orsini & Pompa Pacchi, 2016). Information shared with the purpose of differentiation data traffic are present for charging purposes, for example sponsored data. According to Alcoba (2016), there are discussions on sharing more information, but it is rather under study than commercially deployed.

5.4 Actors' attitudes toward collaborating

In this chapter, actors' attitudes toward B2B collaborations, i.e. collaborations between MNOs and OTTs, and B2C collaborations, i.e. collaborations with end users, will be covered first on an aggregated level and then from each interviewed actors' perspective.

5.4.1 Attitudes toward B2B collaborations

MNOs and OTTs are generally very open toward collaborating with each other, but do not actively seek technical collaborations to the same extent as commercial ones. Omitting SVT-play, who is a public service company and therefore not allowed to have any commercial collaborations, this becomes very clear. Ericsson is the actor that show the most interest in creating new technical collaborations, and Spotify testify that this willingness from Ericsson is sometimes higher that they have the means to handle (Bohrarper & Gustavsson, 2016). On the question why the specific actors see value in and are open toward creating collaborations, but still do not pursue these opportunities, different obstacles to create

collaborations are mentioned. Spotify and Viaplay, for example, mention uncertainty on how to create collaborations, or collaborations taking a lot of time to uphold. With all this effort and no certainty that the investments will pay off, the internal to-do-list gets priority instead (Bohrarper & Gustavsson, 2016; Köpsén, 2016). Telia also mention opportunities in technical collaborations, but recognize that collaborations often require large investments and if so the company need to be able to monetize from the improvements (Lenman, 2016). A full list of the obstacles mentioned is covered in chapter 5.6.

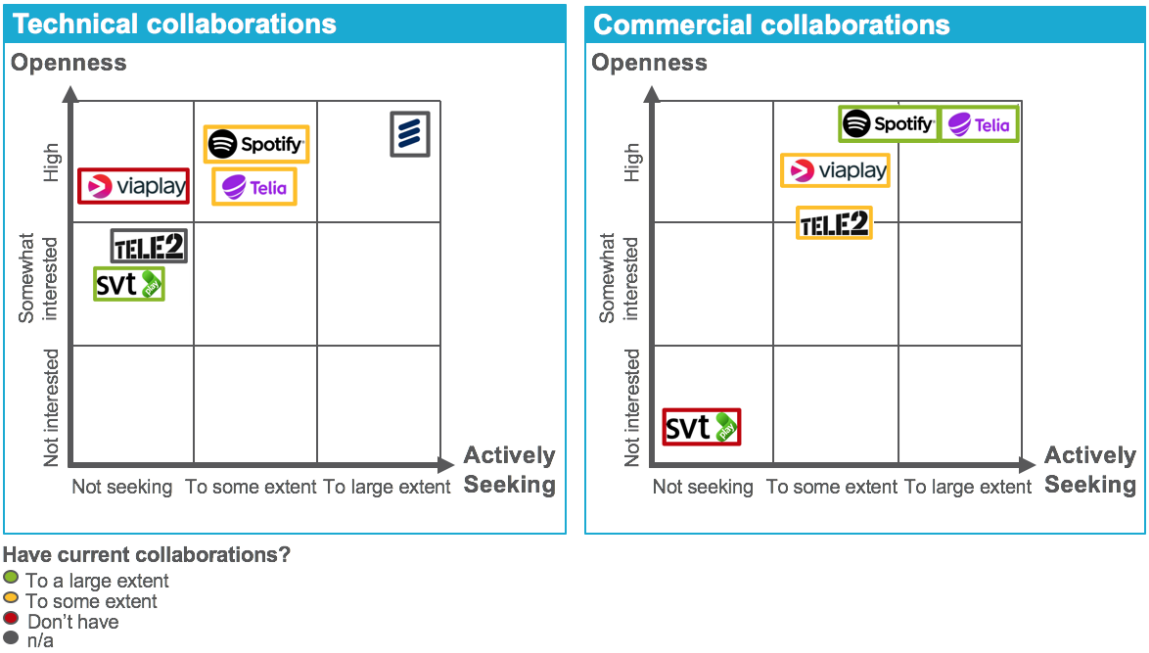


Figure 14. The figures show actors openness toward technical and commercial collaborations respectively, to what extent they are actively seeking such collaborations as well as to what extent they are currently engaged in these types of collaborations. Note that the interviewees have been employed in technology development, not the commercial side. Furthermore, the interview with Tele2 mainly focused on data traffic differentiation.

5.4.1.1 The Tele2 Case

Current collaborations

Tele2 are engaged in commercial collaborations in Lithuania concerning packaging and bundling together with OTT-services, e.g. Spotify, Deezer, etc., in different price models (Rask, 2016). Also, on the Swedish market Tele2 work with campaigns where OTT-services are a part of the value offering toward the end user (Tele2, 2016). As for technical collaborations Tele2 are not deeply engaged in any collaborations, and Rask (2016) argues that the OTT currently send as much data they want and show no interest in working together to enhance the end user experience.

Future collaborations

Tele2 recognize opportunities to create value through collaborations with OTTs by applying zero-rating or the possibility to adapt data traffic to fit the terminal or end user's needs (Rask, 2016). The upside of such collaborations are according to Rask (2016) avoid eroding the end users' data bucket and not to overload the networks by sending too high quality in

vain. Rask (2016) mention T-Mobile's Binge On service as an interesting collaboration. Although, he mentions that the MNO have to consider the option that the end user might use their unit connected to other units with larger screens, and if the quality is adapted for the smaller screen the end user experience is reduced.

From Tele2's perspective, adapting traffic would be especially valuable during peak hours. A potential business model around zero-rating is the AT&T introduced sponsored data concept of "*sender pays*", where the OTT-player is charged for the data traffic used by the end user (Rask, 2016). The US carrier AT&T launch the service as a service where "*customers can browse, stream and enjoy without using monthly data allowance; provides opportunities for businesses across multiple industries"* (AT&T, 2014). The service is a two-sided charging model for mobile data that enable developers and other content providers to subsidize the data bills of subscribers, hence allowing not affecting the end users' monthly data bucket. According to Rask (2016) this is an interesting business model, however it has not yet taken off.

Moreover, Rask (2016) acknowledge that commercial collaborations between MNOs and OTTs, i.e. allowing the parties to leverage each other in branding, marketing and service offering purposes, are probably a consistent trend that will continue in the future. He also adds that such collaboration might involve the MNO to act as a retailer for certain OTT-services. In the Swedish market the collaboration between mobile operator Telia and music streaming service Spotify, is an example of a commercial collaboration where the actors have leveraged each other's strengths to reach new subscribers and further develop their offerings (Rask, 2016).

5.4.1.2 The Telia Case

Current collaborations

Telia's most recent strategic vision is to be the *New Generation Telco,* involves being open to collaborations and partnerships with third parties (Lenman, 2016). In line with this vision Telia aim to develop new customized services in collaboration with other companies both toward enterprises and end users. Currently, Telia is actively engaged in several collaborations aiming to improve end users experience. The most prominent collaboration is together with Spotify, where Telia even own stake, and the companies work together in multiple aspects, commercially and technically. Technical in the sense to co-develop features and improve QoS, however these mutual projects are classified and Lenman (2016) unfortunately cannot further go into detail. Speaking in terms of commercial collaborations, Lenman (2016) argue that there is a win-win situation, e.g. Spotify leverage Telia's existing customer base to reach new end users, and Telia use Spotify's image as a new, hip startup for branding purposes and to create Telia unique bundles. Lenman (2016) adds that in the co-branding, Spotify also benefit from increased marketing exposure since their logo appear on most Telia commercials, and Telia has one of the largest marketing budgets in Sweden. Moreover, Telia take responsible for the payment (in Telia-Spotify bundles) from end user to Spotify. The win for Spotify in this, and also the reason why Telia can charge Spotify for it, is

that one of the most common reasons for Spotify subscribers quitting their subscription is when the registered credit card expires and the subscription is automatically ended. When signing up for Spotify through Telia it is included on the end users' monthly bill, hence not dependent on a specific credit card. Lenman (2016) add in context that collaborations are easier to obtain with Swedish OTTs rather than with large US OTTs with global presence that might regard Sweden as a minor market and hence not prioritized.

The most recent Telia campaign is the zero-rating of social media, and according to Lenman (2016) it aims to attract new subscribers and strategic move in the price war between MNOs. Lenman (2016) further acknowledges that it is a counter-move to the competitors 3's zero-rating of music streaming. The campaign offers subscribers to use the social media applications Facebook, Instagram, Messenger, WhatsApp, Twitter and Kik (Telia, 2016). To realize the campaign Telia has signed agreements with the OTTs to open up their IP-address range, so that the data traffic can be detected easily and not charged to the end user. However, it should be noted that there is now business model involved between Telia and the OTTs since the OTTs does not pay for the traffic. As stated above, the campaign is about positioning in the MNO price war.

Future collaborations

Telia is actively pursuing opportunities to create new, unique and attractive services toward end users and regard collaborations with other actors as a vital part (Lenman, 2016). Services in line with their Spotify offerings and zero-rating of social media, but are also investigating new areas in the pursuing the vision of being *The Next Generation Telco*.

In line with their future vision, Telia signed, together with GSMA and other global operators, a press release saying that they are positive to Google's acquisition of communication service Jibe (Lenman, 2016; GSMA, 2016). Jibe delivers communication services, messaging and enriched voice calls based on a global standard and will now work alongside with MNOs to create an alternative and taking up competition against Facebook's market dominance from Facebook Messenger and WhatsApp. Lenman (2016) regard this collaboration among the global operators (including Telia) and Google as a way to stay competitive in the communication service business.

5.4.1.3 The Spotify case

Current collaborations

Spotify have partnerships with a large number of operators in the geographical markets the company is active in (Bohrarper & Gustavsson, 2016). In new markets, where the partnerships are of most value to Spotify, they collaborate with at least one operator per market. The partnerships are mainly centered around marketing purposes, bundling of subscription, and in some cases on zero-rating of the Spotify service.

Although the collaborations between Spotify and the operators are established due to synergies from a market perspective, additionally they provide an opening to discuss technical matters. Today, Spotify therefore have dialogues regarding technical issues with

many operators across the different regions of operation. Bohrarper and Gustavsson (2016), mention Telia as the Swedish example where the partnership started as a commercial collaboration, and then gradually started to incorporate also technical dialogues. To illustrate the benefits for both parties in such collaborations, Bohrarper and Gustavsson (2016) refer to an Indonesian operator: "*The operator has an interest in being able to say that you as a subscriber will have a particularly good Spotify service using their subscriptions. That initiates a dialogue between us about what is possible to do to improve QoE*". In this specific case, Spotify became aware about cache nodes in the operator's network that they were able to use. Bohrarper and Gustavsson (2016) emphasize that while the discussions are rather focused on what the actors can do on their specific ends rather than together, the discussions provide an understanding of a situation and solutions that would otherwise pass unnoticed.

Future collaborations

Bohrarper and Gustavsson (2016) see great potential for collaboration with the purpose of "debugging the last mile network". For Spotify, a better understanding of the last mile network and obtaining understanding why problems with QoE occur and in close to real-time see when they take place, would imply a possibility to improve the application's performance under adverse conditions. More specifically, it would be possible to configure the settings pursuant to prevailing conditions with higher granularity, for example by sending different bit rates or differentiate how aggressively the service apply prefetching. Today, both bit rates and prefetching strategy is set on a common global level. For operators, Spotify see values partly in that operators would be able to say that certain OTT-services work well with their subscriptions, and additionally in that operators would be able to understand exactly to what extent a limitation of bandwidth impact the experience their end users.

Thenceforth, to attain the actual value information sharing is a necessity. "*All parties have their sporadic understanding of the problem, and then there is a black hole of aspects they do not understand*", Bohrarper and Gustavsson (2016) states. "*We need to improve in measuring at our end, but we also need to better understand the entire infrastructure, and that we can only do by collaborating with the operator*".

Moreover, Bohrarper and Gustavsson (2016) add that regardless of specific collaborations, increased communication and a closer dialogue with the operators are beneficial to Spotify. QoE issues most often come down to one out of two pathways: either the operator need to expand their capacity, or Spotify need to utilize the given bandwidth more efficiently. A closer dialogue would thus provide Spotify an understanding of why noted issues actually occur, and help them decide on appropriate solution.

Operators are usually easy to discuss issues with if Spotify already have an established collaboration. In other cases, the operators may still be interested, but the problems that Spotify bring forward need to be clear and specific, and the process of finding the right

person to talk to is often remarkably time consuming. Of all the actors, Spotify note that Ericsson is by far the actor that show the greatest interest in establishing collaborations between MBB actors.

5.4.1.4 The SVT-play case

Current collaborations

SVT-play have an ongoing dialogue regarding QoS related issues with the majority of the largest operators in Sweden, who often control both mobile and fixed networks (Karlsson & Porsaeus, 2016). This type of collaboration is not particularly common, only employed by half a dozen or so OTTs according to Karlsson and Porsaeus (2016), as most OTTs do not send enough data for the collaboration to be justifiable. The type of OTTs involved in such dialogues include video streaming applications such as SVT-play, but also organizations such as OS providers or online game providers during the releases of software update.

The communication that SVT-play have with the operators are both of proactive and reactive nature. In case of anticipated peaks, as is the case with large sport events, SVT-play initiate discussions with the operators to make them aware of the situation and take necessary precautions. Karlsson and Porsaeus (2016) point out that anticipating the capacity need for events such as the Olympic Games and World championships is difficult, since the number of viewers are highly dependent on the performance of the Swedish teams and athletes. Therefore, there might still be issues with QoS as no one is interested in having invested in increased capacity in the case of lack of Swedish advancement and no subsectial data traffic peak.

Discussions are also held between SVT-play and the operators when issues with QoS have occurred. SVT-play disclose information about measured QoS metrics to make the operators aware of where there are issues, to understand the source of the problem and to discuss what actions can be taken to improve the situation. According to Karlsson and Porsaeus (2016) a conversation could go as follows: "*We sent X GB data traffic and had Y amount of traffic loss. Did you have a bottleneck, where was it, and what can be done about it?*" In some cases, the cause for poor QoS are parts of the network that is not correctly configured, in others the operator need to invest in additional bandwidth to solve the issue. Karlsson and Porsaeus (2016) further states that MNOs sometimes refrain from revealing the cause of the problem, and instead let SVT-play know that they are aware of and working on the issue.

Future collaborations

Karlsson and Porsaeus (2016) are satisfied with the current collaborations between SVT-play and the operators. They would not describe it as SVT-play and operators are working together to improve QoE, but that it is a prioritized area for both parties. SVT-play work constantly with improving the quality for every given bit they send out through for example data compression and argue that QoE in the last mile networks is the responsibility of the

operator. What they can do, and are doing currently, is to enlighten the operators when and where there are QoE issues.

Karlsson and Porseaus (2016) acknowledge that there are always opportunities to open up for further collaborations. Future possibilities could include edge caches, P2P techniques, and strategies when changing protocol from TCP to UDP. They add however that the industry is not quite there yet, that operators have undertakings regarding capacity expansion to tackle on their own, and that extended collaborations between SVT-play and operators specifically is not the best way forward. Furthermore, Karlsson and Porseaus (2016) add that SVT-play is just one of many actors in the networks and they can only do so much.

5.4.1.5 The Viaplay case

Current collaborations

Today, Viaplay has some degree of collaborations with MNOs, such as Tele2, Telia, etc., where end users have the possibility to get the Viaplay service on their MNO-invoice and certain bundles together with certain MNOs (Köpsén, 2016). Viaplay has roots in traditional TV broadcasting and therefore have several collaborations and agreements with TV-operators as well. Köpsén (2016) notes that current collaborations are of commercial character to attract more end users through attractive offerings, and regarding technical collaborations the questions revolve around integrating IT-systems rather than to improve QoS.

Future collaborations

Köpsén (2016) consider collaborations with MNOs around improving content delivery, e.g. quality and latency issues, to be of great interest. The MNOs, for obvious reasons, have deeper knowledge about MBB networks and could provide with valuable information to fine tune video delivery. It would be interesting to get general MBB network information in order to optimize content delivery and thereby deliver best possible service to the end users. For example, if Viaplay has video quality delivery levels of 0.5, 1.5 and 2 Mbit/s and the MBB network does not support 2 Mbit/s, but can deliver quality of 1.8 Mbit/s. Viaplay could with this information fine tune the video quality delivery levels to 1.8 Mbit/s rather than 1.5 Mbit/s, and therefore deliver the best quality possible to end users during certain MBB circumstances. Information sharing and collaborations in such manner would be valuable to Viaplay. Especially considering the fact that Viaplay today has no information at all about what happens in the last mile delivery, i.e. MBB or Wi-Fi. The more information at hand, the easier to identify and optimize problems in the streaming delivery. Viaplay is also open to share their information as long as it brings mutual benefit and that the other actor does not engage in competing business. Köpsén (2016) argue that Viaplay in general are open to collaborations, with the exception of competing businesses.

5.4.2 Attitudes toward B2C collaborations

Collaborations with end users with the purpose of improving the service delivery are rare and not particularly deep. Spotify and SVT-play let end users set their quality preference, but degree of usage are not high, especially in the case of Spotify. With the exception of collaborations with the purpose to improve the product or customer service (focus groups, surveys etc.), the actors are not seeking collaborations with end users. This can be attributed to their experience of end users as passive. It does not mean that end users are against collaborating per se, but rather that they are only willing to put in minimal effort into a collaboration (more on this in chapter 5.7).

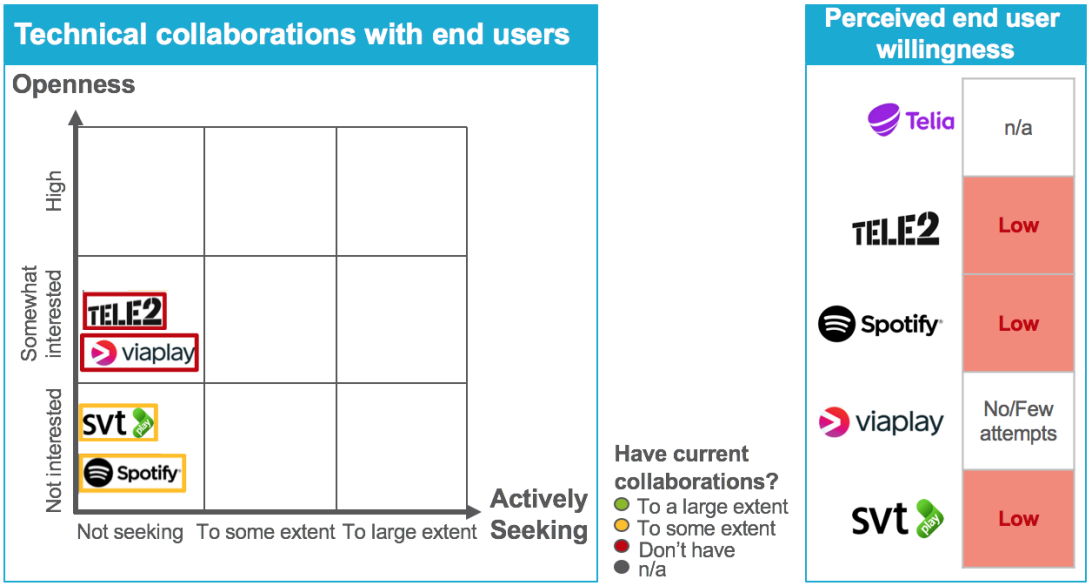


Figure 15. The figure to the left show actors' openness toward collaborating with end users, to what extent they are actively seeking such collaborations as well as to what extent they currently have end user collaborations. Note that only collaborations with end users on large scale and with the aim to improve the service delivery are included, thus not focus groups, customer service etc. The figure to the right show the actors' perception of end users' willingness to collaborate. The interview with Telia concerned mainly collaborations with OTTs and are therefore not mentioned in this section.

5.4.2.1 The Tele2 Case

Just as for OTTs, Rask (2016) mentions that Tele2 are not deeply engaged in any collaborations with end users. Furthermore, he states that Tele2 are interested in improving QoS, but argues that the interest from end users to engage in collaboration is low. *"End users view connectivity the same way as electricity – it shall just work*". Rask (2016) further argues that the concept of QoS, different service levels, and thus the value from collaborations, is difficult to communicate to end users, hence end users are passive to engage in collaboration, and that is where many attempts have failed.

5.4.2.2 The Spotify case

Spotify allow end users to choose desired sound quality as it could be preferable to receive lower quality than default, for example if the subscriber has a small data plan and otherwise risk eroding it prematurely. Bohrarper and Gustavsson (2016), note however that very few users ever change these settings.

Spotify are restrictive with creating new collaborations with end users and have no intentions of expanding the existing ones, on the contrary. Bohrarper and Gustavsson (2016) note that while there is information about the end user that Spotify would benefit from acquiring, to obtain it Spotify often need permission from the end users. According to Bohrarper and Gustavsson (2016) such questions are not appreciated by the end user and thus something Spotify, as far as possible, refrain from asking. Regarding the different actors' willingness to collaborate, Bohrarper and Gustavsson (2016) state that end users are relatively passive and not particularly interested in helping out.

5.4.2.3 The SVT-play case

Toward the viewers, SVT-play detect large scale issues automatically and offer customer support to detect individual or small scale problems. Moreover, to avoid consuming the entire data prematurely, SVT-play offer the users the possibility to choose a lower video quality than they receive as default. This option is used to some extent on MBB, according to Karlsson and Porsaeus (2016), while rather non-existent on FBB. As for extended collaboration with the end users, SVT-play is constantly developing their customer support. Other than that however, no collaborations with the end user is of current interest to the company.

5.4.2.4 The Viaplay case

Concerning collaborations with end users, Köpsén (2016) argues that Viaplay consider end users to be the focus area in improving the streaming service. However, most of the collaborations are focused on collecting operational end user data, customer surveys and customer support functions to improve the delivered service. In addition, Viaplay actively involves end users in developing new features by inviting focus groups for testing and regularly invite selected end users to better understand their experience. Viaplay also notifies end users about any problems related to the service, e.g. delays, technical issues, etc. According to Köpsén (2016) Viaplay strives to be open and transparent as possible toward end users, regardless if the issue lies within the control of Viaplay or external factors causing problems with the streaming service.

As for large scale collaborations with end users with the purpose of improving the service delivery, no collaborations are mentioned. Köpsén (2016) recognize a need from end users to be able to adapt the video quality, but mentions that it's not top priority but rather included in the list of many improvements that need to be done.

5.4.3 Actor stance on net neutrality influence willingness to collaborate

One important factor impacting the actors' attitude toward collaborating is their stance on net neutrality. While all actors emphasis net neutrality to be an important principle to follow, they differ with regards to what they consider a violation of net neutrality. Zero-rating is one source for dissension, for which in most European countries there are no regulatory preconditions that restrict zero-rated service (BEREC, 2016). Telia recently launched an offer with zero-rating of certain social media sites (Lenman, 2016). Spotify says

they are engaged in bundling deals where their service is zero-rated, but point's out that it is the operator who choose to zero-rate, not them (Bohrarper & Gustavsson, 2016). Viaplay and SVT-play on the other hand consider zero-rating a mischief and a clear violation of net neutrality (Köpsén, 2016; Karlsson & Porsaeus, 2016). Thus, the different actors' stance on what they do and do not consider a violation of net neutrality naturally impact what collaborations they are and are not willing to enter.

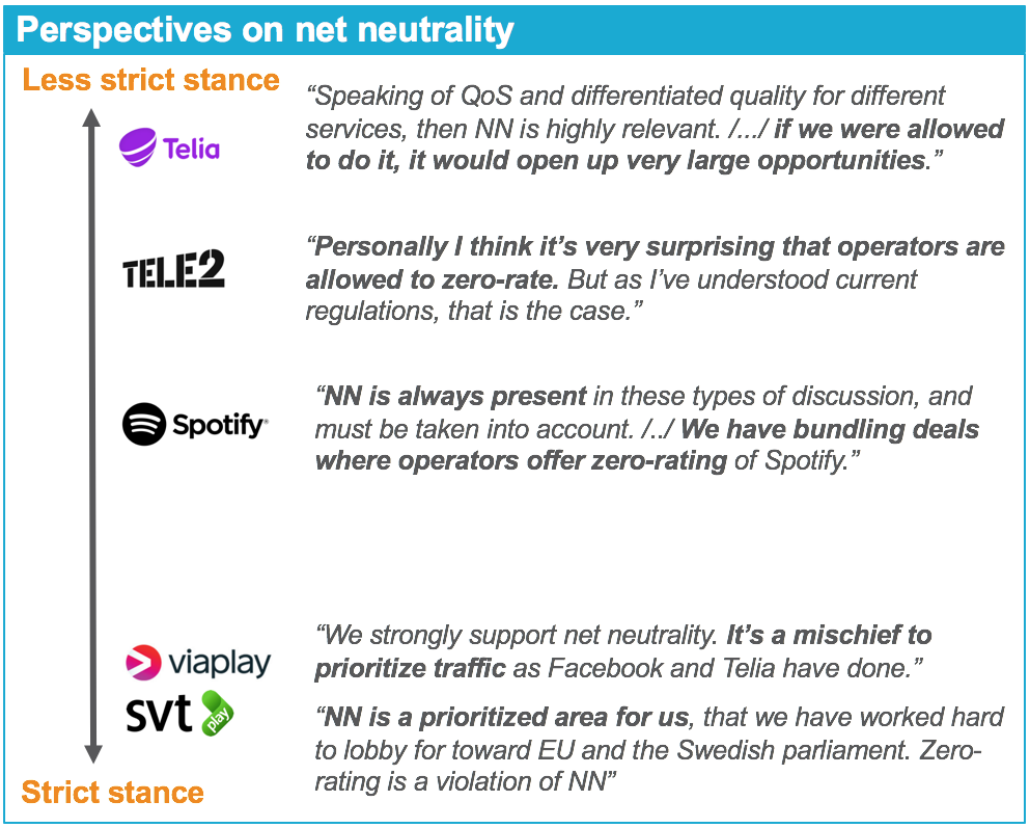


Figure 16. Different actor's perspectives on net neutrality. Note that the actors are placed according to the researchers' perception, not the actors' own opinion

5.4.3.1 The Tele2 Case

Tele2 consider data traffic differentiation with the purpose of improving QoE as a highly interesting area which they follow. Rask (2016) especially points out opportunities in differentiation with regards to whether a service is real-time-sensitive or throughput demanding. Downloading documents or emails do not need to occur in a ms, and (Rask, 2016) argue that "*it does not really matter how long time it takes, whether it is 2 or 3 seconds".* Hence, Rask (2016) argue for the possibility to prioritize real-time sensitive traffic, e.g. calls, video stream, etc., since it is more important for the end users experience. Even though they have looked into the possibilities previously, they are not engaged in any service data differentiation due to net neutrality regulations (Rask, 2016). "*We are very cautious not to do anything until we know what will and will not be allowed".*

In terms of zero-rating, Rask (2016) note that such collaborations were only recently introduced to the Swedish market by 3, when launching their zero-rating of music streaming

services. According to Rask (2016) it is surprising that 3 are allowed to that since it skews the competition in the OTT-market.

5.4.3.2 The Telia Case

Just as Tele2, Telia sees great possibilities in improving QoE, but acknowledges net neutrality to be a principle that is restricting what can and cannot be done. Differentiated QoS would according to Lenman (2016) be an ideal collaboration, as well as a way to ensure return on investments, strengthen the MNOs position in the mobile data delivery value chain, and be a way to financially motivate further investments in MBB networks. When MNOs make large investments in 5G, cache server-solutions and network development, it is only natural to generate revenue in order to finance these kind of network developing investments. Lenman (2016) argue that the MNOs would have a very attractive offer toward OTTs if they were to offer dedicated QoS based on data differentiation, however with the current interpretation of net neutrality regulation it is not possible.

Lenman (2016) consider installing cache servers from OTTs to be in conflict with net neutrality regulations, and support this with the argument that it skews the competition in the same way as paying for dedicated QoS from data differentiation. Large OTTs have far better possibilities to invest in cache server solutions than smaller OTTs and startups, however it is an interesting business model for MNOs to generate revenue.

5.4.3.3 The Spotify case

As previously mentioned, some of the partner operators offer zero-rating of Spotify, and Spotify therefore disclose information used for this type of data traffic differentiation (Bohrarper & Gustavsson, 2016). Concerning data traffic differentiation with the purpose of optimizing the service delivery, Spotify are not engaged in any collaborations. Bohrarper and Gustavsson (2016) state that due to the net neutrality debate, it is a difficult area enter.

5.4.3.4 The SVT-play case

Net neutrality is of paramount importance to SVT-play, and a view point they advocate and lob for toward the Swedish as well as the European parliament. Karlsson & Porseaus (2016) emphasis that they are not and will not discriminate anyone, neither positively nor negatively. Furthermore, they view zero-rating of any kind as a violation of net neutrality.

5.4.3.5 The Viaplay case

Viaplay is aware of collaborations between MNOs and OTTs resulting in zero-rating of certain applications, however Köpsén (2016) regards these kind of collaborations as contemptible. Köpsén (2016) argues that Viaplay has a strong position in favor of net neutrality, and points to the fact that Viaplay, among several other Swedish OTTs and media actors, recently signed an announcement in favor for net neutrality and the open Internet (Almqvist et al., 2016). Moreover, Viaplay is not engaged in any collaborations involving zero-rating or sponsored data and there are no present discussions in the organization to start doing so either (Köpsén, 2016).

_____Executive summary_____

Potential collaborations

- Commercial collaborations are predicted a brighter future than technical collaborations according to many interviewees.
- There are many different potential collaborations, and this thesis aim by no means to provide a full list. Some mentioned are however terminal adapted traffic, zero-rating of services and “good citizen” collaborations.
- One specific type of collaborations of interest, enforced by especially the OTTs, is unbugging of the last mile network. While the purpose is to improve QoS/QoE, the solution can be sought at both the MNOs’ end and/or the OTTs’ end based on information and knowledge exchanged between the parties. It could e.g. comprehend configuring the OTT services to specific MBB network conditions, or finding sources of or warn for QoS/QoE issues as well as adequate ways to fix it. The collaborations can be categorized according to point in time and level of complexity and engagement.
- A second specific type of collaborations of interest, due to the technical opportunities, is service data differentiation. Many different technical opportunities are mentioned, such as ensuring quality based on information sharing, slow lanes and other means of dedicated QoS. It is however also noted that net neutrality is a large concern regarding this type of collaborations.
- For the whole picture, this section should be read together with section 6.3.

5.5 Potential collaborations

There are many different potential collaborations, and this thesis do not aim to provide an exhaustive list. This section will first briefly explain a few collaborations mentioned throughout the interviews, before digging deeper into two specific collaborations of interest: collaborations around unbugging the last mile network and collaborations around service data differentiation. While commercial collaborations are predicted to have the brightest future according to interviewees, the collaborations of interest are chosen within technical collaborations as this is an area where collaborations are used to a lower extent today. This section should be read together with section 6.3 to get the full picture.

5.5.1 Development of current and potential collaborations

Regarding collaborations between MNOs and OTTs and end users, Blennerud (2016) and Orsini and Pompa Pacchi (2016) endorse business models where data traffic is adapted for its final destination, i.e. terminal adapted data traffic. The adapted traffic would require less bandwidth in the MBB network and consume less data from the end users' data bucket (Alcoba, 2016). In such business models the MNO could reach an agreement with OTTs and end users to adapt data traffic to ensure high end user QoE and at the same time avoid eroding the data plan (Blennerud, 2016). MNOs could then tailor subscriptions toward end users. Orsini and Pompa Pacchi (2016) argue that this kind of business model may grow in the future under the condition that the data compression done by the MNOs does not negatively affect the perceived quality.

Moreover, sponsored data and zero-rating are believed to keep growing in use as a collaborative mode of business model between MNOs and OTTs (Orsini & Pompa Pacchi, 2016; Pagani, 2016). Arrangements around sponsored data tend to include a win-win situation for both MNOs and OTTs since it aims to attract new subscribers. Pagani (2016) argue that it might become increasingly popular that the OTT pays for the data in order to not totally erode end user's data plans. The more bandwidth an OTT require, the more interesting it should be for the OTT to subsidize end user's data consumption.

In light of increasing data consumption and risk for congestion in the networks McGillivray (2016) advocate for a solution where actors in the MBB industry collaborate to reward OTTs and end users that act as good Internet citizens. Websites are bloated with advertisement in both video and pictures, making websites that originally are in kB-size to be in MBs. This pose a threat toward the QoE on the Internet and at the same time to erode end users' data plans. If the actors would collaborate around this issue it is possible to significantly improve content delivery in the MBB networks making it fast and flexible with MBB adapted advertisement and services. McGillivray (2016) mention Google's AMP project as an example in the right direction, however actors of the MBB industry should come together to create a universal agreement rewarding MBB adapted websites not controlled by a single firm.

5.5.2 Unbugging the last mile networks

Several of the interviews revealed an interest, see figure 17**,** from the MBB actors to engage in collaborations aiming to improve QoS in MBB networks through conversations and information sharing of performance related issues and metrics.

Different actors' persectives on unbugging the last mile networks

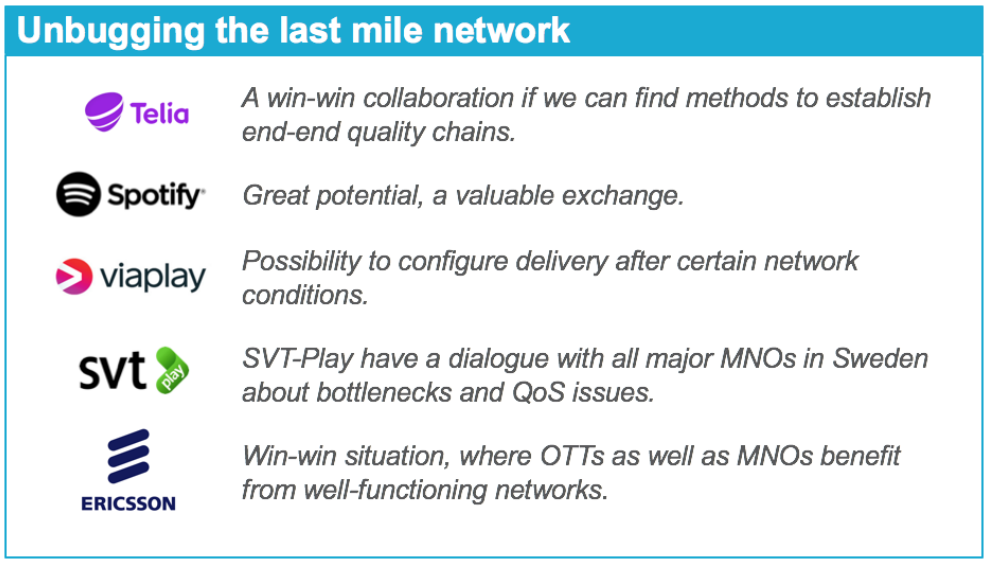


Figure 17. Opinions from interviews on Unbugging the last mile networks.

From an OTT perspective, the interviewees from Spotify, SVT Play and Viaplay all identify values in collaborating with MNOs to gain deeper understanding about the content delivery process in the MBB networks.

SVT-play have already established ongoing dialogues regarding QoS related issues with the majority of the largest operators in Sweden, who often control both mobile and fixed networks (Karlsson & Porsaeus, 2016). This type of collaboration is not particularly common, only employed in Sweden by half a dozen or so OTTs according to Karlsson and Porsaeus (2016), as most OTTs do not send enough data for the collaboration to be justifiable.

Bohrarper and Gustavsson (2016) from Spotify see great potential for collaboration with the purpose of "debugging the last mile network". A better understanding of the last mile network and obtaining understanding why problems with QoE occur and in close to real-time see when they take place, would imply a possibility to improve the application's performance under adverse conditions. To address operational QoE issues, a lucrative undertaking according to Bohrarper and Gustavsson (2016), and which Spotify intend to explore, would be to correlate QoS metrics measured by Spotify with operator metrics regarding capacity. Thus, finding anomalies at Spotify's end and understanding the source of the issues through information exchange. More specifically, it would be possible to configure the settings pursuant to prevailing conditions with higher granularity. Moreover, they argue that "*all parties have their sporadic understanding of the problem, and then there is a black hole of aspects they do not understand*". Bohrarper and Gustavsson (2016)

further states that Spotify need to improve measuring at their end, but are also interested in understanding the entire infrastructure and that can only be done by collaborating with the network operators. Collaborations regarding the last mile network could prove substantially valuable to both Spotify and operators (Bohrarper & Gustavsson, 2016).

Moreover, Bohrarper and Gustavsson (2016) mention that while deeper collaborations, based e.g. on correlating performance metrics, could be of interest, mere dialogues about issues and possible solutions are highly valueable. According to Bohrarper and Gustavsson (2016) these types of dialogues can be particularly valuable in regions or countries with under-developed connectivity infrastructure. Spotify as a Swedish company, comprised of a lot Swedish, Western and American engineers, are used to just contact an internet service provider to get more bandwidth without any problems. However, that is not the case in the rest of the world where some countries have very limited and expensive capacity. With a dialogue Spotify can better understand the capacity limitations and make sure that their client functions also in conditions with low bandwidth capacity.

Köpsén (2016) from Viaplay shares the perception that it would be valuable to know more about the content delivery within the MBB. A big issue for Viaplay is that they do not control the last mile and can only make sure to have good deliveries until the last mile network, i.e. Wi-Fi or MBB, and also have full control at the client on the end users' terminal, but when the content goes into the last mile all control is lost. Collaborations with MNOs around improving content delivery, e.g. quality and latency issues, is considered to be of great interest, especially since the MNOs, for obvious reasons, have deeper knowledge about MBB networks and could provide with valuable information to fine tune video delivery. Engaging in collaborations would present the opportunity to get general MBB network information in order to optimize content delivery and thereby deliver best possible service to the end users. It brings the opportunity to adapt the service to the MBB networks and to fine-tune the video delivery to make it as effective as possible.

Telia, as an MNO, also show interest in establishing an end-end quality chain and taking control over the last mile making it possible to improve QoS. Lenman (2016) argues that it is in the MNOs and the OTTs interest to work closer to improve the content delivery in MBB networks, and therefore it exists an opportunity to collaborate. Telia see great value to improve our MBB networks and it is good for the OTTs, so it becomes a win-win collaboration if methods can be found to establish an end-end quality chain.

Categorization of different types of collaborations

While the end purpose for collaborations around unbugging the last mile network is improved QoS/QoE for end users, the solution could be found at both the MNOs' side and/or the OTTs' side. Today, most of these sort of collaborations consist of OTTs informing MNOs of expected or current QoS/QoE issues, thus e.g. helping the MNO to prepare appropataly for an upcoming event or identify and correct a misconfiguration in the network (Karlsson & Porsaeus, 2016). Viaplay and Spotify are however also open to use the

collaborations to configurate their applications according to the specific network conditions (Köpsén, 2016; Bohrarper and Gustavsson, 2016). Bohrarper and Gustavsson (2016) eludiates adapting the aggressivity of prefetching as an example, and Köpsén (2016) mention adapting the adaptive bitrate thresholds, as mentioned in section 5.4.1.

Collaborations concerning *unbugging the last mile networks* can be plotted in a matrix with two dimensions; time and degree of interaction, that in combination create four levels of collaboration. As shown in table 4 below collaborations may be either reactive or proactive and on an aggregated or detailed level of interaction.

	Aggregated	**Detailed**
Reactive	*Level1:* *Dialogue about occurring issues related to mobile data traffic*	*Level 3:* *Collaborating to solve and understand technical issues ad-hoc*
Proactive	*Level 2:* *Dialogue about anticipated events related to mobile data traffic*	*Level 4:* *Sharing information in advance to optimize and deliver best possible service*

Table 4. The unbugging of last mile matrix.

Level 1 **Reactive & Aggregated:** Collaborations in this level is characterized by exchange of information on a high level of notifying or informing to aid the counterpart in solving the occurred QoS-issue. The dialogue typically takes place at the time of the occurred QoS-issue.

> An example from the interviews is SVT Play that have dialogues and disclose information with major MNOs in Sweden regarding occurred bottlenecks or any errors in network configuration that affects their service resulting in poor QoS. By notifying the MNOs a dialogue can be held to understand the source of the problem and potentially discuss what kind of actions are needed to solve the problem. (Karlsson & Porsaeus, 2016)

Level 2 **Proactive & Aggregated:** In this level collaborations comprise of an aggregated dialogue about anticipated events that most likely will effect the amount of data consumption or network performance. The dialogue is established to inform or notify the counterpart that QoS-issues may arise because of this anticipated event.

> An example from the interviews is SVT Play that in the case with large sport events initiate discussions with the operators to make them aware of the situation and take necessary precautions. (Karlsson & Porsaeus 2016)

Level 3 **Reactive & Detailed***:* These collaborations aim to go further than merely informing and notifying in the case of an occurred QoS-issue, and the actors involve on a deeper and more technical level to solve the problem at hand.

> An example could be that the MNO and the OTT disclose and correlate their performance metrics and share knowledge to gain understanding and eventually solving the occurred QoS-issue. Spotify argue that a closer dialogue with MNOs gives the opportunity to get a better understanding about why the problems actually occur and how they can be solved (Bohrarper & Gustavsson 2016).

Level 4 **Proactive & Detailed**: Collaborations in this level aim work together to optimize the content delivery through MBB. This could be done by correlating performance metrics from both the MBB network and/or OTT-service in order to fine tune and configure content delivery to the current conditions. Optimizing can be done from only one of the actors, but done based on collaboration where information is shared in advance and with a high level of interaction between the actors.

> From the interviews, both Spotify and Viaplay show interest in collaborations that would enable them to optimize and adapt to prevalent MBB conditions in order to deliver the best possible service to the end users. (Bohrarper & Gustavsson 2016; Köpsén 2016).

Bohrarper and Gustavsson (2016) point out that correlating metrics based on a static model lies closer in time than a dynamic one. Furthermore, they emphasize that even though they intend to test said correlation of metric, they will only initiate deployment on large scale if the test prove valuable and worthwhile. Moreover, Bohrarper and Gustavsson (2016) add that regardless of specific collaborations, increased communication and a closer dialogue with the operators are beneficial to Spotify. QoE issues most often come down to one out of two pathways: either the operator need to expand their capacity, or Spotify need to utilize the given bandwidth more efficiently. A closer dialogue would thus provide Spotify an understanding of why noted issues actually occur, and help them decide on appropriate solution. SVT Play today have communication with the operators that are both of proactive and reactive nature and Karlsson and Porsaeus (2016) argue that at the end of the line, the MNOs are responsible for their networks and they need to uphold an acceptable level of QoS/QoE toward their end users.

Orsini and Pompa Pacchi (2016) further on refer to cooperation's between OTTs and operators where skill sharing is core and that there today already exists collaborations. OTTs such as Amazon and Google work in interorganizational project teams with operators to help them deploy best of breed telecommunication networks and cloud environment. The OTTs know that their possibility to offer high-end services depend of the operators' ability

to enhance the capability of the networks. By collaborating in this way the OTTs can help develop the network that will ultimately benefit them and their service, and at the same time the operators receive more value from the OTTs that they would be able to charge any party for it they would have decided to do corresponding improvements singlehandedly.

Mohktar (2016) brings further examples of collaborations to improve QoS in MBB networks by mentioning that Ericsson has already trialed their service *Targeted App Experience*. The service can potentially facilitate further collaborations between MNOs and OTTs in order to optimize end users' app experience. The trials aimed to optimize the communication service WeChat in Hong Kong together with MNOs Tencant and SmarTone (Ericsson, 2016). KPI's from WeChat users are gathered and correlated with network KPI's to create an app coverage map, and from the coverage map it is then possible to find optimization opportunities. Mokhtar (2016) argue that MNOs and OTTs potentially could find revenue sharing model where QoS is improved for specific applications.

5.5.3 Data traffic differentiation a technical opportunity

Data traffic differentiation

Data traffic differentiation is an interesting and debated topic in the MBB industry. It can be used to improve network performance, avoid network congestion and to create customized offerings, but also pose a threat to an open internet from negative discrimination of data traffic and off-setting equal competition in content delivery over internet (Cisco, 2015; Rydberg, 2016). Data differentiation can be divided in user and service data differentiation, where user data differentiation is the different treatment of data from certain users such as premium or low-cost subscriptions (Ludwig, 2016). Service data differentiation concern differentiating between services and types of data, e.g. voice, video, music or mail. According to Ludwig (2016) user differentiation is definitely deployed by MNOs today, whereas service differentiation is more rarely occurring except for the prioritization of voice calls over other services. In order to differentiate data traffic the MNOs need to know what type of traffic it is, and this is most commonly done by either deep packet inspection (DPI) or that the content provider or content requester disclose what kind of data is being transferred (Alcoba, 2016). It should be noted that DPI is not always 100 percent reliable and require resources from the network owner and disclosing of information would be preferred as well as more reliable. In addition, data consumption is growing, more types of data are introduced and the data itself is increasingly being encrypted making it increasingly difficult to perform DPI with high reliability and resource utilization.

However, data differentiation is not the only way to improve network performance, creating new services and to overcome capacity overload in MBB networks. From the conducted interviews cache servers, peering, network slicing, LTE broadcast technology and network function virtualization are all methods mentioned as potential areas to investigate and potentially collaborate around. It should also be noted that all interviewees mention obstacles, especially net neutrality (see chapter 5.6.2), associated with data differentiation.

Opportunities in service data differentiation

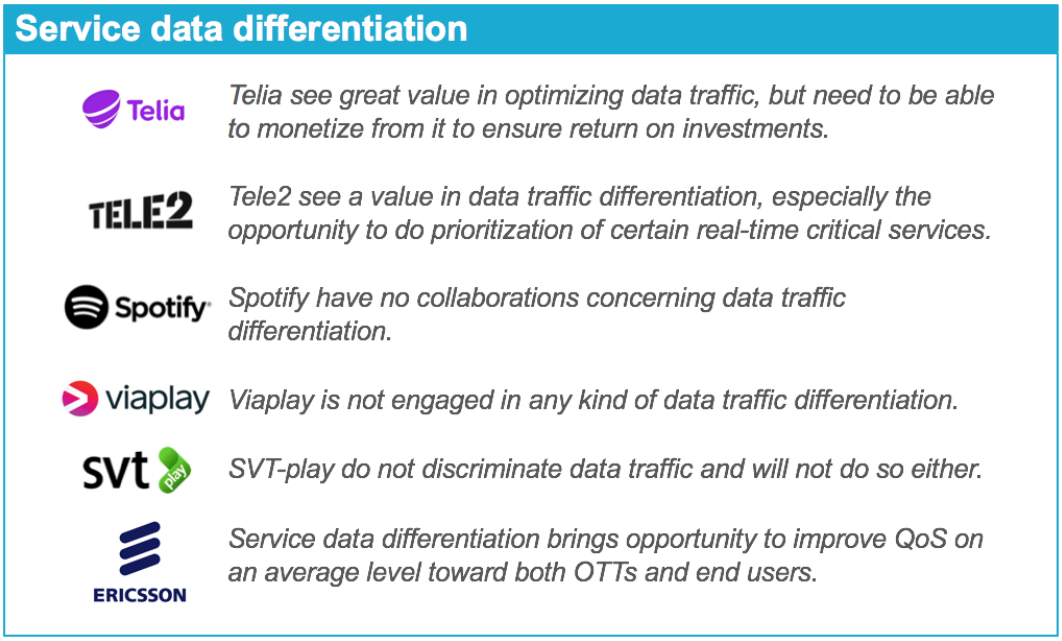


Figure 18. The interviewed actors' opinion about service data differentiation. All actors also mention following net neutrality regulations, when discussing data traffic differentiation.

Service data differentiation is mentioned to be of special interest since it brings the opportunity to improve QoS on an average level toward both OTTs and end users, as a way to optimize the MBB network resources through data traffic management and to create new customized services (Alcoba, 2016; Blennerud, 2016; Ludwig 2016). By deployment of service data differentiation MNOs, the owners of MBB networks, could schedule the data traffic to optimize traffic flows based on type of data packet and enhance the end user QoE as well as providing a better QoS toward OTTs (Alcoba, 2016; Blennerud, 2016). The more information provided to the MNOs, the more opportunities open up for improving QoS and creating new customized services through data differentiation (Martinsson, 2016). Technically it is no problem to perform data differentiation, especially not when considering 5G networks, however there are some business issues (Ludwig, 2016; Orsini & Pompa Pacchi, 2016).

Service data differentiation is also acknowledged by the interviewed MNOs to be an area of interest, and something that they have been looking into but not yet found ways to go further (Rask, 2016). Moreover, Telia concern data differentiation with dedicated QoS for certain services to be a highly interesting (Lenman, 2016). It opens up great opportunities for Telia if they were allowed to do it and Telia would have a very good offer toward OTTs and strengthen their position in the value chain. Overload and congestion of data traffic in the MBB networks is possible to solve technically, the concern is rather around the economical investment and the regulation around net neutrality. With 5G, we see great potential to differentiate and optimize data traffic in certain zones. However, as an MNO Telia need be able to charge in order to balance investments in new techniques.

Differentiated QoS is an ideal collaboration, as well as a crystal clear way to ensure return on investments, e.g. 5G or cache.

Blennerud (2016) mention quality assurance based on information disclosure or information sharing as particularly interesting and by applying service data differentiation, the data traffic can be scheduled to pass through the networks dependent on what kind of data it is and may on top of assuring quality be a measure to avoid congestion in the MBB networks. Real-time services that require a relatively small amount of data, but are dependent on ms in delivery, e.g. VoLTE, voice, online-gaming. Other services, e.g. video-streaming that is dependent on throughput and possible to pre-fetch and therefore make small gaps where real-time services could be delivered without any impact on user experience on the video-stream. Knowing what data packets are latency versus throughput dependent may enable this quality assurance without discrimination of other data traffic. In addition, Tele2 sees a value in data traffic differentiation, especially the opportunity to do real-time prioritization of certain services since that most likely would give a better end user experience (Rask, 2016). It would also lead to a better use of the networks since non-real-time sensitive data traffic can pass through the networks when there is low load. It is an interesting area, but net neutrality regulation today does not allow it. However, Martinsson (2016) argue that service differentiation might become necessary in the future, where certain devices and services may require specific capabilities from the network, e.g. extremely low latency, high security, etc. Examples of services with extreme demands could be remote surgery, banking transactions and emergency organizations (Blennerud, 2016; Martinsson, 2016; Orsini & Pompa Pacchi, 2016).

Moreover, Ludwig (2016) mention “slow lanes” as an interesting future business model for cases when the content owner is relaxed about the end user experience and the content may pass through the network when the capacity load is low. The benefit for MNOs is that the data traffic can be scheduled to avoid congestion and the end user might get discounted or free data consumption. Slow lanes depend on information sharing from the end user to let the MNO know what kind of data might be subject to scheduling. According Ludwig (2016) there are several applications where slow lanes would be applicable, but especially mention content download for future use, i.e. Spotify offline playlists or YouTube Red offline viewing, and in the area of IoT.

Executive summary

Prerequisites and obstacles to create collaborations

- Interviewees argue that the technology needed either exist or could be developed, and thus that obstacles to create collaborations are not primarily technical but relate to business or regulatory aspects.

- The terms prerequisites and obstacles are two sides of the same coin; if an obstacle cannot be overcome, it is a prerequisite. All prerequisites and obstacles need to be met or overcome simultaneously for collaborations to be used on a large scale, and should thus be analyzed as a set rather than individually.

- Prerequisites and obstacles to create collaborations between OTTs and MNOs can be divided into three dimensions; lack of (clear) value for the actors, externa factors (both regulations and public opinion), and difficulties in establishing collaborations due to unsuitable industry structure.

- The value for actors can be divided into three areas. First, a valid business case with a win-win situation where each party can link the value gained to what they consider compteititve advantage, i.e. the values mentioned in chapter 5.2, which need to be larger than the necessary cost and effort. Second, there is an uncertainty if and what types of collaborations, especially technical ones, will yield value and how much. This leads to a costly external trial and error process which either slow down the creation of collaborations or causes actors to refrain from exploring opportunities. Third, MNO path dependency causes fewer actors to seek collaborations, as MNOs focusing on cost efficiency seem less interested in collaborations.

- Prerequisites and obstacles regarding what is allowed can be divided into different levels of the net neutrality debate and sharing user information. Regarding net neutrality, there are the actual regulations, an uncertainty about how to interpretate the regulatory boundaries, public opinion causing fear of bad PR, and actors' own attitude. While the regulatory boundaries may be somewhat clearer thanks to the work of regulatory bodies, actors testing the boundaries is needed at some point.

- Feasability of creating the collaboration can be linked to a fragmented ecosystem and no clear paths inside the counterparts' organization. This causes costs of establishing and maintaining relationships, which if too high cause actors to solve the issue internally or refrain from the task entirely. An asymmetrical power relationship between OTTs and MNOs, often in the OTTs' favor, do not hinder collaborations to form, but define what form they take.

- In addition to a viable business case, i.e benefits exceeding cost or effort, end users demand direct benefits, tangible and easily understood value, and minimal effort to understand and engage in the collaborations. These criteria limit how complex the collaboration can be. If met, they provide however a good alternative to OTT/MNO

5.6 Prerequisites and obstacles to create MNO/OTT collaborations

Establishing collaborations between actors, especially around data traffic differentiation and information sharing, to attain value for each party, is not primarily a technical issue (Ludwig, 2016; Orsini & Pompa Pacchi, 2016). The technology is either there, or could be developed. Instead, Ludwig (2016) and Orsini and Pompa Pacchi (2016) stress, business or regulatory aspects are the critical areas as to why collaborations are or are not created.

In order to create collaborations between MNOs and OTTs, there need to be incentives for the actors to create them. Furthermore, actors need to be allowed to create the specific collaboration and it need to be possible to establish them. All these aspects hold prerequisites and obstacles to create collaborations. Lack of (clear) value for the actors, external factors (both regulations and public opinion), and difficulties in establishing collaborations due to unsuitable industry structure, are mentioned as common hinders. Note that prerequisites and obstacles are two sides of the same coin; if an obstacle cannot be overcome it turn into a prerequisite. Moreover, it should be noted that the prerequisites and obstacles mentioned in this report are only the ones mentioned in the interviews. The list of prerequisites and obstacles are thus not exhaustive, but only portray the ones actors consider problematic. All prerequisites and obstacles need to be met or overcome for collaborations to be used on a large scale.

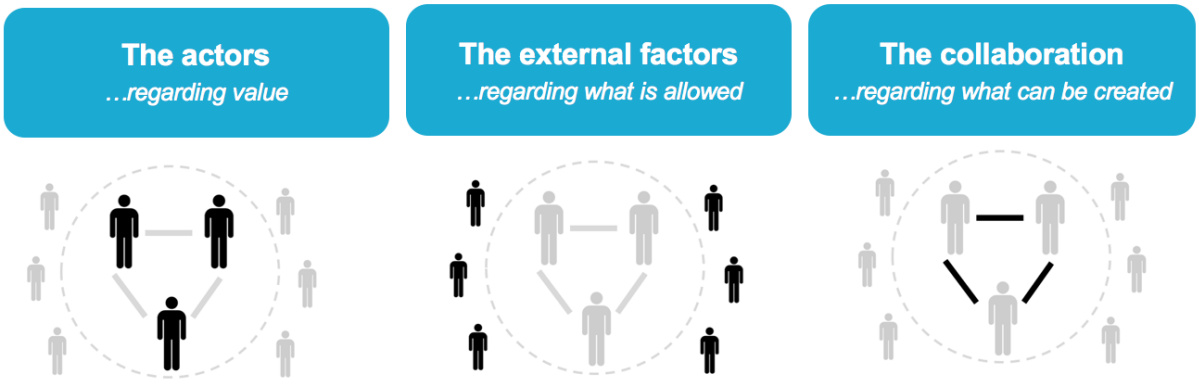


Figure 19. Types of prerequisites and obstacles to create MNO/OTT collaborations. Not that the list is not exhaustive, but only portray the ones actors consider problematic. All prerequisites and obstacles need to be met or overcome for collaborations to be used on a large scale.

5.6.1 Prerequisites and obstacles regarding value

Prerequisites and obstacles regarding value can be divided into three different areas. First, there need to be a valid business case with a win-win situation where each party can link the value gained to what they consider competitive advantage, which need to be larger than the necessary cost and effort. Furthermore, since technical collaborations as previously described are not particularly developed or spread, there is an uncertainty about what collaborations will yield value. This imply a trial and error process of finding valuable collaborations, which either slow down the spread of collaborations or create a reluctance

from the actors to search for viable collaborations as they consider the process too costly. Finally, the majority of the MNOs are still focused on the traditional business model, charging for voice, sms and per MB data, and seeking new types of revenue streams or offerings only on an incremental level. As collaborations are suggested exclusively to improve the value offering toward end users or create new value offerings, and since MNOs focusing on cost efficiency seem less interested in collaborations, fewer actors are in focus for creating collaborations.

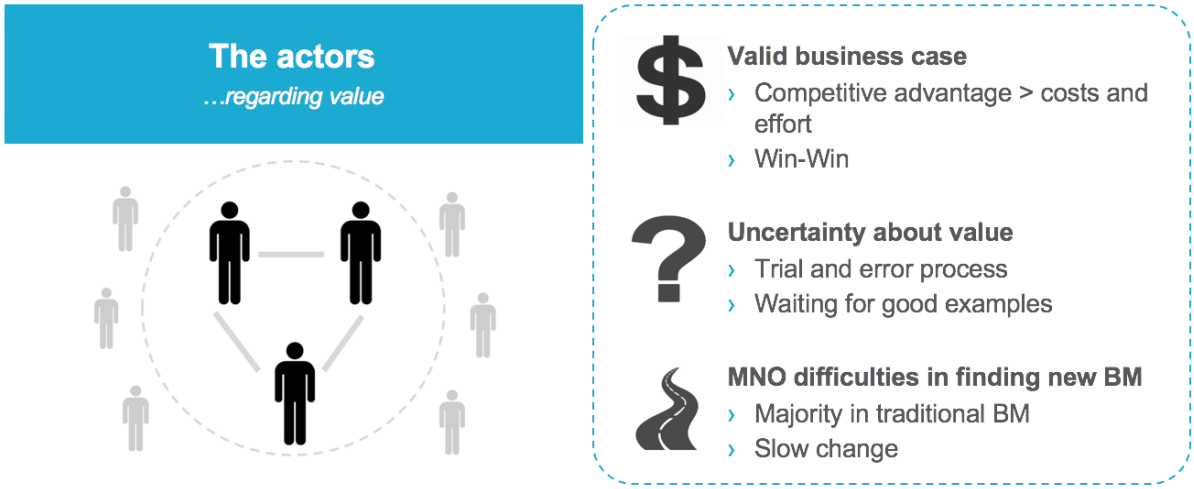


Figure 20. Prerequisites and obstacles regarding value can be divided into valid business case, uncertainty about value and MNO difficulties in finding a new business model.

5.6.1.1 Valid business case

The most fundamental prerequisite for establishing collaborations lies in the creation of a viable business case, where all the involved actors benefit (Blennerud, 2016; Ludwig, 2016; Orsini & Pompa Pacchi, 2016, Karlsson and Porsaeus 2016). As long as there is money to be made, Ludwig (2016) state, the actors will find a solution. While this might seem obvious, it is one of the main reasons why many collaboration attempts do not take off (Blennerud, 2016; Ludwig, 2016; Orsini & Pompa Pacchi, 2016; Karlsson & Porsaeus, 2016; Bohrarper & Gustavsson, 2016; Köpsén, 2016; Lenman, 2016)

In some cases, the actors do not see enough value to invest. Rask (2016) says that Tele2 do not have a problem with lack of capacity in the networks, except some peak hours, and until there is a clear need the MNOs will not invest further in network improvements. Ludwig (2016) stress that the MNOs need to develop the MBB networks and invest in better user experience with faster and more reliable connectivity. However, the investments need to make business sense, and this pose a significant challenge for the MNOs when the previously profitable voice- and messaging business are shrinking and the revenues generated from data are shared with OTT-actors (Blennerud, 2016; Ludwig, 2016).

In other cases, actors do see value but consider the investment in effort or financial terms too high. Martinsson (2016) mentions platforms for IoT as one example, and Spotify (Bohrarper & Gustavsson, 2016) mentions time demanding quests to find the right person

within organization and high costs in maintain relationships as two other, as described in the section for industry structure.

Furthermore, there need to be a win-win situation where the value is linked to what each party consider competitive advantage. One example of this mismatch in what MNOs and OTTs respectively consider as value leading to competitive advantage is improvements in QoS/QoE. As mentioned in chapter 5.2 OTTs are interested in improving QoS/QoE for the sake of it, while MNOs require possibility to directly monetize from the improvements. Ludwig (2016) mention an issue with piggybacking, where the OTTs have a position where they use the networks for free while the MNOs get the blame in case of poor QoE. This becomes an area where conflict of interest occurs, since the OTTs want to send lots of data in highest possible quality to their users at all times while not paying extra to the MNOs, and the MNOs on the other side wants to deliver connectivity with high QoE while securing a good ROI from network development investments (Lenman, 2016; Ludwig, 2016).

5.6.1.2 Uncertainty about value

The uncertainty about value comes in two forms. A first challenge, grounded in the MNOs' need to find new or improved revenue streams, is uncertainty about what paths hold sustainable value, and thus where collaborations are beneficial. The telecom industry is yet not sure to what extent MNOs should play a role in service creation in relation to focusing on pure connectivity or where they can add value (Alcoba, 2016; Lenman, 2016). Second, as mentioned in chapter 5.3, technical collaboration are still not particularly developed or spread and have few obvious paths that provide win-win situation for all engaged parties. Spotify mention a couple of possible collaborations, but also note that these are just suggested trials which not necessarily imply successful outcomes and opportunity for large scale deployment (Bohrarper & Gustavsson, 2016).

The window of opportunity for MNOs for new types of business models and collaborations have just opened, 5-10 years ago data was a too small fraction of the operator's revenue (Ludwig, 2016), and many MNOs are currently in the process of trial and error to identify viable business models (Martinsson, 2016). Martinsson (2016) argues however that the process is slow and that the operators need to leave the stage of idea generation and create viable business models that scale fast. The MBB industry are somewhat waiting for good examples in the field of business innovation within collaborations based in information sharing, and the related business models needs to gain market acceptance and yield proof of concept (Alcoba, 2016). According to Ludwig (2016) a lot of things need to come together to pave the way for these kind of collaborations to take off, and Orsini and Pompa Pacchi (2016) argue that the market waits for the big players, e.g. Vodafone, AT&T, Telefonica, T-Mobile, etc., to take the lead and push business innovation toward the customers. It requires large investments and either you are among the big MNOs or you cannot afford pursue new revenue stream possibilities.

From the OTTs' perspective, both Spotify and Viaplay mention that there is a priority question of seeking external collaborations or work on the internal to-do-list (Bohrarper & Gustavsson, 2016; Köpsén, 2016). Seeking external collaborations require a lot of time and effort in finding the right people in the opposite party's organization and set up the collaboration (Bohrarper & Gustavsson, 2016). There is thus a trial and error process, which is especially costly when trying to solve issues through external collaborations. The implication is partly a slow down of the creation and spread of collaborations, but also reluctance from actors to seek collaborations, which cause a waiting game until there are proof of concepts which allow the actors to skip large parts of the trial and error process. Thus, for collaborations to be established on a large extent, there need to be actors paving the way.

5.6.1.3 MNO difficulties in finding a new business model

The need for MNOs to find ways of assuring long term profit is established in chapter 5.2. However, In pursuit of business innovation and collaborations substantially different from current way of operating, one large challenge is the difficulties for MNOs to break old paths (Orsini & Pompa Pacchi, 2016). The industry has changed, and the MNOs need to change with it (Ludwig, 2016). But significantly changing the business model and face a completely new market, such as going into IoT/M2M, require large investments and involves reshaping of the organization and acquisition of new competencies (Martinsson, 2016). Facing such risk is a tough task that comes down to culture and strategy (Orsini & Pompa Pacchi, 2016). Martinsson (2016) agrees and add that MNOs suffer from strategy inertia.

MNOs' difficulties in finding a new business model is linked to opportunities for collaboration in the way that interviewed actors seek collaborations mainly to improve the revenue aspect of the business model. Thus for the MNOs who do not seek actively to radically innovate their business model, or those who pursue a cost competitor path, collaborations are of less interest.

5.6.2 Prerequisites and obstacles regarding what is allowed

Prerequisites and obstacles regarding what is allowed can be divided into two areas. A major aspect is different levels of the net neutrality debate, which partly concerns actual regulation prohibiting certain types of actions and collaborations, as well as an ambiguity about the regulatory boundaries and what will and will not be allowed in the future. Net neutrality debate stretch however further as actors' fear of bad PR may prevent actors from pursuing opportunities that are allowed according to prevalent regulations but not according to public opinion. Furthermore, actors themselves are sometimes against certain types of collaborations as they believe them to be a violation of net neutrality. Regarding uncertainty about regulatory boundaries, PTS states that while it will likely be somewhat clearer as the national regulatory bodies draw up guidelines for interpreting the regulations set on EU level, the uncertainty will due to the Internet's dynamics never be eliminated entirely. Instead a lot of the uncertainty will be reduced through application in the market,

where actors try the boundaries. The second aspect that is not dug deep into, but is a highly important factor in cases where user information is shared, is privacy and trust.

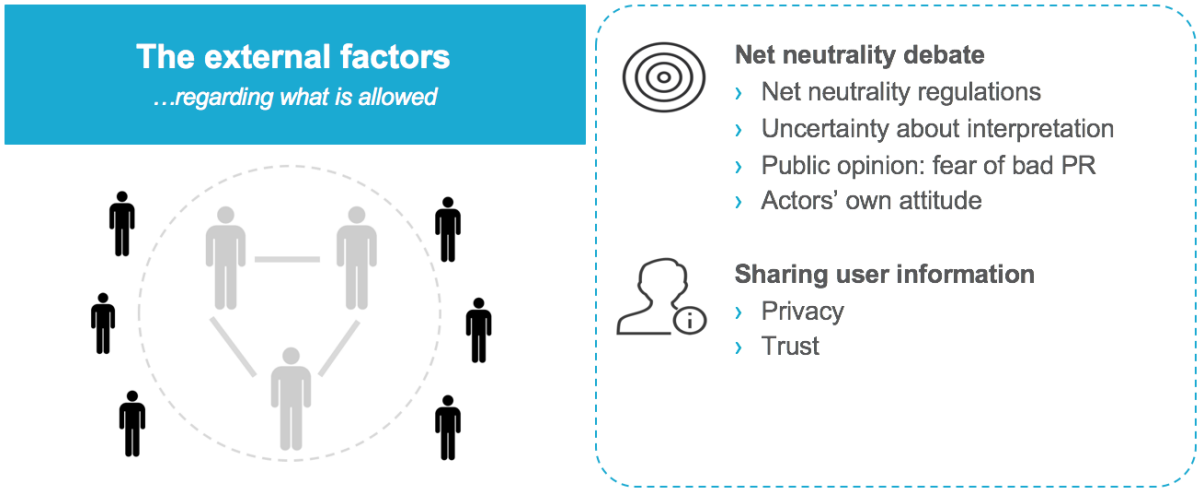


Figure 21. Prerequisites and obstacles regarding what is allowed can be divided into different layers of the net neutrality debate and sharing user information.

5.6.2.1 The net neutrality debate

Net neutrality regulations

The net neutrality principle heavily impact what measures or collaborations can be taken by the MNOs, and by extension the OTTs (Alcoba, 2016; Blennerud, 2016; Ludwig, 2016; Martinsson, 2016; Orsini & Pompa Pacchi, 2016; Pagani, 2016). The basis of net neutrality is that all Internet traffic shall be treated equally regardless of sender, receiver, platform or content (The Swedish Post and Telecom Authority, 2016). It should be noted that there are significant geographical differences in the impact of net neutrality principle on the operators. While net neutrality is mentioned by all 17 interviewees with area of operation in Europe or on a global level as one of the most prominent prerequisites or obstacles to develop and deploy certain types of solutions and collaborations, Mokhtar (2016) argues that net neutrality is not high on the agenda in neither Bangladesh nor Vietnam, countries with a relatively underdeveloped internet infrastructure, but present in countries such as Singapore and Australia. Moreover, Rask (2016) elucidates the Netherlands as a European country with extensive net neutrality regulations. Zero rating of services is one area where the regulation rigority differ. The Netherlands, Slovenia (BEREC 2016) and India (Telecom Regulatory Authority of India, 2016) have stipulated legal restrictions against zero-rating. On the other hand, the Body of European Regulators for Electronic Communications (BEREC) remark that the majority of their member states have no regulatory preconditions that restrict zero-rated services.

Uncertainty about interpretation

According to Alcoba (2016), Blennerud (2016), Ludwig (2016), Lenman (2016) and Rask (2016) there is an uncertainty around net neutrality and what is and will be allowed to do. This contributes to a reluctance from the MNOs to act upon anything that might be in

conflict with net neutrality and to do anything until the regulatory landscape is settled. There is an interest from major OTT-players and MNOs to create collaborations to improve QoS. Blennerud (2016) however just one of many interviewees that stress that the collaborations need to be net neutrality compatible and that the uncertainty around net neutrality is an obstacle. According to Ludwig (2016), the net neutrality debate is especially a challenge for service data differentiation, and adds that information sharing with the particular purpose of traffic differentiation do not have good support from any of the actors. The uncertainty implies that not only collaborations that are against the net neutrality regulations get hindered, but also collaborations that would be allowed but that are in the grey zone. A prerequisite for establishing collaborations between the actors within MBB will be clarity and quality of net neutrality regulations, a framework that the involved actors feel safe with (Alcoba, 2016; Blennerud, 2016; Lenman, 2016; Ludwig, 2016; Pagani, 2016; Rask, 2016; Rydberg, 2016).

Public opinion and fear of bad PR

A third aspect of net neutrality is how public opinion affect the operators. The debate has from time to time been fierce and any perceived violations of the net neutrality-principle result in bad PR for the companies involved (Ludwig, 2016). The operator 3 received bad press with the Swedish newspaper GP claiming it to breach the net neutrality principle with their offering of zero-rating music streaming services (Karlsten, 2016). Similarly, Telia received criticism for their zero-rating of social media sites (Lenman, 2016), not the least from 18 Swedish media organizations (Almqvist et al., 2016). Furthermore T-Mobile's service Binge On (Ludwig, 2016), Netflix collaboration with Comcast connecting cache servers directly to Comcast's network (Brian Fung, Washington Post, 2015), and Facebooks Free Basics service in India (Soni, The Guardian, 2016) are all services that have received massive criticism and bad PR. Not because they are (or in Facebook's case were) strictly prohibited by law, there are no regulatory precondition against the services or measures, but due to members of the public considering them violations of net neutrality. As touched upon in section 5.3, MNOs seem more willing than OTTs to risk bad PR, by looking at the number of offers or actions each type of actor are in charge of.

Actors own attitude toward net neutrality

The last factor related to net neutrality, and together with the regulation themselves, the most important factor is the actors' own attitude toward what is and is not against net neutrality. If the actor is against certain types of measure or collaboration, they of course will not engage in it. According to Blennerud (2016) and Ludwig (2016) all the major OTT-players are in favor of strong net neutrality regulations. As mentioned in section 6.4.3, the viewpoints still differ – especially regarding zero-rating of services. Some actors (Viaplay and SVT-play) consider it to be a violation of the principle, other actors (Spotify) do not sponsor the data themselves but are involved in partnerships where the operators have chosen to sponsor the service, and yet others have (Facebook with Facebook free) have engaged more in zero-rating activities.

5.6.2.2 *PTS's and the Pirate Party of Sweden's perspectives on Net neutrality and the related uncertainty*

According to Rydberg (2016), the interpretation of net neutrality is more or less the same across the world, however the rigority in regulations might differ and the problems in different countries vary. Rydberg (2016) acknowledges that the Internet has never been built on strict net neutrality, elucidating CDNs as lawful ways for OTTs to pay for improved QoS. Net neutrality regulations focus on access network operators, which is justified by those actors having the largest possibilities to take competition restricting measures. Rydberg (2016) states that the core of the net neutrality regulations is to prevent operators to try to get paid for how people or organizations use the Internet, or deploy traffic management in order to sell subscriptions based on differentiated priority. Furthermore, no consideration shall be taken to whether a service is real-time critical or not. Rydberg (2016) recognize the increasing demand for improved quality form end users, and the consequential challenges due to the net neutrality principle in catering for said demand under circumstances, especially for mobile network, where expansion of the capacity is not an option.

In November 2015 regulations from the EU-parliament came into force regarding net neutrality. Andersdotter (2016) points out that the regulations are still too vague to have any real impact on diminishing the uncertainty about what is in conflict or in accordance with net neutrality. Rydberg (2016) agrees that the grey areas are plenty, and state that the current task for regulation authorities is to interpret and clarify the regulations. The step from a level of principle to detailed level applicable on the market, is however not an easy task. Firstly, Internet's dynamic nature makes it difficult from a regulatory point of view to draw boundaries that are clear enough to act upon and general enough to be relevant in the foreseeable future. Secondly, Rydberg (2016) says that dedicated QoS services for public good, e.g. self-driving cars and remote surgery, will be allowed, but stress that what is considered justifiable as public good is ambiguous and difficult to frame seeing that possibilities in 5G is yet to unfold. Furthermore, Rydberg (2016) states that while net neutrality is a good principle, it is problematic to say that it should be enforced in all cases.

Rydberg (2016) points out that the regulative grey areas will be clearer, mainly through application in the market and through establishment of case-laws. Andersdotter (2016) emphasis, however, that actual rulings in the European Court takes time, up to 10 years, and Rydberg (2016) continues by adding that established case-laws might become outdated depending on the development of new technologies and business models. Therefore, Rydberg (2016) concludes, it is impossible to anticipate how clear the regulations will become and how long they are applicable. This implies that, sure the uncertainty might still in the future refrain actors to engage in activities or collaborations due to uncertainty about the net neutrality regulations. However, if actors do see the business case solid enough, they cannot wait for the regulatory landscape to become crystal clear as clarity comes from the application itself. In EU the regulations are in place, and it will likely be somewhat

clearer after the regulatory bodies' interpretation. Though, at some point actors need to test the boarders to see where the lines go, as mentioned by Telia (Lenman, 2016). Actors can of course wait to let other actors test the boarders, but that comes with the cost of not being first in engaging in that measure or collaboration.

5.6.2.3 Sharing user information

Ludwig (2016) and Bohrarper and Gustavsson (2016) point out that if collaborations were to take place where information is shared, it must be in a way that does not violate any privacy regulations or disclose any sensitive information for the end user. Alcoba (2016), Ludwig (2016) and Pagani (2016) further argues that MNOs are subject to tough lawful requirements that might not apply to other actors, and in addition to the constrain from tougher regulations it also brings an uncertainty for the MNOs about how much information they can trust to share with other actors.

Due to said privacy issues and lack of trust, as well as information often being a valuable asset, there is an initial reluctance to share information between parties (Alcoba, 2016). The reluctance is by far the strongest for information about the users. Starting collaborations concerning such information is therefore tricky, and engaging in collaborations regarding other types of information e.g. network performance metrics should be much easier (Bohrarper & Gustavsson, 2016).

5.6.3 Prerequisites and obstacles regarding what can be created

Prerequisites and obstacles regarding what can be created can be divided into three areas. A fragmented ecosystem where large OTTs need to collaborate with a large number of MNOs to span, and where MNOs need to collaborate with a large number of OTTs to span the most data heavy services and applications, as well as no clear paths inside organizations imply much time and effort to set up and maintain relationships. If the costs due to time and effort requirements are too high, actors tend to solve the issues in alternative ways or refrain from it entirely. A third obstacle can be found in an asymmetrical power relationship between the actors, where large OTTs are often substantially larger than the MNOs. This does not necessarily hinder collaborations to form, but impact the form they take.

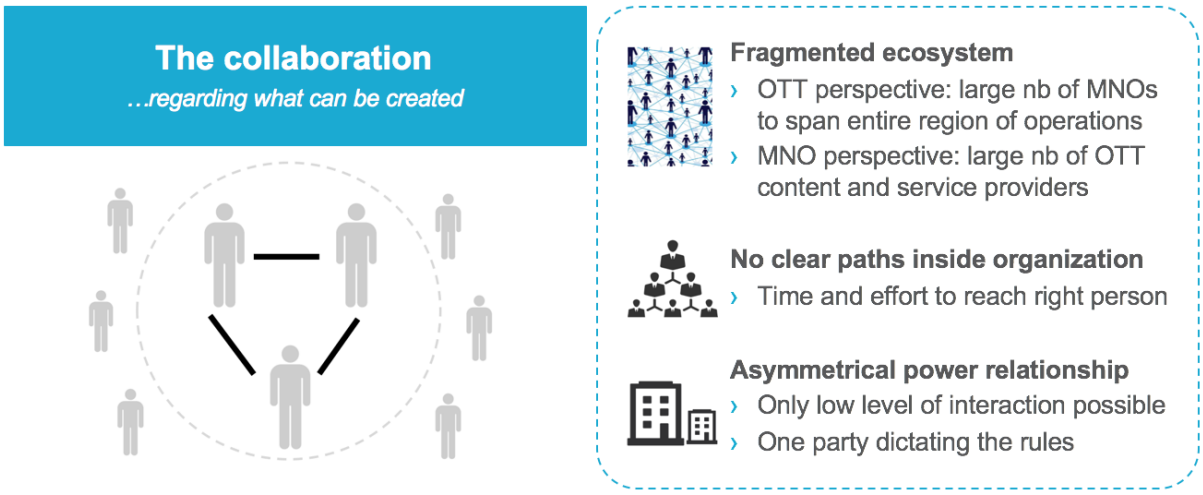


Figure 22. Prerequisites and obstacles regarding what can be created can be divided into fragmented ecosystem, no clear paths inside organizations and asymmetrical power relationships.

5.6.3.1 Fragmented ecosystem

An obstacle against creating collaborations between OTTs and MNOs is the time and effort necessary to establish and maintain contact with the organizations (Gustavsson, 2016). One aspect is the mere number of OTTs and MNOs. The larger OTTs, e.g. Facebook, Google, Netflix, etc., are all global actors with users dispersed all over the world and MNOs in general have significantly smaller reach (Mokhtar, 2016; Pagani, 2016), and from the MNO's perspective there is a plethora of OTTs sending traffic through their networks. This fact implies a difficulty to arrange agreements and collaborations with a vast number of parties for both MNOs and OTT (Alcoba, 2016). Alcoba (2016) further argues that for MNOs this becomes a problem especially since they probably would need to offer the same treatment and service to all OTTs in order to comply with net neutrality regulations. Bohrarper and Gustavsson (2016) remark that in the end it is question about time and money, and prioritization of problems to maximizing resource utilization, which holds true for both MNOs as well as Spotify themselves. *"There are 1000s of operators and we cannot talk to all of them. If we would, we would need a lot more personnel to handle those communications. Instead we choose to most important problems and the most important operators."* (Gustavsson, 2016). If collaborations should be utilized to a larger extent, especially technical collaborations, the costs related to creating and upholding collaborations need to be lowered.

5.6.3.2 No clear paths inside organization

An aspect related to the fragmented ecosystem is the time and effort required to find the right person within the other organization, both for MNOs and OTTs. In addition to having to motivate why the other organizations should dedicate time to solve an issue, it takes a lot of work to go through the layers and get in contact with the right person to solve a particular problem (Bohrarper & Gustavsson 2016). One way that the industry itself have addressed this issue is to turn to existing collaborations established for commercial purposes as a door opener for technical collaborations, as the existing collaborations often require less time

and effort to find the right people as well as open up for general discussion without basing them on a highly specified problem or need (Bohrarper & Gustavsson 2016).

5.6.3.3 Asymmetrical power relationships

The fact that the biggest OTTs have an enormous reach and customer base result in an asymmetrical power relationship between the OTT and most MNOs, where the OTTs more or less dictate the rules (Orsini & Pompa Pacchi 2016). According to Lenman (2016), this difference in bargaining power may affect the degree of collaborations between the parties and takes as an example Facebook who show interest in connecting cache servers to Telia's networks, but where the deal toward Telia is of take-it-or-leave-it character and where an agreement would not imply that information is shared other than to ensure connection of the cache servers.

Mokhtar (2016) and Orsini and Pompa Pacchi (2016) further elucidate the lack of time, interest and resources for the major OTTs to collaborate with small and national MNOs, especially in under-developed markets with low penetration of data subscriptions. Lenman (2016) add in context that collaborations are easier to obtain with Swedish OTTs rather than with large US OTTs with global presence that might regard Sweden as a minor market and hence not prioritized. According to Bohrarper and Gustavsson (2016) politics also play a significant part in realizing collaborations between actors, they argue that some actors will or will not engage in collaborations based on politics or relationships to each other.

5.7 Prerequisites and obstacles to create end user collaborations

In addition to a viable business case, i.e. benefits exceeding cost or effort, end users have certain demands to enter collaborations or engage in any activity with either OTTs or MNOs. The three prerequisites are tangible and easily understood value, direct benefits and minimal effort to engage and understand. Collaborations with end users are possible if they follow the above stated criteria and are valuable enough for the end user to engage in. However, the criteria vastly limit the extent to how complex the collaborations can be. As mentioned by Spotify, Tele2, etc., this makes the MNOs and OTTs hesitant toward investigating the area as the area of opportunity is narrow (Bohrarper & Gustavsson, 2016; Rask, 2016). If it is possible to attain the sought value in collaboration with organizations instead, or internally, the MNOs and OTTs tend to look to those solutions instead.

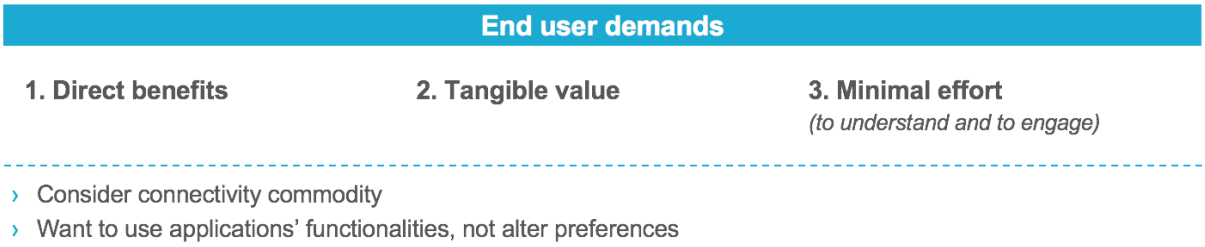


Figure 23. Criteria to set up collaborations with end users are direct benefits for the end user, tangible value and minimal effort to understand and engage. These criteria derive from end users considering connectivity a commodity service and an interest in using the applications' functionalities, not altering preferences.

In addition to creation of a viable business case, many interviewees mention difficulties to communicate certain values or offerings to the end users (Rask, 2016; Gustavsson, 2016; Blennerud, 2016). One recurring example for MNOs is attempts to improve QoS, as it is not possible for a MNO to guarantee an improved QoS in the individual end user case but rather on an average level (Alcoba, 2016; Rask, 2016). Regarding improvements through data traffic differentiation Rask (2016) says that the end user would not be able to assess whether they or a certain type of traffic were prioritized as there are so many other factors impacting QoS. Blennerud (2016) emphasize on difficulties in making it a commercial product, and Alcoba (2016) argues that instead financial incentives or other tangible values need to be provided for the users to be willing to collaborate, such as free data usage or lower subscription costs, and that the benefits need to be direct; an increase of QoS for people in general is for example not enough.

Other than direct benefits and tangible value, minimal effort both to understand the collaboration and to engage in is required for end users to enter into collaborations with MNOs and/or OTTs. The reasons behind the demands are an increased view on connectivity to be a commodity such as electricity or water (Rask, 2016), and lack of interest and time to in engaging too much with the many applications end user utilize (Bohrarper & Gustavsson, 2016). Rask (2016) tell that the end user interest to understand the connectivity offering is low; "*it should just work*". In order for a connectivity offering to succeed in the market, it need to be easy for the end user to understand. From the OTT perspective, Spotify experience the same with their application: "*end user does not want to spend time on understanding the settings, they just want to listen to music*" (Bohrarper & Gustavsson, 2016). As an example, Spotify has settings to adjust sound quality, but the vast majority of end users never change it. Important to note, however, is that companies can use the criteria to their advantage. Taking the examples with T-Mobile and Spotify, both provide end users with the opportunity to alter the quality in order for end users to stream more content (Bohrarper & Gustavsson, 2016; T-Mobile, 2016). The difference between the two is that T-Mobile has it set to lower quality as default and offer the opportunity to opt out. Thus, while the minimal effort requirement is true in both cases, the effort starting point is different. This doesn't mean that it would necessarily make sense for Spotify to follow T-Mobile's example, only that organizations in certain cases can alter starting point for the end user demands.

_____Executive summary_____

The importance of MBB from an OTT perspective

- One observation made throughout the interviews is that the interviewed OTTs do not differ between MBB and FBB when developing their services. They are highly aware and pay attention to the increased use of mobile devices, but either do not see or do not focus on what data go over MBB versus FBB.

- A second observation is that MBB is not a top priority for interviewed video streaming services. While the majority of the data sent over MBB is video, for many video streaming service data sent over MBB still only constitute a small fraction of the total amount of data sent. This equation is explained by the fact that the video data sent over MBB can be linked to only a few actors, mostly Youtube. The reason why not more video data go over MBB is said to be that video streaming services are data intensive and thus erode end users' data plans.

- At the same time, the price war has caused MNOs to over time offer larger data plans to lower price.

- Thus, while the need to collaborate around MBB, in specic, is not treated with special priority today, the need could possibly increase in the future.

5.8 The importance of MBB from an OTT perspective

One aspect that stood out in the interviews is that none of the interviewed OTTs differ between MBB and FBB when developing their applications. Moreover, the fraction of data sent over MBB is still very small for many video streaming services, and the need for collaborations around MBB in specific is thus not always considered top priority. However, if the size of data plans continues to grow, more video will likely be consumed over the MBB and thereby possibly the need for collaborations around MBB.

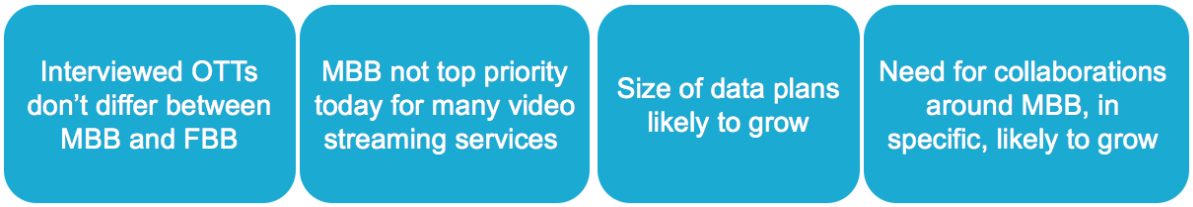


Figure 24. Interviewed OTTs do not differ between MBB and FBB when developing their applications. For the interviewed video streamers data is consumed over MBB only to a very small extent. If the size of data plans keeps growing, the need and priority of MBB might however increase.

While all interview OTTs are aware of end users streaming their service on mobile devices, and take that into account when developing their applications, none of the interviewed OTTs differ significantly or at all between MBB and FBB. On the question how much of the data traffic is sent over MBB, Spotify and Viaplay state that "a majority" vs "around 50 per cent" of the traffic goes to mobile devices, but that these can be connected either through WiFi or MBB (Köpsén, 2016; Bohrarper & Gustavsson, 2016). Moreover, Viaplay add that they cannot tell how much of the data traffic goes over MBB (Köpsén, 2016). SVT-play argues that percentage of mobile devices is increasing, but also they point out that they do not differ between MBB and FBB (Karlsson & Porsaeus, 2016).

In section 5.2 it is noted that the OTTs which would gain mostly from collaborating are the ones with very high demands on the network. Video streaming services, being by far the most data heavy service (Bohrarper & Gustavsson, 2016; Karlsson & Porsaeus, 2016; Köpsén, 2016), is therefore a prioritized partner (Bohrarper & Gustavsson, 2016). However, while video constitute the majority of the data sent over MBB (Ericsson, 2015), data sent over MBB constitute a very small part of the total volume for many video streaming services (Karlsson & Porsaeus, 2016). A reason for this is that a few video streaming services, Youtube in specific, constitute the absolute majority of the video traffic over MBB (Ericsson, 2016). Thus looking at specific issues for data traffic over MBB is not top priority for many video streaming services.

The reason why video streaming tent to go over FBB is that it burn through end users' data plans, also in countries where data plans can be considered large and relatively cheap (Karlsson & Porsaeus, 2016; Köpsén, 2016). Köpsén (2016) point out that if end user's get larger data plans more data heavy services will be consumed over MBB. Seeing that trend, mentioned in section 5.2, that data plans are getting large, would according to Köpséns

statement imply more video streaming over MBB and potentially a larger interest around collaborating around MBB in specific. Whether or not this is a likely scenario is further discussed in section 6.4.

6 Analysis

In this chapter the findings from the data gathering will be analyzed by applying the theoretical framework, presented earlier in this thesis, in combination with insights from the researchers.

6.1 Industry adequacy for collaborations

This section discusses industry adequacy from a theoretical perspective, and aim to explain current level of commercial as well as technical collaborations.

6.1.1 Industry prerequisites

The fact that there are values for each party that could be satisfied through collaboration have been established in the empirical part of this thesis. However, to answer whether the actors would actually benefit from collaborating, it needs to be established whether a collaborative approach is not only beneficial, but superior to a pure market approach or for the companies to attend to the needs in-house, i.e. what (Williamson, 1981) refer to as hierarchies.

Looking at the MBB ecosystem as a whole, one can argue that it has the characteristics that generally favor a network structure. Powell (1990) mention three circumstantialities where networks are superior: demand for speed, variable resources and uncertain environment. Furthermore, both Powell (1990) and Jacobsson and Bergek (2004) argues that networks are especially valuable for innovation of technological systems as it facilitates identification of problems, transfer of tacit know-how, and a rapid innovation process. The MBB ecosystem fulfill all these criteria. The demand for speed is certain; Rydberg (2016) mentions Internet's dynamic nature and how the technological landscape can be vastly different in just a couple of years, and Martinsson (2016) point out that MNOs need not only to innovate their business model, they need to do it fast if they are to survive. Regarding uncertainty, this is true for both OTTs and MNOs. As Lenman (2016) states, momentum can change fast and a seemingly impregnable lead, as in the case with Windows Live Messenger, might be taken off the market only a couple of years later. However, while this uncertainty is innate and a constant future threat for all actors, the uncertainty is particularly high for MNOs as their old business model is not sustainable even in the short term, and there is not yet consensus about exactly what a new long term sustainable business model looks like.

Thus, according to previous research the MBB ecosystem most likely hold opportunities where inter-actor collaborations are far superior to other ways of organizing activities. According to Sandström (2015), the industry would then gain the flexibility and scalability and still be able cater for the knowledge transfer needed for technology system innovation. At the same time, as Gadde et al. (2003) point out, investing in collaborations is a tradeoff. Interlinking activities and resources, which is necessary to gain the benefits of collaborating, imply the risk of lock-in. Collaboration might still be superior to a market or hierarchy structure, but it is attached to a cost and it is important to measure this against the gain.

6.1.2 Commercial collaborations

Many on the existing collaborations between MNOs and OTTs are of commercial character, where the actors work together to create attractive bundling of services and offerings to attract new subscribers. These commercial offerings include sponsored data of certain services and packaging where MNOs may act as a vendor offering OTT-services together with a mobile data subscription, as well as efforts in co-branding and mutual marketing. In these cases, the actors draw mutual benefits from collaborating. As described by Rashid et al. (2013) value can be co-created between actors and creating sustainable business models founded on relationships and interactions. This is also consistent with Lindmark (2006) arguing that value can be described as utility, or the usefulness, and actors strive to maximize their utility. This can be regarded as a foundation for engaging in collaborations between MNOs and OTTs, where the actors gain different but mutual value. The Telia-Spotify collaboration can be taken as an example, where the both the MNO and the OTT reap benefits at the same time, but in different aspects where Spotify leverage Telia's existing customer base to reach new end users, and Telia use Spotify's image as a new, hip startup for branding purposes and to create Telia unique bundles. Collaborations between MNOs and OTTs allow them to access each other's resources and certain strengths, such as utilizing the partner's market reach in order to attract new customers outside of the existing customer base. Drawing upon the empirical findings, it reveals that Spotify have used a partnering strategy with local MNOs to gain foothold when entering new markets.

Drawing upon Powell (1990), trust lowers the transaction costs and can push actors to engage in collaborations by establishing reciprocal relationships and start working on developing services together rather than separately. By initiating collaborations in one business area, e.g. in branding or marketing purposes, a foundation can be created and built upon for engaging in deeper collaborations in the future. An example of this derived from the empirical findings is the Telia-Spotify collaboration that has evolved from initially only be of commercial character has developed to payment solution, service development and collaborations with a more technical character.

6.1.3 Technical collaborations

The nature of networks are founded on interdependence among the actors, with different and control of resources throughout the network (Sandström & Osborne, 2011). The MBB ecosystem is no exception, since it comprises of several entities, systems, smaller networks and actors intertwined and dependent on each other. This implies that there should be a notable interest among the OTTs to collaborate with MNOs to ensure the best possible content delivery through MBB networks. It should also be acknowledged that MNOs are dependent on OTTs as well, since they act as a strong driver to increase end user mobile data consumption, hence generating more revenue for MNOs. There exists logic to engage in collaborations derived from establishing a sustainable business model based on the assumption that the creation of value depends on the others actor's capabilities throughout

the network (Rashid et al, 2013; Sandström & Osborne, 2011). However, all collaborations can be reagarded an investment and require resources as well as commitment (Gadde et al, 2003) that needs to be balanced against the financial benefits in order to make business sense.

6.2 Prerequisite and obstacle origins

While the corresponding chapter in the empirical findings explain what prerequisites and obstacles there are in creating collaborations and how they impact collaborations between actors, this section aims to analyze why they exist and place them in context with preexisting research.

6.2.1 Prerequisites and obstacles regarding value

The first prerequisite *valid business case* is fairly straight forward, and need no deeper explanation. What is important to note is that value can come in different forms, as mentioned by Rashid et al (2013) and Lindmark (2006), and that for for-profit organizations the value gained from collaborations, as Grant (2010) state, need to be linked to increased competitive advantage, or rather the value that each organization *believe* will lead to enhanced competitive advantage.

Concerning *the uncertainty about value* and valuable collaborations, one can argue that technical collaborations are in and MNOs having reentered a formative period, as described by Jacobsson and Bergek (2004). MNOs are seeking new ways of organizing their business model, according to different strategies and characterized with different degrees of radicality. However as stated in the empirical findings, there are, as customary for this formative period, many different ways of doing so and no dominant design of the business model is prevalent. As Breshanan et al. Saxenian (2001) point out, it is vital with investments in the formative period to develop a new technological system, even if they are seemingly fruitless. As Ericsson Growth Report show, companies making these investments in attempt to gain technology leadership do exist. The question is thus not whether the industry is moving, but rather as Martinsson (2016) state: is it moving fast enough.

The way Orsini and Pompa Pacchi (2016), Ludwig (2016) and Martinsson (2016) describe the MNOs situation, it is obvious that act according to path dependence, described by Sydow, Schreyögg and Koch (2009). The fact that MNOs need to innovate their business model is clear, but how disruptive the new technologies are and thus to what extent their core strengths have become what Grant (2010) core rigidities varies. While entering into the M2M/IoT business will demand organizations and revenues streams that are substantially different from most MNO's current business model, just continuing with variations of revenue streams from selling data to B2C end users demand less business model innovation.

While most MNOs are still focused on old ways of getting revenue, there are a few that do try to innovate and break free from the path dependency. As Danneels (2004) and Sydow, Schreyögg and Koch (2009) state however, even if the actors do realize that they have to

change, it becomes harder the further time goes up to a point that it is no longer possible. As pointed out by many interviewees the MNOs need to change quickly if the window of opportunity shall not pass, implying that while the lock-in phase might not be here entirely, it is certainly approaching.

6.2.2 Prerequisites and obstacles regarding what is allowed

The two prerequisites/obstacles mentioned in section 5.6.2 in the empirical findings, *different layers of net neutrality* and *sharing user information*, are two examples how external factors outside the immediate industry environment influence actors' activities. Using the PEST framework (ALoA 2004) and Williamsson's (1998) model, the empirical findings show that especially the political and legal environment and the social environment in the PEST framework (ALoA 2004) and the institution layer in Williamsson's (1998) model prove most problematic for the industry to create collaborations with around areas associated with net neutrality and sharing user information. To note as well is that several employees at Ericsson have mentioned that the technological aspect is not the hindering element.

Regarding the actual regulations around net neutrality and privacy issues as well as the uncertainty about the net neutrality regulatory boundaries, these can be classified as institutions according to Williamsson's (1998) model, or the political environment according to the PEST framework (ALoA 2004). The next layer, where public opinion and not the regulations per se is the factor prohibiting actors to enter into collaboration, it is instead connected to what the PEST framework consider social environment (ALoA 2004) and potentially what Williamson (1998) describe as social norms. Regulations can of course be changed, but as describe by Williamsson (1998) it is a very slow process, and they should thus be considered given in the short to medium term perspective, and complying with the regulations a prerequisite for collaboration to be established.

6.2.3 Prerequisites and obstacles regarding what can be created

The first two prerequisites/obstacles mentioned in section 5.6.3 in the empirical findings, *scattered ecosystem* and *no clear paths inside organizations*, can be closely linked to how Coase (1960) define transaction costs. Drawing upon Spotify's statement that "a lot of time and effort is required to find the right person within the other organization" to initiate collaborations and "having to motivate why the other organizations should dedicate time to solve an issue", *no clear paths inside organizations* can be closely linked to what Williamson (1995) defines as search and information costs as well as bargaining and decision costs. In contrast, *the scattered ecosystem*, implying many relationships to handle if an actor shall cover its region(s) of operation, concern a more holistic view of the entire process of handling relationships, and can thus linked be to all aspects Williamsson (1995) mentions of transaction costs.

The two outcomes, stated by Williamsson (1995), of transaction costs being higher than the gained value - organizations solving the task internally or refraining from pursuing an

activity entirely - have also been observed throughout the interviews. Several interviewees including Spotify point to the relationship costs as a reason why actors do not enter into collaborations and both Via play and Spotify refer to the internal to-do-list as the first choice. However, to what extent transaction costs due to creating and maintaining relationships impact the existents of collaborations vary depending on how global the actor is (and thus how many collaborations are needed in total to cover its area of operation) as well as how much value the actor believe they will gain from the collaboration.

Taking Spotify as an example, the gains for Spotify in entering new markets in partnership with an operator are larger than the transaction cost, which is one major reason why this is seen. The benefit/transaction costs ratio seem not to be as favorable for collaborations where the main focus is technical collaborations. In contrast, the technical collaborations between SVT-play and operators are less costly as the total number of collaborations needed are not as high. SVT-play and the major operators are first of all large enough (the operators in terms of subscribers, and SVT-play in terms of the amount of data they send over the networks), and secondly they all operate under a fairly limited geographical area.

While the transaction costs due to the segmented ecosystem and no clear paths inside organizations provide significant obstacles with the current industry structure if the measure require collaborations with numerous actors, it is still possible under the circumstances where just a few collaborations return enough benefits for the involved actors. If collaborations should be utilized to a larger extent, especially technical collaborations, the transaction costs need to be lowered.

Turning to the third prerequisite/obstacle mentioned in section 5.6.3 in the empirical findings, *asymmetrical power relationships*, it is something that Gadde et al. (2003) touch upon when describing the three dimensions for a well-functioning network. Using the example mentioned by Telia, where OTTs do want to collaborate with operators by connecting cache servers to the MNOs' networks, but where the terms for collaborating are of take-it-or-leave-it character, it is a perfect example of one actor have substantially larger bargaining power and thus larger influence on the terms for the network characteristics. According to Gadde et al. (2003) this implies a suboptimal network structure. The researchers would however not like to say that this would imply that this type of network cannot be beneficial to involved actors. The automotive industry is just one example where networks often are highly influence by and centered around one single actor. The take-away instead is that the existence of an asymmetrical power relationship highly influence the characteristics of the collaborations and relationships between the involved actors.

6.3 Specific collaborations of interest

In this section three specific types of collaborations are discussed, as well as the obstacles and prerequisities encountered as most troublesome for each specific collaboration. For the collaboration type to be created and used on a large extent, these need to be addressed.

6.3.1 Unbugging the last mile networks

The interviews conducted with representatives for MNOs and OTTs reveal that there exists interest in engaging in collaborations to improve QoS in the MBB networks, especially from the OTTs. The value delivered to end user, i.e. the direct and indirect source of revenue for both MNOs and OTTs, may be enhanced while at the same time achieving mutual benefits for the collaborating actors. It should be noted that, as the empirical findings indicate, collaborations to improve QoS are most likely to happen regarding OTT-services that are stringent on bandwidth resources, e.g. video streaming, online gaming, music streaming, etc. Despite the interest, there are obstacels associated with collaborations aiming to debug the last mile networks.

Uncertainty about value and valid business case

As stated in the empirical findings, there exist collaborations to some extent around unbugging the last mile network on a superficial dialogue level, while no deeper collaborations have been mentioned. Drawing upon the fact that so far the actors' have only shown interest in these kinds of in depth collaborations rather than actively seeking them, there is not yet a best practice or even a proof of concept to validate that collaborating on a deeper level to debug the MBB networks actually brings sufficient value. Being in an external trail and error process is both cost and time consuming, and the lack of successful examples is inhibiting the actors' willingness to allocate resources toward collaborations, and instead pursue internal development project where it is easier to estimate the expected value and control the process and outcome of the project. The nature of collaborations imply interdependency on other actors, as well as sharing of responsibilities and resources, and based on the interviews both MNOs and OTTs have focused on internal development. Hence, the prioritization of resources is directed to activities believed to generate maximum value, and the actors appear to be waiting for good example to follow. While both OTTs and MNOs see values in collaborating around this topic, MNOs question to a larger extent whether the business case is valid beyond collaborations requiring only a relatively low level of investments.

Fragmented ecosystem and no clear paths inside counterparts' organizations

In addition to an uncertainty about value, the fragmented ecosystem and no clear paths inside counterparts' organizations imply high transaction costs. In the MBB market there are a number of MNOs and a vast amount of OTTs to take into consideration when planning to engage in collaborations to improve QoS in the whole market. Considering that it requires resources in time and capital to establish and maintain relationships, the resource allocation needs to be balanced against the value attained from being engaged in collaborations with a great number of actors. A fragmented, or scattered ecosystem, implies difficulties for both MNOs and OTTs to arrange agreements and maintaining collaborations. In addition to establishing relationships with other organizations, it may also take a lot of effort to get in contact with the right person to solve a particular problem in the counterpart organization.

Given the fact that debugging of the MBB networks is not the only option to improve QoS for any of the concerned actors, it will become a prioritization issue where resources are going to be allocated toward solving problems based on maximizing the resource utilization.

Provided that only a few collaborations are needed to yield enough benefits to the actors, transaction costs are less troublesome. If collaborations should be utilized to a larger extent however, these costs need to be lowered. Establishing methods to standardize the collaborations in a scalable way to include a large number of participants without demanding large amounts of resource for every new participant, is therefore imperative for these types of collaboration to expand. This may be in the form of equipment that facilitate easy correlation of metrics from MBB networks with metrics from the OTT-service.

6.3.2 Service data differentiation

Throughout the interviews potential collaborations around service data differentiation were brought up as a way to improve the handling of data traffic in MBB networks. There are many opportunities when treating types of data differently such as ensuring quality based on information sharing, slow lanes and other means of dedicated QoS. As Blennerud (2016) among others mention, dedicated QoS can be done without discrimination of other data traffic, however when allowing special treatment to certain traffic there is always the risk negative discrimination done by the MNOs. However, while service data differentiation have the potential to create clear values and improved QoS, it is also associated with various obstacles to tackle.

Net neutrality

When evaluating the opportunities for service data differentiation, all levels of the net neutrality regulations come into play and hinder the actors from pursuing the technical opportunities and creating collaborations around them. Regulations, uncertainty about interpretation, fear of bad PR – especially from the OTTs, and actors' perspectives on net neutrality all pose significant obstacles to create collaborations around different types of service data differentiation. The interviews revealed a more positive attitude toward data differentiation among Ericsson employees and MNOs who elucidate on the opportunities and values that can be created in improving the use of MBB. Seing that the area is associated with different levels of the net neutrality debate, MNOs as well as OTTs tend however to refrain from investigating opportunities and instead seek solutions to their needs in alterantive ways.

Other prerequisites and obstacles being amplified

All prerequisites and obstacles brought up in chapter 5.6 are present to various extent when discussion service data differentiation depending on the specific type of collaboration. Some of the prerequsites and obstacles would be there even if net neutrality debate did not exist, such as difficulties privacy and trust issues regarding sharing user information, while others are amplified due to the net neutrality regulations, e.g. the implications of a scattered ecosystem and no clear paths inside organizations.

All aspects in the value/actor dimension provide obstacles to create these types of collaborations. Considering the fact that service data differentiation is not deployed on a large scale, and the business cases are few so far, there exists uncertainty about what values can be realized. Moreover, net neutrality regulations prohibit MNOs from monetizing on improved QoS in all the obvious ways. Hence, the actors are not convinced that the benefits are large enough to allocate sufficient resources toward service data differentiation.

Would the collaborations be established with end users rather that between OTTs and MNOs, many interviewees mention difficulties to communicate certain values or offerings to the end users as an obstacle in addition to difficulties in finding a valid business case (Rask, 2016; Gustavsson, 2016; Blennerud, 2016). One recurring example from MNOs is attempts to improve QoS, as it is not possible for a MNO to guarantee an improved QoS in the individual end user case but rather on an average level. Regarding improvements through data traffic differentiation the end user would not be able to assess whether they or a certain type of traffic were prioritized as there are so many other factors impacting QoS. Blennerud (2016) emphasize on difficulties in making it a commercial product, and Alcoba (2016) argues that instead financial incentives or other tangible values need to be provided for the users to be willing to collaborate, such as free data usage or lower subscription costs.

In the cases when service data differentiation requires sharing of end user information, privacy regulations and trust issues come into play. The distribution of end user information is regarded to be sensitive by the actors from various reasons, including end user information as a valuable asset, laws and regulations for distribution of the data and a suspicion toward MNOs.

Two obstacles that are increasing in magnitude due to net neutrality regulations are the transaction costs related to a scattered ecosystem and no clear paths inside organizations. While certain collaborations are not allowed if carried out only between an MNOs and a few OTTs, they may be allowed if carried out with all OTTs of a specific type. This implies however a vast number of relationships, which limits the possible complexity and level of interaction between the involved parties.

In brief, there are many technical possibilities related to services data differentiation. There are however also many obstacles related to these types of collaborations, which heavily restrain both the creation of and the search for collaborations with valid business cases. Interviewed MNOs and OTTs are not convinced value can be found within the net neutrality regulations, and turn instead to other types of collaborations or internal projects. It is possible that it does exist collaborations within this area that provide valid business cases, but there is only a moderate interest from the MNOs and OTTs to seek the trial and error process necessary to find these paths. If the actors are to engage in collaborations based on information sharing trust, transparency and clarity regarding regulations need to be put in place. Good examples need to be set to build trust and to ensure that sensitive information is treated properly among the actors and to show that service data differentiation can realize important values for the actors.

6.3.3 Establishing collaborations with end user

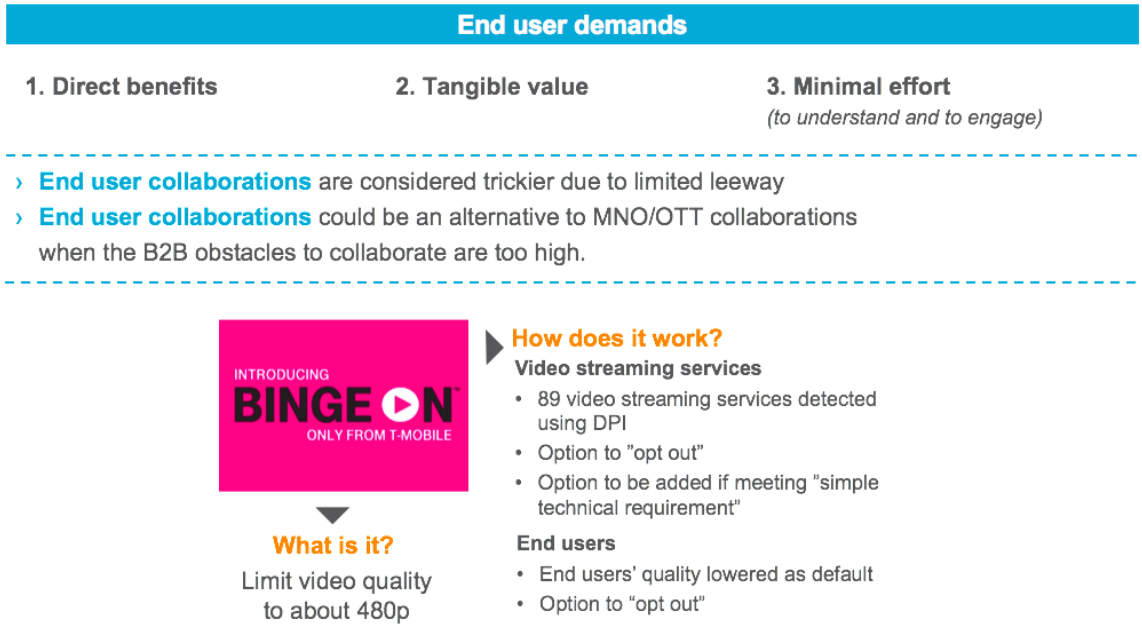


Figure 25. Binge On as an example of end user collaborations that facilitate MNO-OTT collaborations and meeting end users' demands.

The interviews reveal limited alternatives to involve end users in collaborations since they need direct benefits, tangible value and the collaborations need to require minimal effort from the end users' behalf. However, end user collaborations can be an alternative to overcome obstacles associated with MNO-OTT collaborations. An example found in this study is the case of T-Mobile's Binge On-offer. By allowing all OTT video streaming services, as long as they meet "simple technical requirements" T-Mobile has managed to circumvent the net neutrality obstacle, even though it should be noted that criticism do exist regarding zero-rating in general and that the technical requirements might come to change in the future making it difficult for minor OTTs to be a part of the offer. All T-Mobile end user subscriptions were changed to be Binge On by default, but presents the opportunity to opt out, and with a large number of active Binge On-end users the OTTs have a clear incentive to be on the Binge On-list. Hence, presenting a tangible and clear value for the OTTs, as well as for the end users from the large number listed OTTs. Moreover, joining Binge On requires minimal effort from the end users, with clear and direct benefits whether in avoiding excess data consumption through zero-rating or optimized streaming.

6.4 The importance of MBB from an OTT perspective

As mentioned in section 5.8, two interesting observations from the interviews are that OTTs do not differ between MBB and FBB when developing their service as well as the fact MBB, specifically, is not a top priority for many video streaming services today as a very small share of the total data traffic sent goes over MBB. However, if the trend of larger and larger data plans continues, there need for collaborations around MBB would potentially grow as more video will likely be consumed over MBB. So how likely is that?

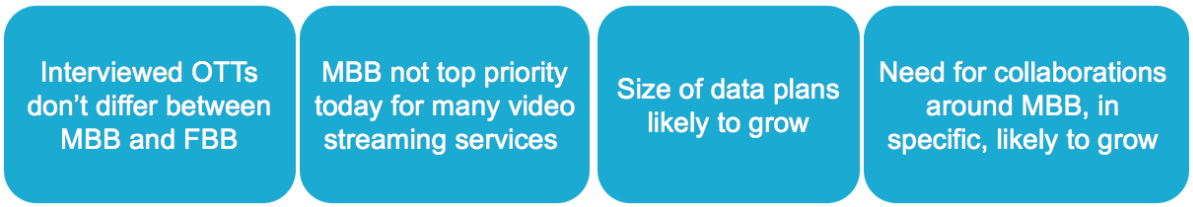


Figure 26. Interviewed OTTs do not differ between MBB and FBB when developing their applications. For the interviewed video streamers data is consumed over MBB only to a very small extent. If the size of data plans keeps growing, the need and priority of MBB might however increase.

As for whether increased consumption of video over MBB would imply higher likeliness for inter-actor collaborations, two statements are important to have resurfaced. First, as Rask (2016) points out, if end users substantially increase their usage of MBB it would challenge the current network performance. Second, Rydberg (2016) states, it is more difficult to assure high QoS on MBB relative FBB as it is not always possible to increase the bandwidth. Thus, increased use of data heavy throughput and latency dependent services over MBB would most likely imply challenges in assuring adequate QoE. It does not necessarily mean that collaborations will form, but it implies challenges around QoS/QoE that need to be addressed.

As for the likeliness of a continued increase of data plan sizes possessed by end users, one can draw upon theories described by Grant (2010) and Fey and Revin (2005). The current price war where operators offer increased data plans for lower price, or the same data plans cheaper, is an example of the prisoner's dilemma and game theory explained in section 4.3.5. None of the MNOs actually benefit from entering this cost competition in the long term, unless any MNO go bankrupt or cannot continue with price reductions, and is eliminated from the game.

		MNO #2	
		Keep price/kB	**Lower price/kB**
MNO #1	**Keep price/kB**	A / A	B / D
	Lower price/kB	D / B	C / C

Figure 27. The figure shows how MNO cost competition regarding data plans is an example of the prisoner's dilemma. The MNOs will eventually end up in the lower-right cell, thus sub-optimizing their revenues.

As Grant (2010) point out, game theory have proven most valuable when explaining the development of an industry. However, considering Fey and Revins' (2005) first law, "increasing degree of ideality", this development is likely to continue in a long term perspective. End users will be able have access to larger data plans, and thus likely use stream more video and music over MBB. Consequently, a well performing MBB is likely to be imperative for more OTTs and thus open up further for collaboration around the performance of the service delivery.

7 Conclusion

This chapter aims to elucidate the main conclusions and provide with answers to the research questions for this master thesis.

7.1 RQ1: Actors' main values and/or challenges related to MBB

For the OTTs, improved QoS is a valuable improvement brought up by several interviewees. Especially the possibility for OTTs to obtain more end-to-end control over the QoS, including the last mile network that is under the control of the operator. Video streaming services mention live streaming to be especially challenging. A second challenge, is the limited end user data plans and the risk for OTTs to use the end users' data plans and thus leave them unable to use their application OTT content and service providers stringent on resources and with high throughput and latency demands are more dependent on the performance of the MBB networks. Considering the fact that MBB is becoming increasingly popular and thus an important channel of content delivery, the need for improving QoS and avoiding eroding end users' data plans will probably grow even more in the future.

When looking at the mobile network operators, their overall values to obtain are finding new revenue streams and how to properly capitalize on mobile data. There are other values and challenges prevalent, however those are regarded secondary in the MNOs shift from traditional voice and messaging over to ensuring growth derived from mobile data.

From the study, the end user's values were found to be easy-to-use and applications meeting their needs with high availability and high quality to a low cost.

While the above stated values are of high importance to the actors, there are different ways to attain said values; alone or through collaborations. While the values have proven large enough for actors to form commercial OTT/MNO collaborations, it is questionable whether the values in creating technical collaborations are high enough to exceed the associated cost to create and uphold the collaborations.

7.2 RQ2: Actors' willingness and interest in engaging in collaborations

The openness toward collaborating with other actors in the MBB ecosystem is high among both OTTs and MNOs. The participating actors in this study are to a greater extent interested in collaborations than actually actively seeking to engage in specific collaborations. It should also be noted that commercial collaborations aiming to retain or attain subscribers have come further than technical collaborations to improve the use of MBB. In technical collaborations, the OTTs show a willingness to adapt their services to certain MBB network conditions, whereas the MNOs to a larger extent want to be able to charge for improvements related to QoS. In relation to improved QoS, the participating actors were found to have different perspectives on net neutrality, where OTTs in general are more in favor for strong net neutrality interpretations and less willing to risk bad

publicity due to what the public opinion may consider a violation of the net neutrality principle.

Concerning end users, the study reveals that collaborations are difficult to establish since end users show low interest to engage. Collaborations need to require minimal effort from end users' as well as offering tangible and direct value that is easy for the end user to understand. The concept of improved QoS is difficult to communicate toward end user since it only can be improved on an average level rather than individual.

7.3 RQ3: Opportunities to collaborate toward improved use of MBB?

The MBB ecosystem is tinged by an interdependence of resources and activities, as well as meeting the criteria's established by Powell (1990) concerning: demand for speed, variable resources and an uncertain environment. Moreover, previous research show that networks are particularly valuable for innovation of technological systems, where the MBB ecosystem may be regarded to comprise of several systems and smaller networks. Drawing upon the previous literature presented in this thesis, the MBB ecosystem would be suitable for facilitating collaborations among its actors and potentially benefit from establishment of business models based on the assumption that value is co-created and dependent on other actors' capabilities.

The conducted interviews resulted in revealing a number of interesting ways to collaborate to improve the use of MBB, however two types of collaborations were deemed to be of particular interest for this study. This being, service data differentiation and unbugging the last mile networks. Service data differentiation brings the opportunity to improve QoS toward end users and OTTS, and as a way to optimize the MBB network resources through data traffic management and create new customized services. Information sharing among the actors could facilitate differentiating between types of data traffic and enable service data differentiation by the MNOs. While MNOs and Ericsson acknowledge the values to be obtained, net neutrality is creating a reluctance and especially the OTTs oppose the idea of unequal treatment of data. Whereas, unbugging the last mile networks involves establishing dialogues and information sharing of performance related issues and metrics in order to improve QoS in MBB networks. Currently OTTs argue that MBB networks are blind spots in the content delivery value chain and better understanding of MBB specific conditions are considered valuable. To establish an end-end content delivery chain would also prove valuable to MNOs, since it is in their interest to deliver best possible connectivity solution toward end users.

7.4 RQ4: Prerequisites and obstacles to establish collaborations

Technological possibilities open up for opportunities in creating collaborations between actors within the MBB ecosystem, whereof many are still unexploited. The prerequisites and obstacles to create collaborations both explain common reasons what is hindering the

development, and thus what also has to be addressed for collaborations to be widely spread. Important to note is that while not all prerequisites and obstacles are problematic for all collaborations, all need to be met or overcome. Furthermore, while the prerequisites and obstacles are not associated specifically to one type of collaboration, they have proved more troublesome for technical collaborations than for commercial ones.

As for prerequisites and obstacles to establish collaborations between OTTs and MNOs, these can be divided into lack of (clear) value for the actors, external factors, and difficulties in establishing collaborations due to unsuitable industry structure.

Regarding the value perspective, *valid business case, uncertainty about value* and *MNO focus on the traditional business model* are the three aspects most often mentioned. These aspects either hinders or slow down the creation of collaborations due to the fact that the actors do not see enough value in collaborating or because the external trial and error process is considered too costly when there is no certainty which or how much value a collaboration will yield. MNO's difficulties to find and adapt to new business models can be linked to the concept of path dependency, implying that even if the MNOs want to radically innovate their business model it is very difficult due to reinforcing processes.

Turning to external factors, obstacles and prerequisites and obstacles can be found in different layers of the *net neutrality debate*, and privacy and trust issues regarding *sharing user information*. As for the net neutrality debate, the actual regulations as well as uncertainty about where the regulatory boundaries are or will be drawn are two aspects hindering certain types of collaborations. While the uncertainty might be reduced to some extent following the introduction of guidelines on how to interpret the regulations, the main mean to reduce uncertainty will be through market application where actors test the boundaries. Moreover, there is a fear of bad publicity hindering actors, especially the OTTs, from entering into collaboration that are allowed according to the regulations but not allowed according to public opinion. Finally, the actors' own stance on what can be defined as the net neutrality grey zone also impact the opportunity for collaborations. Both the net neutrality debate as well as privacy and trust issues regarding sharing user information are examples of how especially the political and social environment in the PEST framework and the institution level in Williamsson's model impact an industry and its actors' actions.

Concerning difficulties to establish collaborations, they can partly be linked to the transaction costs inherent in initiating and upholding a large number of relationships, which is due to a *scattered ecosystem* and *no clear paths inside organizations.* In cases where only a few collaborations don't yield enough value, these transaction costs need to be lowered for collaborations to be used to a large extent. Quite often there is an *asymmetrical power relationship* between the actors, which do not hinder collaboration per say but largely influence their nature.

As for B2C collaborations, i.e. collaborations between an MNO or an OTT and end users, end users have three demands on the characteristics of the collaboration to be willing to enter:

tangible and easily understood value, direct benefits and minimal effort to engage and understand. These criteria limit the leeway for collaborations, but if they are met, end user collaboration provide a good alternative when B2B prerequisites and obstacles to create collaborations, especially due to net neutrality regulations, are too high.

7.5 RQ5: Impact and implications of prerequisites and obstacles on interesting collaborations

Applying the found prerequisites and obstacles on the two specific types of interesting collaborations, the researchers conclude the following.

Concerning service data differentiation MNOs are reluctant to act upon any activities that can be considered to be in conflict with net neutrality, privacy and trust concerns inhibit information sharing and OTTs in general are against service differentiation. Therefore, different treatment of data from certain services is considered not to be possible from today's net neutrality perspective, however technically possible to do.

Obstacles in uncertainty about value and a fragmented ecosystem may lead to in-house development prioritization of resources, where value is easier to estimate and are not dependent on other actors' willingness to collaborate. Currently no proof of concept has been established to ascertain the value of such collaborations. However, the interest exists among MNOs and OTT and collaborations are believed to hold great potential if value is identified and/or transaction costs reduced.

8 Further research

An important reminder is that this report has excluded many areas: the scope includes MNOs, OTTs offering music or video streaming, and B2C end users, it focuses on the European market, especially the Nordic market, and it disregards everything that cannot be categorized as commercial collaborations where the purpose is to attract or retain customers, or technical collaborations with the aim to improve the service delivery. It's thus possible that opportunities exist outside the thesis scope.

One interesting area for future research, mentioned by several interviewees, is opportunities linked to collaborations with B2B end users, specifically around IoT/M2M, where the consumer of the connectivity service is an organization. As some of these collaborations, e.g. collaborations around self-driving cars or remote surgery, are in line with net neutrality regulations provided they are considered justifiable as public good (Rydberg 2016), one of the largest obstacles to create collaborations is in those cases not present. Moreover, if collaborations with other types of OTTs are investigated, we recommend including OTTs seeking other types of values rather than differentiating the OTTs based on industries. One example of a different type of value brought up by Ericsson employees but not echoed by the OTTs in scope would be security.

9 Recommendations to Ericsson

The master thesis has been conducted on behalf of Ericsson. This section suggests how Ericsson can use the outcome as well as provide recommendations on how to proceed if Ericsson which to further investigate possible technical collaborations.

9.1 How to use the report outcome

As with all reports, the outcome can be used in different ways. Three suggestions are hereby provided as food for thought.

To decide whether or not to pursue found opportunities to collaborate

One way to use the report outcome is to use the insights in what actors consider most valuable to have solved or improved, their attitudes toward collaborating as well as the prerequisites and obstacles to create collaborations and what can be done about these prerequisites and obstacles, to decide whether or not to pursue found opportunities to collaborate. The researchers would not argue that there is no opportunity for collaborations within areas investigated, but rather acknowledge that the prerequisites and obstacles regarding technical collaborations are plenty and pose the question if there are not other paths to be exploited that would require less costs and effort in finding the collaborations that meet or overcome the prerequisites and obstacles to create collaborations. Technical and commercial collaborations will be discussed on a high level in 9.2.2 and two specific collaborations in 9.2.3.

Apply prerequisite and obstacle frameworks on other collaborations

Another way to use the report is to apply the frameworks of prerequisites and obstacles for creating OTT/MNO or end user collaborations when investigating opportunities for new types of collaborations. A lot of potential collaborations have been discussed throughout the interviews, but for obvious reasons it is not an exhaustive list, as new ideas form regularly. The prerequisite and obstacle frameworks are however not specific to one single type of collaboration, but applies to many different cases. The researchers therefore advice Ericsson to use the frameworks, including stated prerequisites and obstacles, as an analysis tool when investigating new possibilities for collaborations.

Use the dimensions to find additional obstacles and prerequisites

The three dimensions; *actors, external factors,* and *the collaboration,* are present not just in what we have chosen to name technical and commercial collaborations. There need to be incentives for actors to engage in collaborations, it need to be allowed, and it need to be feasible to create the collaborations. While the list of prerequisites and obstacles are composed according to what the interviewed actors currently consider troublesome with regards to technical and commercial collaborations, the dimensions can be used in other cases and at other points in time to detect additional prerequisites and obstacles present in a specific context at a specific point in time.

9.2 If choosing to help create technical collaborations

This section aims to give recommendations on how to proceed if Ericsson which to further investigate possible technical collaborations. It ought to be noted that Ericsson have not been in focus for the report, and thus that the company's resources and capabilities have not been assessed. To properly understand how Ericsson can help reduce obstacles to create collaborations, such an assessment is necessary. Section 9.2.1 should therefore be looked upon as areas to look into rather than definite recommendations.

9.2.1 Help reducing obstacles and meet prerequisites

While actors are not actively seeking technical collaborations, there is an openness toward collaborating if clear win-win situations can be found where the competitive advantage for each actor exceed the effort and cost necessary to create and uphold the collaboration. If prevalent prerequisites and obstacles to create collaborations can be met or overcome, there is an opportunity to collaborate for a better use of MBB. It's not necessarily the actors that have been subjects for investigation in this thesis that need to meet what is above stated. Ericsson, as the actor that is currently pushing the most for technical collaborations, could therefore have a part in helping reduce obstacles and meet prerequisites.

- **Find win-win collaborations, set up pilot collaborations with interested parties and display the successful results**
  - Act as integrator → lower uncertainty and efforts in setting up collaborations
  - Display proof of concept → lower uncertainty about value (trial and error process)
- **Eliminate or reduce the costs of maintaining relationships**
  → Option 1: Act as a broker
  → Option 2: Create standardized collaborations that require minimal actor interaction

Figure 28. Examples of how Ericsson could address and help reduce prevalent prerequisites and obstacles to create collaborations.

Three aspects to address are *valid business case, uncertainty about value* and *no clear paths inside organizations*. Ericsson need to find win-win situations, set up pilot collaborations with interested parties and displaying the successful result would help reducing obstacles and meeting prerequisites in two ways. By acting as an integrator, Ericsson would lower the uncertainty and efforts in setting up collaborations, and by displaying proof of concept, Ericsson would help lower uncertainty about value and thus take some of the costs related to the trial and error process.

Moreover, Ericsson could help reduce the relationships cost, i.e. transaction costs, related to *the scattered ecosystem.* There are many ways in which this could be done. One option is for an external actor, potentially Ericsson, to act as a broker and thus taking the transaction costs on them. Another option is to creating collaborations that are standardized and

require only minimal interaction between the actors, thus lowering the transaction costs for each collaboration.

9.2.2 Types of collaborations to aim for

Contrasting commercial collaborations to technical collaborations, the researchers see larger opportunities for commercial collaborations to be used to a large extent. Commercial collaborations have come the furthest with regards to both structure and spread. Actors actively seek these types of collaborations as the value proposition is more obvious for involved actors.

Regarding technical collaborations, interest exists and there is probably some room for collaborations around QoS. The question is how much value that can be created from the collaborations and how urgent the need to create collaborations is. While the values stated in chapter 5.2 are of high importance to the actors, the researchers experience technical collaborations to be talked about as a “nice to have” rather than a “must have”. Furthermore, there is some misalignment of incentives as the OTTs are interested in better service and satisfied with the fact that a better product will lead to more or retained customers. MNOs do not see the direct linkage, and are more focused on ensuring payback on all investments made. In addition to this, there are many obstacles to create MNO/OTT collaborations and specific end user demands on collaborations implying a narrow leeway to create collaboration. This causes a reluctance from actors to seek technical collaborations.

At the same time, it should be noted that the demands on the MBB service are increasing. The data consumption is growing rapidly, end users have increasingly high demands and are less patient, and as mentioned in chapter 6.4 the need around MBB is likely to grow.

Comparing end user collaborations to OTT/MNO collaborations, the researchers suggest Ericsson to opt for OTT/MNO collaborations if possible. First, OTTs and MNOs are more open toward these types of collaborations, and second, there is a larger leeway to create collaborations. End user (or three party) collaborations do provide a good alternative when net neutrality prohibits alternative ways, and the researchers then recommend to take all end user demands on collaboration into account and use the minimal effort criteria to wisely – as did T-Mobile with its BingeOn offer.

9.2.3 Specific types of collaborations

Two types of collaborations have been discussed more than others throughout the interviews: service data differentiation and unbugging the last mile network.

Service data differentiation implies data traffic differentiation with the purpose of altering QoS, which includes many different sub types: differentiation between real-time and non real-time traffic, prioritization of initial packets when streaming, etc. The area holds large opportunities from a technical perspective, but also have many other aspects working against collaborations to form. There are huge obstacles in different layers due to net neutrality, which in turn also cause other obstacles to be amplified. One example is that the

fragmented ecosystem gets more troublesome due to that fact that if MNO have collaborations, they need to have them with all OTTs. Furthermore, no interviewed MNO or OTT is currently seeking value in this area, but instead try to satisfy their needs and solve their challenges in alternative ways. Thus our recommendation to Ericsson is that, if Ericsson believe they have found win-win collaborations, go for it. But before taking the go decision, the company needs to thoroughly analyze the potential collaborations from all prerequisites and obstacles perspectives. All prerequisites and obstacles need to be met or overcome simultaneously.

Turning to unbugging the last mile network, there are potentially larger opportunities to create collaborations in this area. First of all, net neutrality is for the most part not an issue. Furthermore, both OTTs and MNOs express values in sharing information or knowledge to understand the networks better and how they impact QoE, and discussing related issues and solutions. However, if the collaboration requires large investments, MNOs need to be able to strongly link it to competitive advantage, i.e. attracting or retaining customers, or directly monetize from the investments. There is thus potentially value to be attained in this area, but Ericsson need to investigate the area and specific opportunities for unbugging the last mile network deeper to discern what types of collaborations are and are not viable.

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APPENDIX: INTERVIEW GUIDES

The Appendix provide the interview guides for all conducted interviews. Not all questions where asked to all interviews, as the interview guides were used as guidelines rather than a questionnaire. All interviews with OTTs and MNOs were conducted in Swedish.

A. Ericsson interview guide

Background information

The interview will be semi structured, i.e. of a conversational form, where we are interested in your thoughts on current and potential future collaborations and information sharing between MBB actors, focusing on MNOs, OTTs and/or end users.

The basis for the thesis projects is that even though it is technically possible to differentiate data traffic over the MBB, were OTTs and/or end users willing to reveal information about the data being transferred, MNOs are today unaware of the information being sent over the network. The objective for the thesis is to investigate possibilities for MNOs to adopt business models based on collaboration and information sharing between MBB actors. What kinds of business models are likely, which are the key enablers and what would be the pains and gains for actors involved in the MBB ecosystem?

The purpose for this phase is to acquire insight and knowledge about...

- ...what is possible to do to optimize the data traffic in the MBB.
- ...what types of collaborations/information exchange are needed to optimize the traffic.
- ...what types of collaborations/business models the different actors are interested in.
- ...what prerequisites need to be in place to create said collaborations/business models (including potential barriers or limitations)

Areas that will be covered are:

1. General questions about the MBB industry
2. Data traffic differentiation and information sharing
3. Collaborations and business models between MNOs and OTTs or MNOs and End users.
4. Future interviews

Interview questions

1. General questions about the MBB industry

- What is your field of expertise/what do you work with?
- What are the most urgent (future) challenges in the MBB industry?
- What is the MBB industry actors' general attitude toward sharing information used for data traffic differentiation?

2. Data traffic differentiation and information sharing

2.1 Technical possibility to differentiate data packets

- On a high level, explain the technical idea with differentiation of data traffic?

- What are the most important needs or challenges whose solution depend on data traffic differentiation as a mean?
- What is technically possible and not possible today?

2.2 Current use of data traffic differentiation in the MBB industry

- To what extent is data traffic differentiation used by MNOs today based on information disclosed from other actors in the MBB ecosystem?
- What would be needed from OTTs and end user respectively in order to (better) increase QoS in general or for specific users or use cases?

3. MBB Actor collaborations

3.1 Willingness to share information

- What aspects would you say are most important for *OTT's* willingness to share information necessary for differentiation of data traffic?
    - Do these aspects vary depending on geography, type of actor, anything else...? And if so, how?
- What aspects would you say are most important for *end users'* willingness to share information necessary for differentiation of data traffic?
    - Do these aspects vary depending on geography, type of actor, anything else...? And if so, how?

3.2 Types of collaborations

- What kinds of collaborations or business models based on information sharing...?
    - exist today between MNOs/OTTs or MNOs/end users?
    - are potential future collaborations between MNOs/OTTs or MNOs/end users?
- How would you describe the collaboration/business models? (core idea, involved parties, type of region, value for involved parties, revenue stream)

3.3 Possibilities or limitations for collaborations to increase in use

For the collaborations/business models mentioned above:

- Which are most/least likely to be utilized to a large extent in the future? Why?
- Where are they likely and not likely to grow (e.g. regions, types of actor etc.)?
- What are the prerequisites for them to be used considerably?
- Are there any barriers or limitation to speak of in deployment or for widespread use? (e.g. net neutrality)
- What would be the short term and long term effects on other actors in the MBB ecosystem?
    - Would utilization imply reshaping of the ecosystem?
    - Who would and would not benefit?

4. Future interviews

- What OTTs and MNOs would you say are most interesting for us to talk to in future interviews?

B. OTT interview guide

Bakgrundsinformation

Intervjun kommer att vara semistrukturerad, dvs. i formen av en konversation, där vi är intresserade av dina tankar kring nuvarande och potentiella framtida samarbeten och informationsdelning mellan MBB-aktörer, med fokus på MBB providers, OTT content/service providers och/eller slutanvändare.

Syftet med den här intervju är att skaffa insikt och kunskap om..

- ..vilka värden som kan realiseras för respektive MBB-aktör genom ökat samarbete.
- ..vilka typer av samarbeten/affärsmodeller som de olika aktörerna är intresserade av.
- ..vilka förutsättningar som behöver finnas på plats för att skapa nämnda samarbeten/affärsmodeller (inklusive potentiella barriärer och begränsningar).

Områden som kommer att behandlas i intervjun är:

1. OTT/Content Providers och XYs roll i MBB-ekosystemet
2. Samarbeten och affärsmodeller mellan aktörer inom MBB
3. Samarbeten kopplade till utmaningar i ökad datakonsumtion och höga krav på QoS/QoE

Intervjufrågor

1. OTT-tjänster och content providers' roll i MBB-ekosystemet

1.1 Musik/Video streaming-tjänsters roll i MBB-ekosystemet

- Vad har M/V streaming-tjänster för roll i dagens MBB-ekosystem? Hur har denna roll förändrats under senare år och hur förväntar du dig att den kommer utvecklas i framtiden?
- Vilka är de största utmaningarna för M/V streaming-tjänster gällande MBB?

1.2 XY roll i MBB-ekosystemet

- Hur stor del av XYs trafik går genom MBB?
    - *Sen ni någon trend av ökat alternativ minskat användande av MBB?*
- Hur skiljer XY mot sina konkurrenter?
- Vad fokuserar ni på för att fortsätta vara konkurrenskraftiga? Vilka värden är viktiga för er att utveckla för att förbättra ert värdeerbjudande och ert företag?
- Vad finns det för möjligheter och utmaningar i att nå dit ni vill?
- Skiljer sig era utmaningar åt mellan de olika länder ni är aktiva i?

2. Samarbeten och affärsmodeller mellan MBB-aktörer

2.1 Typer av samarbeten

- Har ni samarbeten med mobiloperatörer eller slutanvändare idag?
- Varför är ni delaktiga i de här samarbetena?
- Vad skulle vara ideala samarbeten med OTT:er/Content Providers respektive slutanvändare? (kommersiella och tekniska)
    - *Vad vill ni ha/behöver ni från varje part för att utveckla era tjänster och värdeerbjudanden?*

    - *Vad får ni och kan ni dela med er i sådana samarbeten?*
- Vilka är de viktigaste värden som kan realiserade för XY genom att samarbeta med andra aktörer i det mobila bredbandet?

3. Samarbeten kopplade till tekniska utmaningar

3.1 Utmaningar kopplade till ökad data konsumtion och höga krav på QoS/QoE:

- Vad ser ni för utmaningar med att bibehålla eller förbättra QoS/QoE inom MBB?
- Vad kan XY som OTT-tjänst göra för att bemöta dessa utmaningar?
- Vad är er syn på data traffic differentiation som ett sätt att optimera nätverken och säkerställa hög QoS?
    - *Är det något ni använder idag? User differentiation vs Service differentiation*
    - *Tror ni det kommer krävas i framtiden för att leverera efterfrågad QoS/QoE?*
- Vad är din syn på potentiella samarbeten med mobiloperatörer och/eller slutanvändare för att säkerställa QoS?
    - Hur gör XY idag?
    - Vilka kan man tänka sig? Hur skulle de se ut?
    - Vilka värden kan man skapa genom samarbeten?
    - Vilken typ av information skulle ni som OTT-tjänst behöva från övriga aktörer?
    - Vad är de viktigaste faktorerna för att få mobiloperatörer att dela med sig av information?
    - Vad är de viktigaste faktorerna för att få slutanvändare att dela med sig av information?
- Vad finns det för barriärer för att realisera utökade samarbeten mellan aktörerna inom MBB?
    - Tekniska?
    - Affärsmässiga?
    - Sociala/Politiska/Juridiska?
- Hur ställer ni er till nätneutralitetsdebatten?

C. MNO interview guide

Områden som kommer att behandlas under intervjun:

- Mobiloperatörens roll i MBB ekosystemet
- Samarbeten mellan aktörer inom MBB
- Förutsättningar för framtida samarbeten och affärsmodeller inom MBB

Intervjufrågor

1. Vad har mobiloperatören för roll i dagens MBB-ekosystem?

- Hur har denna rollen förändrats under senare år?
- Vad har mobil operatörer för möjligheter och utmaningar?
- Hur skiljer sig XY mot sina konkurrenter?
- Hur kommer XY at utvecklas framöver, på kort respektive lång sikt?
- Vad finns det för möjligheter och utmaningar?

2. Utmaningar kopplade till ökad data konsumtion och höga krav på QoS/QoE:

- Vad ser du för utmaningar med att bibehålla eller förbättra QoS/QoE inom MBB?
- Vad kan XY som mobiloperatör göra för att bemöta dessa utmaningar?
- Vad är din syn på potentiella samarbeten med OTT-tjänster och/eller slutanvändare för att säkerställa QoS?
    - Hur gör XY idag?
    - Vilka kan man tänka sig? Hur skulle de se ut?
    - Vilka värden kan man skapa genom samarbeten?
    - Vilken typ av information skulle ni som mobiloperatör behöva från de andra aktörerna?
- Vad är er syn data differentiering för att skydda alternativt optimera nätverken och säkerställa en hög QoS?
    - Använder ni det idag? User differentiation vs. Service differentiation?
    - Vilka problem skulle man kunna lösa genom data differentiering i MBB-nätverken?
    - Vad skulle ni som operatör önska för information från de andra aktörerna för att kunna maximera nyttan av data differentiering?
        - Vad är de viktigaste faktorerna för att få OTT-tjänster att dela med sig av information?
        - Vad är de viktigaste faktorerna för att få slutanvändare att dela med sig av information?
- Vad finns det för barriärer för att realisera utökade samarbeten mellan aktörerna inom MBB?
    - Tekniska?
    - Affärsmässiga?
    - Sociala/Politiska/Juridiska?
    - Ser dessa olika ut beroende på var i världen man är?

3. Framtida intervjuer

Kan du rekommendera oss att prata med någon särskild person i denna frågan?