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Beyond the Core: From Telco to ICT Provider - How Italian Telecom companies are changing their Business Models to shift from their core business and become ecosystem enablers to generate new revenue streams.

Prof. Irene Pipola	Prof. Donato Iacovone
SUPERVISOR	CO-SUPERVISOR

Matteo Ferramondo

CANDIDATE

ID number: 752491

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Abstract

In an era of digitalization and increasing reliance on technology, the telecom sector faces formidable challenges to its business model, struggling to maintain consistent revenues and invest in new technologies and infrastructure. This research explores how Italian telecom operators can diversify beyond connectivity and counter the decline of their core business by creating new revenue streams. Through a comprehensive analysis of the Italian telecom industry, emerging market trends such as 5G and Value-Added Services (VAS) are examined. By employing both quantitative and qualitative methods, including the analysis of sector financials and interviews with telecom executives, three key themes emerge: Sector Challenges, Traditional Assets, and Beyond Core Services. The study emphasizes the significance of leveraging core assets, capitalizing on 5G and VAS, and adopting the role of ecosystem enablers to generate innovative revenue streams.

"it's a great invention but who would want to use it anyway?"

Rutherford B. Hayes, U.S. President, after a demonstration of Alexander Bell's telephone, 1876.

To date, there are over 6.8b phones worldwide, about 85% of the world's population.

Source: International Telecommunications Union

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Introduction

In an era of digitalization and increasing reliance on technology, the telecom sector is confronted with significant challenges to its business model. While it was once a highly lucrative industry, it now struggles to generate consistent revenues. Over the past decade, the NASDAQ Index[1] has witnessed a staggering growth of 349%, whereas the NASDAQ Telecommunications Index[2] has only experienced a modest increase of 57%[3]. This discrepancy of 292 percent points underscores the disparity between the telecommunications sector and the flourishing growth of big tech companies, despite the fact that the telecom sector plays a vital role as an enabler of these technologies. The declining performance of the telecom sector is evidenced by a sharp decrease in revenues from core business activities (fixed and mobile services), coupled with the need for substantial investments in both new and existing infrastructure. Despite a consistent growth in the number of connected lines, telecom companies face dwindling EBIT.

The objective of this research is to address the following question: How can Italian telecom operators leverage their traditional assets to diversify beyond connectivity and counter the decline of their core business by creating new revenue streams? To answer this question, both a quantitative method and a qualitative method was used. A quantitative analysis was performed by analyzing sector's data and operator's balance sheet to understand the state of the telecommunication sector from a financial point of view. Then, qualitative data was collected through interviews conducted with current and former telecom executives, who possess expertise in the subject matter and can provide valuable insights into addressing the research question. Following the interviews, significant quotes were analyzed to extract key "data points" (1st order concepts). Related data points were then organized into topics (2nd order concepts), which further contributed to the formation of overarching themes. Ultimately, three distinct aggregate themes emerged, closely aligned with various aspects of the research question: Sector Challenges, Traditional Assets, and Beyond Core Services.

This research is structured into four chapters. The first chapter provides an overview of the Italian telecom industry, analyzing its markets trends, key players, business models, and defining characteristics. Furthermore, it examines the regulatory structure and environment, compares the

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[1] The NASDAQ Index, often referred to as the NASDAQ Composite, is a stock market index that represents the performance of a wide range of stocks listed on the NASDAQ stock exchange. It is one of the major stock market indices in the United States and includes stocks from various sectors, such as technology, telecommunications, biotechnology, and financial services. The NASDAQ Index is known for its focus on technology companies and is often seen as an indicator of the performance of the technology sector as a whole. (https://indexes.nasdaqomx.com/)

[2] The NASDAQ Telecommunications Index comprises securities of companies listed on NASDAQ that are classified under the Industry Classification Benchmark as Telecommunications and Telecommunications Equipment. This index includes companies involved in various aspects of the telecommunications industry, such as fixed-line and mobile telephone service providers, as well as manufacturers and distributors of advanced communication products. (https://indexes.nasdaqomx.com/Index/Overview/IXTC)

[3] *See* TradingView Data. Accessed on 27/05/2023

Italian telecom sector with other countries, and delves into the industry's core business decline (fixed and mobile services). The second chapter offers insights into emerging market trends. Specifically, it explores the 5G Mobile Network, its potential as a technology enabler, and its significant use cases. The third chapter focuses on Value-Added Services (VAS), elucidating their definition and presenting various use cases of VAS implementation by telecom companies worldwide. VAS is examined across four categories: the Internet of Things and edge computing, financial services, the opportunities in the gaming sector, and the potential offered by the metaverse. Finally, the fourth chapter analyzes the interview findings. It begins by detailing the methodology employed in analyzing the interviews and subsequently explores the three aggregate themes individually (sector challenges, traditional assets, beyond core services), featuring quotes from the interviewees and real use cases. Ultimately, the chapter identifies the need for a change in the business model of telecom companies, focused on leveraging its core assets, taking advantages of 5G and VAS, in order to become ecosystem enablers and generate new revenue streams.

Chapter I – Background and Market Context of the Italian Telecommunications Sector

Overview

The telecommunications sector plays a major role in the Italian economic fabric. The telecommunications services (fixed and mobile) not only contribute to employment and added value but enable connections between individuals, the growth of the digital economy, and the development of Enterprises: in summary, the telecommunications services are transversal enablers for all areas of economic activity. And, due to the phenomenon of globalization and technology innovation, the world as become more connected than ever. Nowadays digitalization is not an *if* anymore, it's a *when*. And it is in this context that the telecommunication sector is placed at the foundation of it. The telecommunication sector is split between fixed-network services and mobile telecom services. Fixed network services are divided between fixed data services and fixed voice services. Fixed data services include all retail and wholesale revenues from dedicated/private lines, packet, and circuit-switched access services (such as frame relay, asynchronous transfer mode, Internet Protocol (IP), Integrated Services Digital Network, DSL, multichannel multipoint distribution service [MMDS], and satellite). Fixed voice services, on the other hand, include retail voice service revenue for all products that are sold as such to customers, including enhanced voice services, data and fax transmission over the circuit switched PSTN, and retail voice over IP. This category also includes calling costs, line rental/subscription and connection fees. Meanwhile, the mobile telecom services refer to the income from mobile telephone calls and mobile data usage (Short-Message Service [SMS], mobile data access, mobile telephone calling charger, line rental/subscription and connection fees)[4].

Principal Telecom Operators in the Italian Telecom Sector

Telecom operators in Italy have various business models. Typically, the operators fall between two categories: retail and wholesale. Retail focused operators typically sell to both consumer and enterprise clients, with a principal focus on the consumer side and developing a large customer base through an extended footprint of locations (i.e., TIM, Vodafone, WindTre, etc.). In the wholesale-only business model, the telecom operator acts as a supplier or wholesaler, providing other businesses with the underlying network infrastructure, such as fiber-optic cables, wireless towers, or other

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[4] *See* Telecommunications Services, Information technology Glossary by Gartner

physical components (i.e., Open Fiber, Retelit, etc.)[5]. Now we will analyze the leading telecom operators in Italy.

Telecom Italia (also known as TIM)

On July 27, 1994, the combination of Sip, Iritel, Telespazio, Italcable, and Sirm gave birth to Telecom Italia. Telecom Italia Mobile (Tim) was established the next year. TIM is a publicly listed company on the Italian stock exchange in Milan, and its main shareholders are Vivendi SE[6], the Italian Government through Cassa Depositi e Prestiti (CDP)[7], and Norges Bank Investment Management[8]. Telecom Italia has always been the flagship Italian telecom company as its origin lie in state sponsored companies and most of the national network is owned and operated by TIM itself. The company operates in two markets: the Italian market, and the Brazilian market. In the Year 2021, Telecom Italia registered domestic revenues for €12,5bn and EBITDA for €3,73bn. Fixed network services accesses were equal to 16,3m between TIM Retail and TIM Wholesale and Mobile network services users were equal to 30,46m[9]. ICT revenues increased 23% Year on Year.

Vodafone Plc

Vodafone is a multinational company based in the United Kingdom which operates in over twenty countries. The company has to main customer segments, consumer, and business. For the consumer Vodafone offers mobile line services, fixed line services, convergence plans, and other value-added services such as Internet of Things applications. On the business side, the company offers all kinds of connectivity services, but lately its focus has been on unified communications, internet of things, and cloud & security. At a global level, the company counts 315m mobile customers, 28m broadband customers, and 105,000 employees. At Italian level the company registered in the year 2021 €5,02bn

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[5] *See* "Retail Telecoms Success with Wholesale Innovation" by Tata Communications.

[6] Vivendi is a French communication company, with activities ranging from communications to publishing and to cinema. The company generated €9,6bn in revenue and €868m in EBITDA during 2022 (https://www.vivendi.com/en/shareholders-investors/shareholders-and-investors-in-a-nutshell/).

[7] Cassa Depositi e Prestiti S.p.A., also known as CDP S.p.A., is the Italian development bank and it was founded on November 20, 1850, in Turin. Its original duty was to finance public works like roads and waterworks during the reign of Victor Emmanuel II of Italy, King of Sardinia-Piedmont. CDP main goal is the economic development of Italy through long-term investments at local, regional, and national level and acts as the government's arm for executing public policy mandates. CDP is the third largest Italian bank according to total assets (€470bn as of 2022), after Intesa Sanpaolo and UniCredit. Also, the bank manages the entire Italian Postal savings in Italy (€281bn in 2022). And it generated €2,5bn of Net Income in 2022 (https://www.cdp.it/sitointernet/en/investitori.page).

[8] Norway's Government Pension Fund Global, with a total value of €1,2 trillion as of 2022, is managed by Norges Bank, the country's central bank. The bank has made investments in over 9,000 businesses in more than 70 different nations (https://www.nbim.no/).

[9] *See* "TIM Relazione Finanziaria Annuale 2021" and Figure 33 in the Appendix.

in revenue, and an EBITDA equal to €1,6bn. Fixed line users were 3,05m while mobile line users were 17,9m[10].

WindTre

WindTre is owned by CK Hutchison Holdings Ltd, and it was born out of the merger between H3G and Wind in 2016[11]. The company is the second biggest mobile telecom operator in terms of market share. In 2021 it registered revenues for €4,19bn and an EBITDA of €1,71bn[12]. The company has a total registered customer base of 20,7m between fixed and mobile, of which 19m are considered active.

Iliad

Iliad is a French telecom operator which entered the Italian market in 2018 following the requirement imposed by the European competition authority for the need of a fourth telecom operator following the merger of H3G and Wind. The authority imposed some limitation such as the required sales of certain assets from the newly created WindTre to Iliad. The entrance of Iliad in the Italian market was a focal point as the company began an aggressive pricing campaign to attract customers which resulted in its competitors lowering their prices to keep up. Iliad has gained a 6% market share in just 4 years[13]. Telecom pricing plans became more of a commodity, and the only difference between them were the different services each operator would begin offering on top of the connectivity services. In 2021, Iliad generated revenues for €7,58bn, and an EBITDA for €3,03bn. The company began offering fixed line services only in 2022 and as of the Year 2022 it had a total of 9,6m mobile network services users[14].

Fastweb

Fastweb is a leading provider of fixed and mobile phone services, broadband Internet, and VAS ICT (Cloud, Cybersecurity), in Italy. The company is a leader in the business user segment and is among the top 3 players in fixed line services[15]. Swiss telecom company Swisscom AG is the sole owner of

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[10] *See* "Vodafone Group Plc Annual Report 2022" and Figure 34 in the Appendix
[11] *See* "CK Hutchison Holdings Limited 2021 Annual Report" and Figure 35 in the Appendix.
[12] *See* 11.
[13] *See* Figure 3.
[14] *See* "Iliad Group FY 2021 Results".
[15] *See* Figure 3.

Fastweb after having bought a controlling stake in 2007. As of year 2021, the company registered revenues for €2,48bn with an EBTDA of 854m. The company has a total of 3,14m customers in the fixed network services segment, and 3M in the mobile network services segment[16].

Open Fiber

Open Fiber was created in 2015 by the Italian government. The company was founded to create FTTH (Fiber to The House) fiber-optic network infrastructure for ultra-broadband (UBB) in all of Italy, specifically in the "white" and "grey" areas. These areas are zone where investments in telecom network would generate a loss rather than a profit. This strategy is known as BUL and makes it possible for every Italian citizen to access internet at reasonable prices. The company is based on a "wholesale-only" business model to ensure unfettered access to all interested Operators, on equal terms, and to give end-users a variety of options. The Open Fiber Group confirmed its position as Italy's leading FTTH fiber-optic network operator and one of the first in Europe by covering 15.5m real estate units as of December 31, 2022 (of which 13m FTTH and 2.5m FWA). Revenues and margins are both increasing according to the Financial Statements for 2022. Revenues are roughly 470m euros, up (24%) from about 380m euros at the end of 2021. EBITDA increases by 18%, from almost €152m in 2021 to almost €179m in 2022, with margins of 38%[17].

Retelit

Retelit is an example of a wholesale only operator. Retelit is a market pioneer in Italy when it comes to creating specialized digital transformation projects that are carried out wholly on platforms under the control of the Company. Thanks to a suite of services that spans the whole value chain of ICT telecom and digitalization services, the company is focused on partnering with businesses, the public sector, and operators wanting to address the challenges of innovation head-on. Retelit is a unique company in Italy that can offer integrated digital solutions because to the integration of its proprietary assets (a vast fiber-optic network in Italy and throughout the world, as well as a national data center network). Retelit is fully owned by the Asterion fund, also the owner of Irideos. Retelit and Irideos represent the largest Italian player in the telco industry focused on the B2B market. During the first

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[16] *See* "Fastweb announces financial results for fiscal year 2022: 38th consecutive quarter of growth for customers, revenues and margins" by Fastweb.
[17] *See* "Open Fiber approved the financial statements 2022".

9 months of 2021 (the latest data available) the company generated €126m of revenues, and €37m of EBITDA[18].

Regulatory overview of the Italian Telecom Sector

The Italian telecommunications sector is governed by two distinct authorities: the Italian Competition Authority (AGCM) and the independent telecommunications regulator (AGCOM)[19]. The first was established in 1990 with the introduction of Law No. 287 "The Competition and Fair-Trading Act", which acted as a basis for the current competition laws in Italy. The AGCM's main goal is to suppress unfair business practices, deceptive and illegal comparative advertising, and the application of conflict-of-interest laws to those who occupy public office. Due to its independence, it has the standing of a public body, making decisions under the Act without the chance of interference from the government. After AGCM, with Law No. 249, AGCOM was created in 1997. The law entrusts AGCOM with the dual task of ensuring the correct competition of telecom operators on the market and protecting the consumption of fundamental freedoms of users. AGCOM is composed of a president, a council, and two committees.

The committees are divided between the commission for infrastructure and networks, and commission for services and products. The first deals with[20]:

- Regulating the leading operator's rates to maintain a balance between service costs and prices.
- Regulating interconnections to guarantee all present and future operators have access to the telecommunications infrastructure.
- Determining the universal service's reach and the rules for calculating and allocating the expenses associated with it.
- Deciding on the frequency allocations, which must be approved by the Ministry of Communications after being submitted to it.
- Resolving disputes between service providers and consumers.

And the second commission deals with[21]:

- Monitoring the flow of goods and services
- Directing the interactions between network administrators and service resellers.

In particular, the main regulatory capabilities can be identified in (1) licensing, (2) rights of way, (3) interconnection and local loop unbundling, (4) universal service, (5) numbering, (6) service quality,

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[18] *See* "Resoconto Intermedio di Gestione al 30 Giugno 2021" by Retelit.
[19] *See* "Market Evolution and Regulation in the Italian Telecommunications Industry" by Carlo Cambini (Politecnico di Torino & Florence School of Regulation) and Golnoush Soroush (Politecnico di Torino).
[20] *See* 19.
[21] *See* 19.

and (7) governance. The first refers to the fact that for tasks including providing networks, installing, and managing networks, providing voice and mobile telephony, and any combination of these tasks, individual licenses are necessary. The licenses must be obtained from the Ministry of Communications, and it usually lasts for 15 years (which may be renewed), and a license fee must be paid to cover the associated administrative costs (as of March 2001, responsibility for granting licenses was transferred from AGCOM to the Ministry of Communication. The rights of way capability are needed to mitigate the harmful effects of this diversity. AGCOM must combine the numerous rights of way procedures in diverse local settings. The AGCOM should have the authority to enforce regulations and settle disputes between operators and local governments over things like facility and property sharing. The unbundling of local loops (3) is governed by a series of policies that the European Commission has created. These policies ask the incumbent operators, who are acknowledged as having significant market power, to grant unbundled access to their facilities so that new entrants only pay for the ones they use to provide their services, specializing in the kind of entry that best fits their business plan. The idea of universal service (4) refers to the process of offering a cheap basic set of services to all users without considering their location. In Italy, Telecom Italia is the provider of the universal service, and AGCOM is the body in responsibility of determining the service's net cost. The Ministry of Communications-approved fund, which is funded by the payments of all the market operators, would then reimburse Telecom Italia for the net cost. Regarding numbering (5), special national services, mobile network services, geographic services, and non-geographic services are the four types of numbers that are allotted on a first-come, first-served basis. Operators are required to pay an annual numbering fee for the usage of numbers on a per-number basis. In terms of service quality (6) operators must provide yearly service quality standards, suggested approaches for improvement, and appropriate measuring techniques. The application of these quality controls must be supervised and inspected by the AGCOM. And, lastly, in terms of governance (7), there is unavoidably a need for better sorts of regulation given the rapid technological convergence occurring across the numerous telecoms industry sectors, including broadcasting, content, and communications. AGCOM's organizational design enables it to handle this problem in a technologically impartial manner, which is essential to fostering fair competition in the industry[22].

The State of the Italian Telecommunications Market

The Italian telecommunications market its regulated by Autorità per le Garanzie nelle Comunicazioni (AGCOM), the national regulator and competition authority for the communication industries in Italy.

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[22] *See* 19.

According to AGCOM, the Italian telecommunications market, as of 2021, had a market value of €27,84bn, with fixed network services generating €15,40bn in revenue, and mobile network services generating €12,44bn in revenue (Figure 1)[23].

Figure 1: Italian Telecommunications Sector Total Revenue
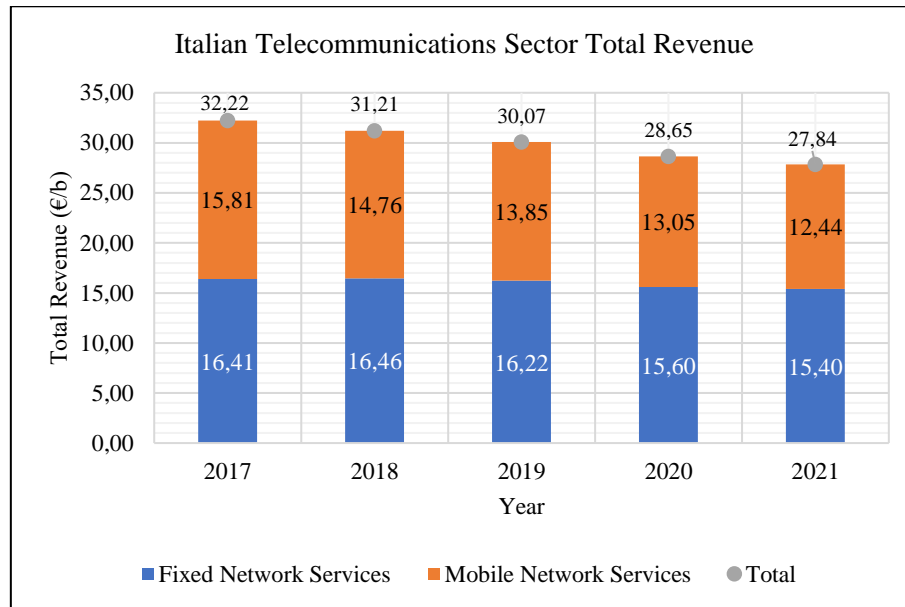
In terms of total expenditure, in 2021 fixed line services and mobile line services generated a total expenditure of €11,75bn and €10,42bn respectively. Since 2017, on average, total expenditure accounted for 81% of total revenue (Figure 2)[24]. Total Revenues, also known as sales or income, represent the total amount of money a telecom company generates from its operations and various business activities. These revenues typically come from sources such as subscriptions fees generated by data plans, devices sales, roaming charges, etc. On the other hand, total expenditure refers to the overall expenses incurred by a telecom company in running its operations, maintaining its infrastructure, and conducting its business activities. These expenditures may include infrastructure investments, network maintenance and upgrades, marketing, and etc.

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[23] *See* "AGCOM Relazione Annuale 2022" available at:
https://www.agcom.it/documentazione/documento?p_p_auth=fLw7zRht&p_p_id=101_INSTANCE_FnOw5lVOIXoE&p_p_lifecycl
e=0&p_p_col_id=column-
1&p_p_col_count=1&_101_INSTANCE_FnOw5lVOIXoE_struts_action=%2Fasset_publisher%2Fview_content&_101_INSTANC
E_FnOw5lVOIXoE_assetEntryId=27520162&_101_INSTANCE_FnOw5lVOIXoE_type=document. *See* also Table 7 in the
Appendix.
[24] *See* 23 and *see* also Table 8 in the Appendix.

Figure 2: Italian Telecommunications Sector Total Expenditure

Figure: Italian Telecommunications Sector Total Expenditure
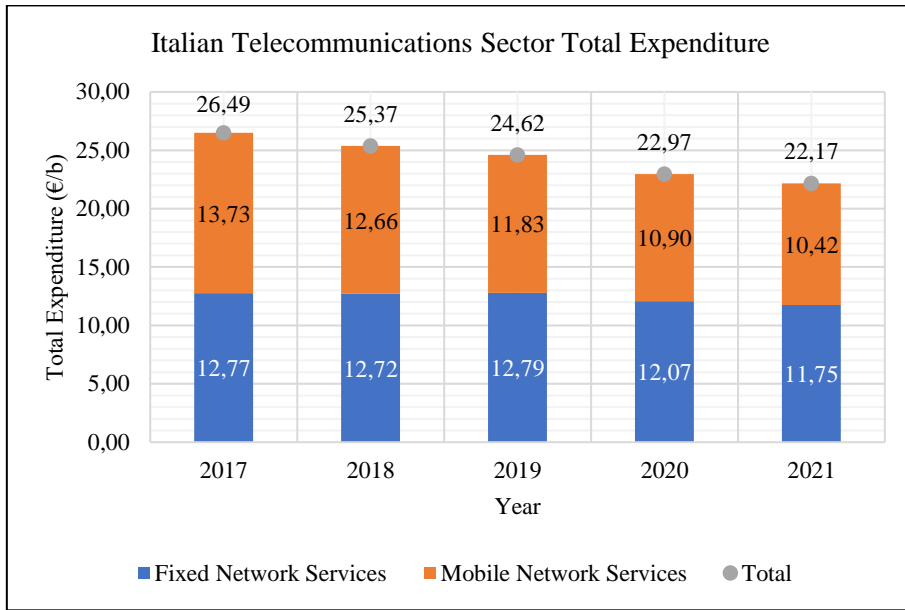
Furthermore, AGCOM provides an overview of total market shares between fixed and mobile network services based on total expenditure (Figure 3)[25].

Figure 3: User expenditure on fixed and mobile network services by operator

Figure: Italian Telecommunications Sector Total Market Shares (%) - €22,17bn
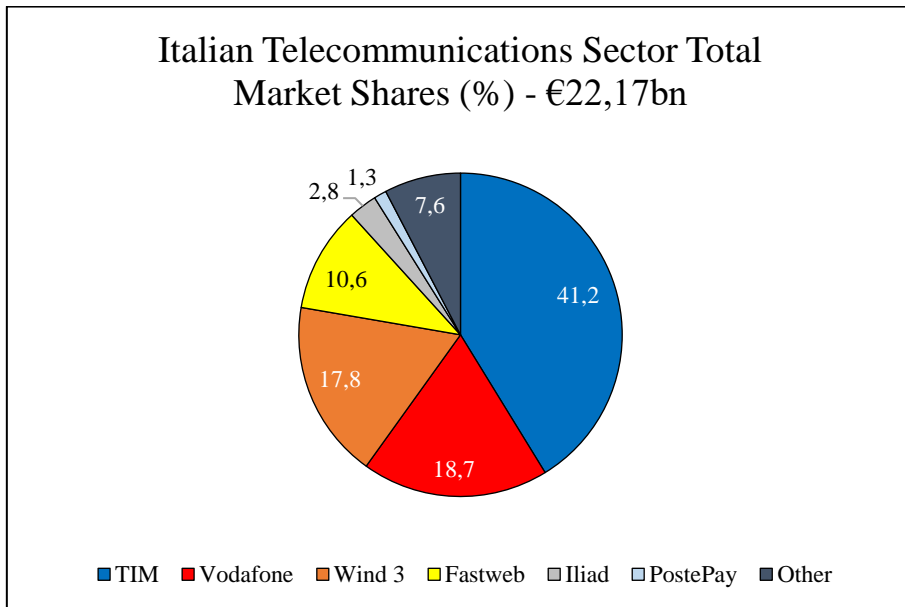
The market is considered to have reached commoditization status as revenues are decreasing year on year, average revenue per user (ARPU) is declining, and market shares are rather

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[25] *See* 23 and *see* also Table 9 in the Appendix.

consolidated[26]. But, looking at the future, the market has a positive outlook, as megatrends such as 5G-enabled services, big data, Cloud, and Cybersecurity, are set to reshape how the industry operates.

Fixed Network Markets

The fixed network services segments in Italy have been experiencing an overall decline in revenue over recent years. Since 2017, overall revenues have declined by 6,1% from €16,41bn to €15,40bn[27]. And overall total expenditure has declined from €12,77bn to €11,75bn, an 8% decrease[28]. A significant negative impact is the decrease in fixed voice services over the years as consumer are switching to messaging apps and are not customed to use fixed voice services anymore. On the contrary, fixed data services revenue has increased because of an increased data consumption in recent years especially after the Covid-19 pandemic which led to an increase in smart working e and other data-consuming activities (**Error! Reference source not found.**)[29]. This is supported by an i ncrease in broadband accesses mainly with Fiber to The Cabinet (FTTC) and Fiber to The Home (FTTH)[30], and at a smaller scale also with Fixed Wireless Access (FWA)[31], which have substituted Digital Subscriber Line (DSL) technology as they are faster and more reliable technologies[32]. As seen in Figure 4, the number of Broadband (BB) and Ultrabroadband (UBB) total accesses is increasing, as is total Average Data Traffic (ADT)[33].

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[26] *See* 23 and *see* also "Commoditization in the wireless telecom industry" by Strategy& (PwC).
[27] *See* 23 and *see* also Table 7 in the Appendix.
[28] *See* 23 and *see* also Table 11 in the Appendix.
[29] *See* "AGCOM Relazione Annuale 2022".
[30] *See* "FTTC e FTTH, qual è la differenza?" By Open Fiber.
[31] FWA, also known as Fixed Wireless Access, is a form of 5G or 4G LTE wireless technology that allows fixed broadband access without the use of cables. FWA can be used to link buildings and private residences to the internet. *See* "What is fixed wireless access (FWA) technology?" By Verizon.
[32] *See* 23 and *see* also Table 10 in the Appendix.
[33] *See* "Osservatorio sulle comunicazioni N.4/2022" by AGCOM.

Figure 4: Broadband and Ultrabroadband total accesses vs Average Data Traffic
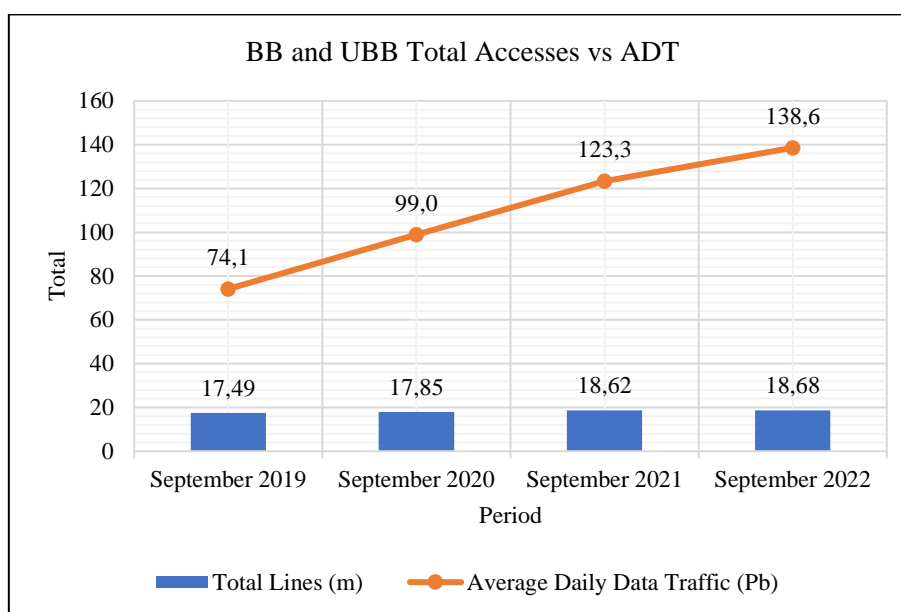
But, in line with the revenue decline, residential and enterprise user expenditures has been declining. And, as shown in Table 1**Error! Reference source not found.**, the latter has decreased by 5% since 2 017 (from 6,3€bn to 6,1€bn), while the residential user expenditure has decreased a staggering 14% (from 6,6€bn to 5,7€bn)[34].

Table 1: Fixed Network Markets - User spending by type and operator

millions of €	2017	2018	2019	2020	2021
Residential User	6,6	6,5	6,3	6,0	5,7
Enterprise User	6,3	6,2	6,4	6,1	6,1
Total	12,9	12,7	12,7	12,0	11,7

Lastly, the market is made of four main players which control 88% of the market, and smaller players which rely on specific customer segments or some geographical areas that are not covered by the bigger operators. The total market volume in 2021 was €11,75bn (Figure 5)[35].

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[34] *See* 23 and *see* also Table 7 in the Appendix.
[35] *See* 23.

Figure 5: Fixed Network Markets - Market Shares: Final Expenditure per Fixed Network Operator

Italian Telecommunicaitons Sector Total Fixed
Market Shares (%) - €11,75bn

- Tim 51,6
- Fastweb 17,9
- Vodafone 10,7
- Wind Tre 7,9
- BT Italia 1,6
- Eolo 1,5
- Other 8,8
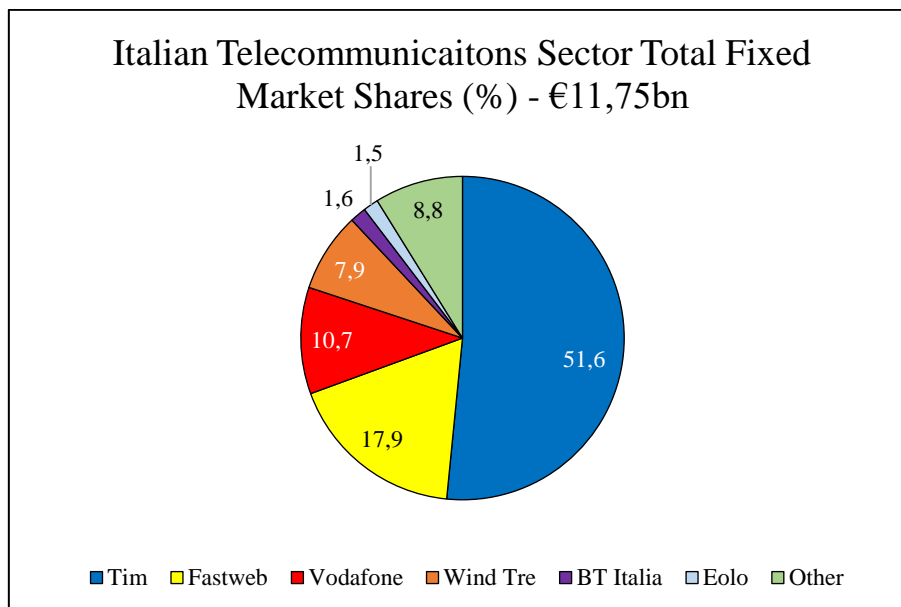
Mobile Network Markets

Similarly, to fixed network services, the mobile network services segment in Italy has been experiencing a decline in revenue despite an increase in use of its services. Indeed, total annual revenue has fallen 21% since 2017, from €15,81bn to €12,44bn[36]. While total expenditure has decreased from €13,73bn to €10,42bn, a 24% decrease[37]. Contrary to the decrease in revenue, the number of SIMs (the total number of mobile lines) has increased from 104,3m in 2019 to 107,1m in 2022 (Figure 6) The total amount of SIMs takes into consideration both Human (SIM Human) and Machine to Machine (SIM M2M). With the latter increasing from 23,5m to 28,6m from 2019 to 2022. A 22% increase compared to the 3% decrease in the former during the same period (from 80,8m to 78,5m)[38]. M2M SIMs are typically used for utilities and retail applications, and IoT applications for cars, work, or homes.

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[36] *See* 19.
[37] *See* 23 and *see* also Table 7 in the Appendix.
[38] *See* Figure 6.

Figure 6: Total Mobile Network Lines (SIM Human and SIM Machine to Machine)
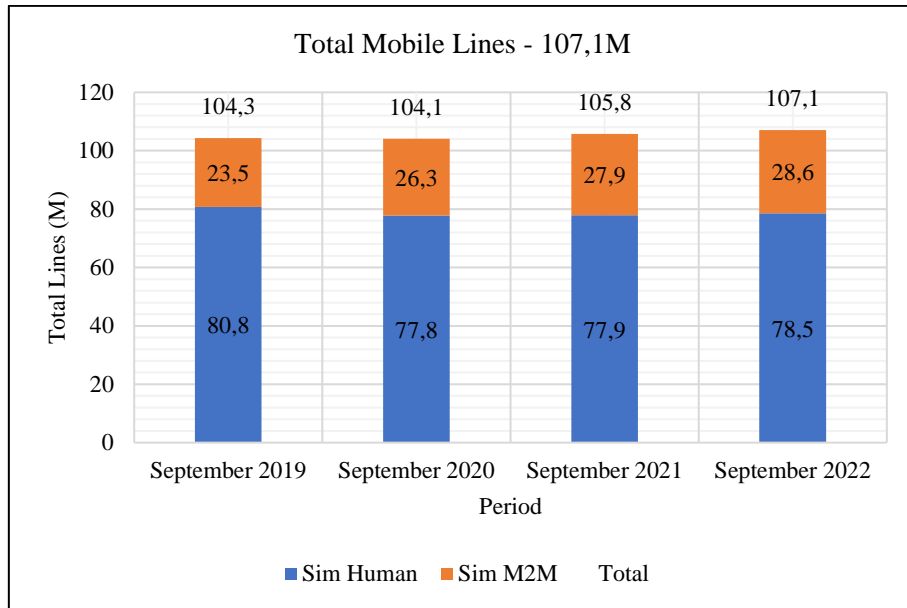
As the number of SIMs increased, the Average Daily Data Traffic increased as well (Figure 7)[39].

Figure 7: Mobile Network Average Data Traffic (ADDT)
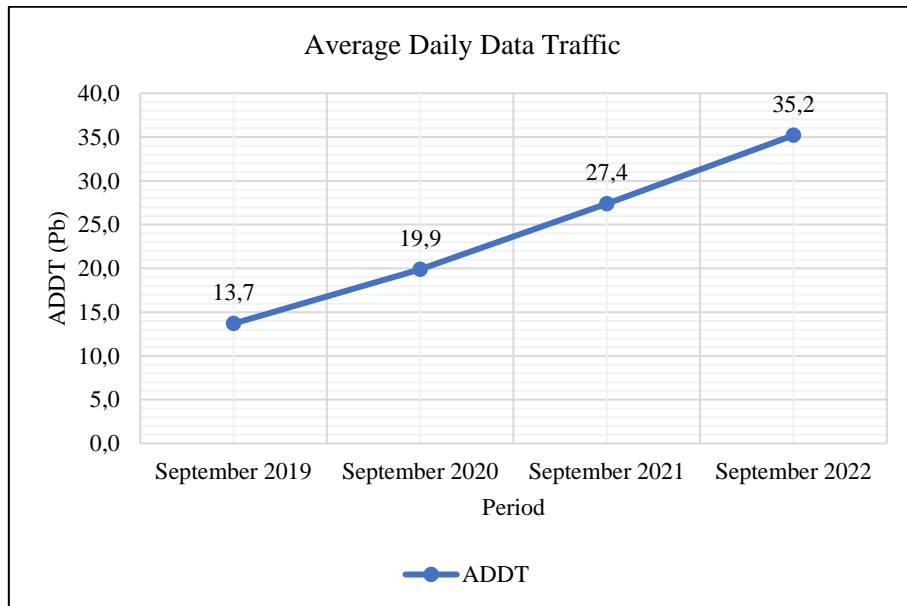
But, similarly with Fixed Network Services, revenues in the mobile network services have decreased. With mobile network services suffering a worse decline than Fixed Network Services.

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[39] *See* 29.

Total residential users' expenditure has decreased 26% since 2017 from €10,9bn to €8,1bn. And total enterprise users' revenue, has decreased 16% from €2,8bn to €2,3bn (Table 2)[40].

Table 2: Mobile Network Markets - User Spending by Type

millions of €	2017	2018	2019	2020	2021
Residential User	10,9	10,1	9,0	8,1	8,1
Enterprise User	2,8	2,7	2,7	2,7	2,3
Total	13,7	12,8	11,7	10,9	10,4

Lastly, the mobile network services market is controlled for more than 86% by three players, which are followed by one main smaller player and then smaller MVNOs (Figure 8)[41].

Figure 8: Mobile Network Market - Market Shares: Final Expenditure per Mobile Network Operator
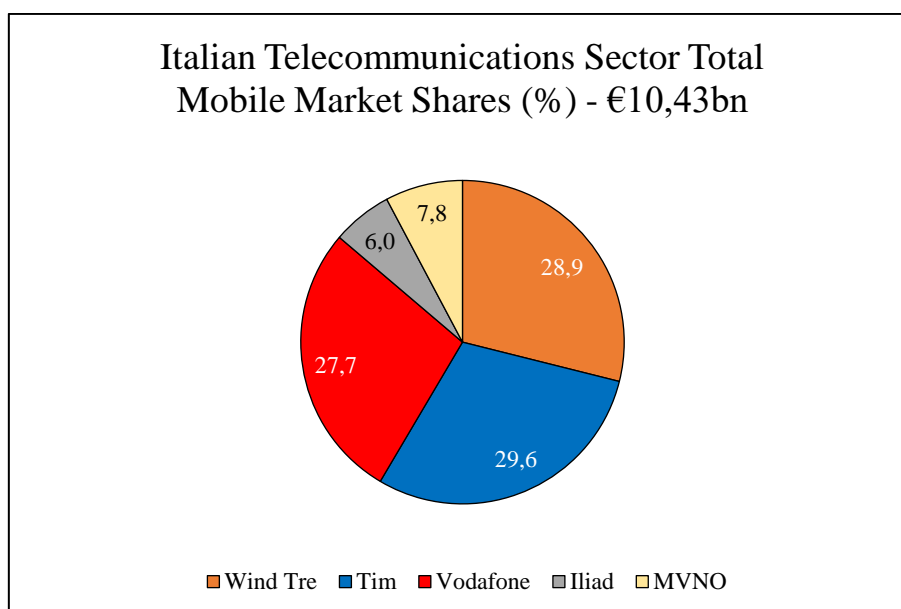
The decline of the core business in telecom sector

To further examine the Italian telecom sector, we must look at the overall decline the core business services are experiencing over the recent years. First, total revenue and total cost have been on a steady decrease as seen in Table 1, as the sector has gone through major structural changes and consumer preferences have changed over the years. The sector has always been characterized by a

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[40] *See* 23.

[41] *See* 23 and *see* also Table 12 in the Appendix. A mobile virtual network operator (MVNO) is a company that offers wireless communications services but does not possess the wireless network infrastructure it uses to serve its clients. To get wholesale access to network services in large quantities, an MVNO enters a business deal with a mobile network operator. The MVNO then sets retail prices independently. An MVNO can either use its own staff for customer service, billing support, marketing, and sales, or it can hire a mobile virtual network enabler (MVNE).

high degree of concentration[42], with few players controlling the market. As a result of this, competition has been stagnant, barriers of entry have drastically increased, and prices have dropped. In fact, as the General Price Index of Italy went from €104,1 in 2011 to €114,7 in 2021, the Telecommunication price index went from €97,8 in 2011 to €68,1 in 2021 (Figure 9)[43].

Figure 9: Electronic Communications Markets - Price Developments
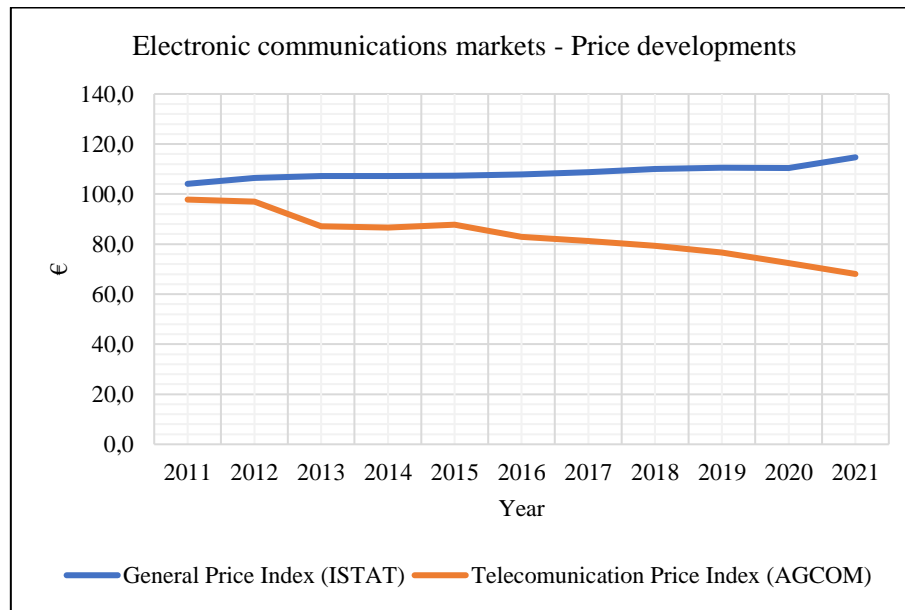
The price decrease has positively impacted consumers as they can access operator's services by spending less, but it has negatively impacted the operators themselves. Because, at the same time prices are declining, there is a strong competition to improve subscriptions plans for consumers by adding certain value-added services, which increases costs. So, although the number of registered users is rising (specifically there is an increase in the use of BB or UBB lines), investments and operating costs are increasing as well leading to lower margins and lower revenues. Fixed line services in Italy are completing a much-needed upgrade in performances with the growth of FTTC-FTTH coverage and lines[44]. Total data traffic has increased[45], and almost 50% of Italian households have the top performing ultrabroadband line[46]. But the fixed line market total expenditure has been decreasing (Table 3).

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[42] *See* "An HHI-based analysis of the H3G-Wind merger" by Maurizio Naldi.
[43] *See* 29.
[44] *See* 29
[45] *See* 29
[46] *See* 29

Table 3: Fixed Network Markets - User Expenditure by Type of Service

in billions of €	2017	2018	2019	2020	2021
Voice	4,06	3,68	3,24	2,54	2,13
Data	6,18	6,46	6,67	6,87	6,87
Other	2,53	2,58	2,88	2,66	2,75
Total	**12,77**	**12,72**	**12,79**	**12,07**	**11,75**

From a mobile network services point of view, user data revenues have increased due to the higher number of registered SIMs and a higher level of data consumption (with the number of SIM Human remaining pretty much unchanged, while the number of SIM M2M is increasing), but overall, SMS revenue has as customers are more and more reliable on third party internet-based messaging apps rather than using telecom's native SMS services (Table 4)[47].

Table 4: Mobile Network Markets - Revenue from SMS and other data services

in billions of €	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
SMS	2,26	2,12	2,06	1,56	1,17	0,91	0,75	0,64	0,45	0,31	0,20	0,19
Data Services	2,27	2,53	2,86	3,30	3,65	4,12	4,45	5,13	4,51	4,00	3,56	3,24
Total	**4,53**	**4,65**	**4,92**	**4,85**	**4,81**	**5,03**	**5,20**	**5,77**	**4,95**	**4,31**	**3,77**	**3,44**

Because of this, ARPU, one of the most important key performance indicators which shows the overall revenue performance of the sector, has fallen as well. Since 2017, Average Revenue per SIM has fallen by 17% from €161,65 to €134, while Average Revenue per User (ARPU) has fallen 26% from €268.98 to €200 (Table 5)[48].

Table 5: Mobile Network Markets - ARPU: Average Revenue Per SIM and User (€/year)

Average revenue per SIM in €/year	**2017**	**2018**	**2019**	**2020**	**2021**
Total expenditure	161,65	152,08	145,89	139,0	134,0
Voice Services	56,61	53,60	51,01	47,0	48,0
Data Services	69,81	59,51	53,18	47,0	43,0
Terminals and various services	35,20	38,97	41,70	35,0	32,0
Average revenue per USER in €/year	**2017**	**2018**	**2019**	**2020**	**2021**
Total expenditure	268,98	245,98	224,69	207,0	200,0
Voice Services	94,20	86,70	78,56	70,0	71,0
Data Services	116,16	96,25	81,90	70,0	64,0
Terminals and various services	58,57	63,03	64,22	53,0	48,0

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[47] *See* 29
[48] *See* 29

As prices have reached a low price point, now the different operators are focusing on creating a competitive advantage by increasing the number of GB and VAS available at a lower cost. Consequentially, EBITDA (EBITDA, which stands for earnings before interest, taxes, depreciation, and amortization, is a commonly used metric to assess fundamental corporate performance: EBITDA enables investors to evaluate organizational profitability after expenses in light of choices made regarding financing, tax planning, and discretionary depreciation schedules) and CAPEX (Funds used by a business to purchase, improve, and maintain tangible assets including land, buildings, machinery, plants, and other property are known as capital expenditures, CPEX), have suffered the most. Since 2011 total EBITDA for the Italian telecom sector has decline because of lower revenues and lower costs. From 2011 to 2021, total EBITDA decreased 46% from €16,6bn to €8,9bn. For an operator, having a lower EBITDA means a lower ability to perform investments in infrastructures and new services. In fact, from 2010 ASSTEL reports that investments by Italian telecom operators have been stagnant in terms of value but relatively increasing when regarded as a percentage of EBITDA. In 2010 total capex was reported to be €6,1bn, in 2021 it was €7,2bn. And, in 2021 CAPEX was equal to 88% of EBITDA, a 48% increase since 2011 (Figure 10)[49].

Figure 10: The dynamics of EBITDA and CAPEX in TLC Operators
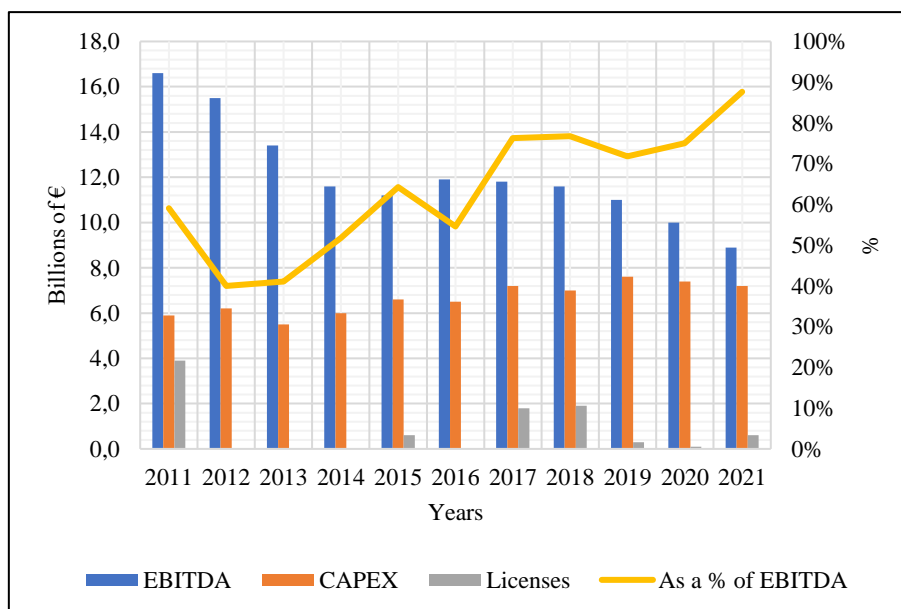
As a result of the low price point, Italy has been ranked as the second least expensive country in the world when it comes to € spent per GB used. The average cost of 1GB of mobile data in Italy is just

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[49] *See* "Rapporto sulla filiera delle Telecomunicazioni in Italia Edizione 2022" by ASSTEL, SLC/CGIL, FISTEL/CISL, UILCOM/UIL. With data from ASSTEL, AGCOM, and Osservatorio del Politecnico di Milano. And *See* Table 16 in the Appendix.

$0.12, 95.59% lower than the regional average of $2.72[50]. The country is only second to Israel[51]. Figure 11 shows a comparison with other major countries, while Figure 12 shows the Italian historical trend of lowering prices[52].

Figure 11: Comparison of $/GB in different countries around the world
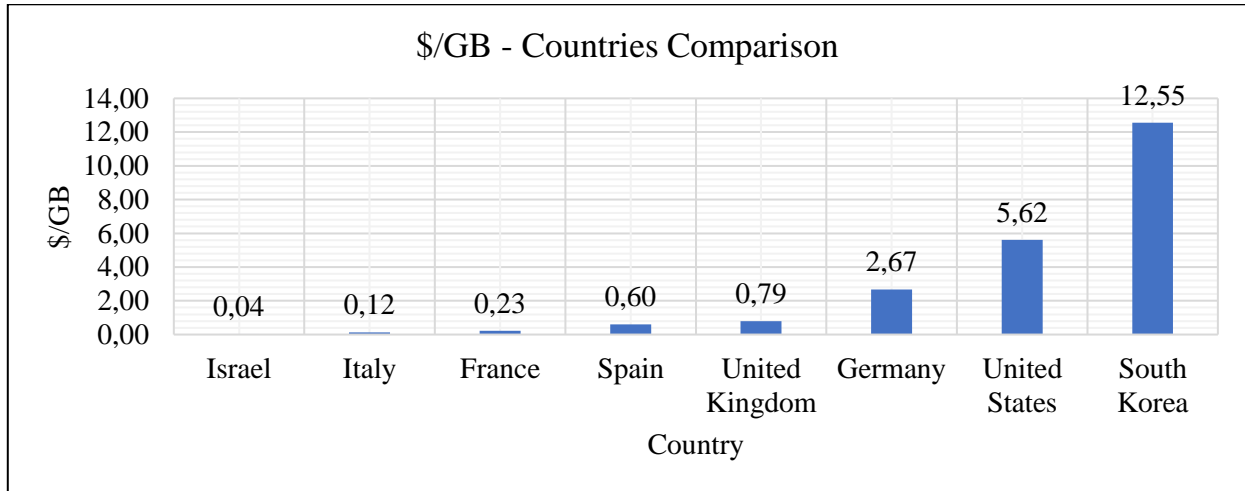
Figure 12: Italian €/GB Historical Trend

The current market situation is certainly beneficial for the customer, as it enjoys a range of services at relatively low prices, but it adds a strain to the situation telecom companies are facing.

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[50] *See* "Worldwide mobile data pricing 2022" by Cable UK.
[51] *See* 49.
[52] *See* 49.

Comparison with European Peers

To better analyze the decline of the core segments in the Italian telecommunications sector (fixed network services and mobile network services), it is good to look at how the telecommunications sector is behaving in other European countries. For this work, the focus is on the German, French, and Spanish telecommunications sector.

The German telecommunications sector

The German telecommunications market is mainly dominated by three players: Deutsch Telekom, Vodafone Germany, and O2 Germany (Telefònica subsidiary in Germany). Total market value has been declining with Mobile network services and Intermediary Services being hit the most. In 2021 revenues were equal to €51,6 bn, a 4,1% decrease from 2011. Since 2011 the mobile network services segment has lost 11,6% in value, and the intermediary services has lost 22,1% in value. On the contrary, fixed line services have grown by 2,5% from €19,9bn to €20,4bn. In addition, investments in the market have grown from €6,3bn to €11bn, a 75% increase (Figure 13)[53].

Figure 13: Overview of the German Telecommunication sector (2011-2021)
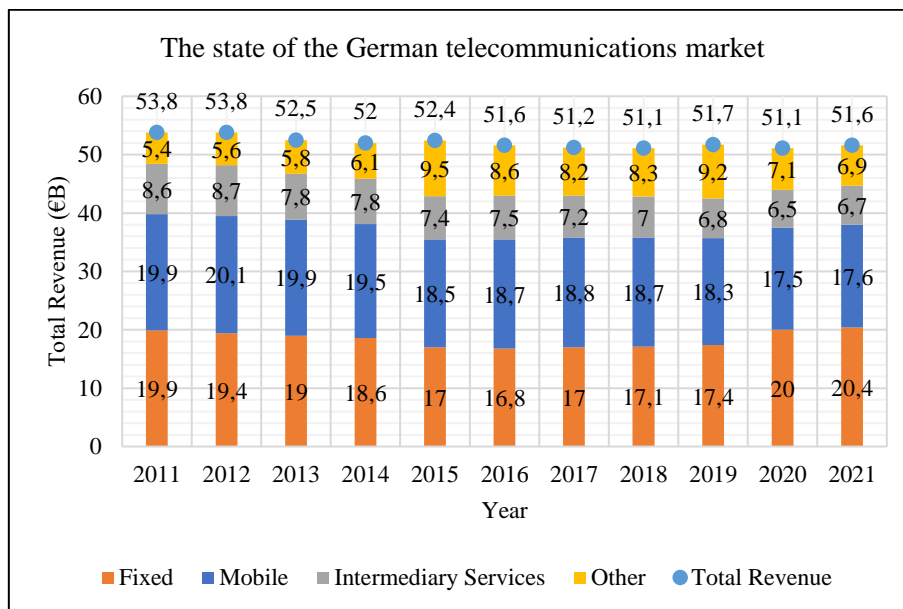
[53] *See* 49

The French telecommunications sector

The main players in the French telecommunications sector are Orange, Free (Iliad's brand in France), Bouygues Telecom, RED, SFR, and Sosh. Similarly with the Italian telecom sector, the French telecom sector has been going through a steep decline in the revenue related to its core segments. In 2021 revenues were equal to €45,0bn, a 13% decrease from 2011. Fixed network services revenues have dropped by 9,7% since 2011, while mobile network services revenues have dropped by 25,5%. Total market value has decreased by 13% from €51,7bn in 2011 to €45bn in 2021 (Figure 14)[54].

Figure 14: Overview of the French Telecommunication sector (2011-2021)
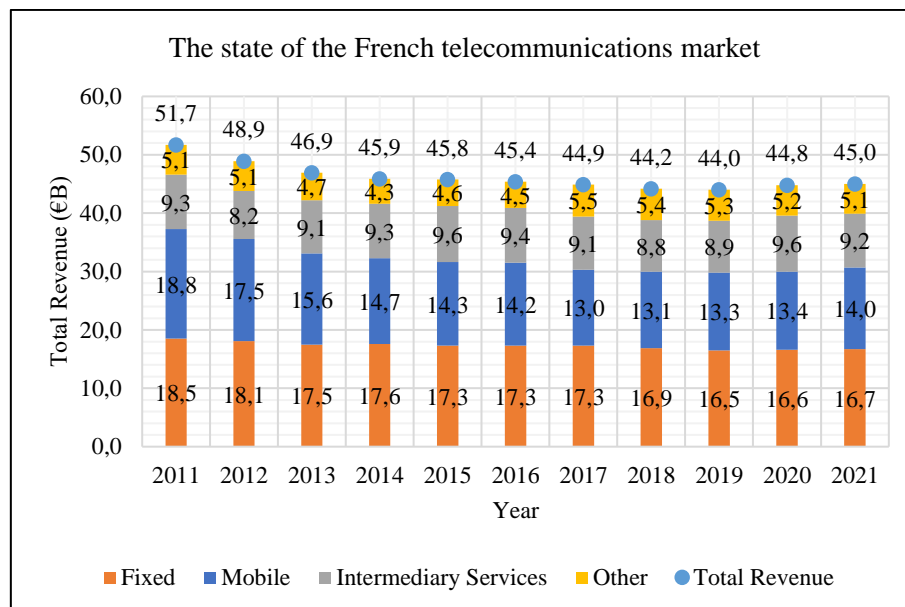
The Spanish Telecommunications sector

The biggest players in the Spanish telecom sector are Movistar (the Spanish subsidiary of Telefònica), Vodafone Spain, and Orange Spain. The Spanish telecommunications sector is the one which state resembles the most like the Italian telecommunication sector. In 2021 revenues were equal to €25,9bn, a 22,2% decrease from 2011. In fact, revenues in the fixed and mobile network services segment shave dropped more than 30% over the last ten years. In particular, the fixed service segment revenue has dropped by 30,2% from €10,6 Bn, to €7,4bn. And the mobile network services segment revenue has dropped by 37,8% since 2011, from €13,5bn to €8,4bn (Figure 15)[55].

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[54] *See* 49
[55] *See* 49

Figure 15: Overview of the Spanish Telecommunication sector (2011-2021)

The state of the French telecommunications market
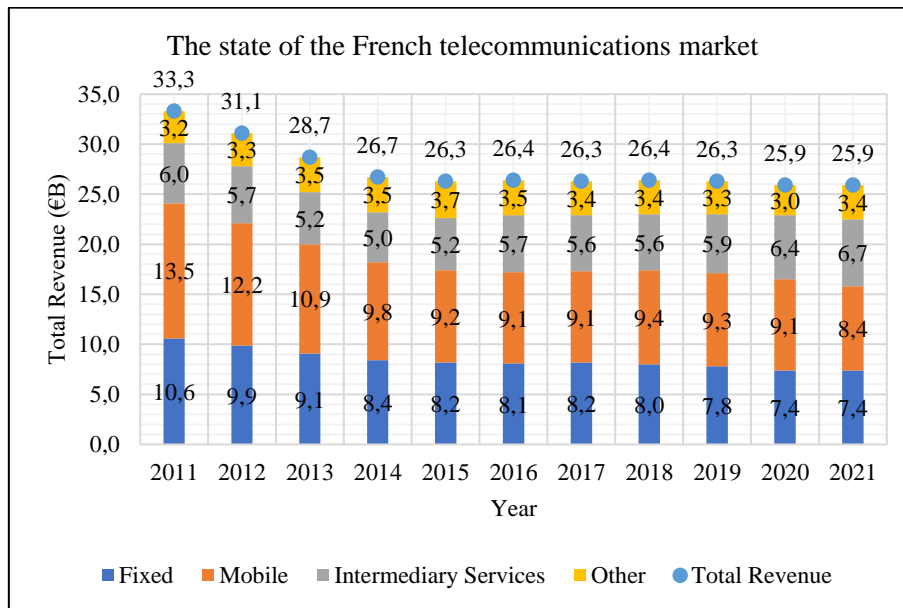
So, as seen from the data, the decline in the core business of the telecom sector that the Italian market is experiencing, is also happening in other European countries to a similar degree. Number of fixed network access or number of mobile lines is increasing, data traffic is increasing, but at the same time costs are increasing, and Revenues and EBITDA are declining.

Chapter II – 5G as a technology enabler

The Evolution of mobile connectivity

The first commercial cellular network, or 1G (with the G referring to "generation") was introduced by the Nippon Telegraph and Telephone (NTT) Company in 1979 in Tokyo, Japan[56]. Then, the network expanded throughout Europe and the US during the 1980s and early 1990s[57]. The 1G network supported the 1st generation of analog phones, it relied on low frequencies, and it featured a low data rate (2kbps). Yet, the network introduced wireless phone calls and data transfers, so it was revolutionary at the time. A big drawback to 1G was the almost no security it offered since voice calls were played through radio towers making them highly imperceptible to the unwanted[58]. Then, in 1991, Finland launched the 2G network[59].

The 2G network introduced text messages, picture messages, and multimedia messaging services (MMS). The network also had much higher security standards, with text messages being digitally encrypted. Also, the 2G network received an upgrade to 2.5G which enabled General Packet Radio Service (GPRS) technology, web browsing, and email exchange. By now, a greater demand to remove the separation between fixed and mobile networks had become apparent networks needed to be more integrated[60]. So, the 3G network was introduced.

The 3G network was based on the newly introduced standards by the International Telecommunication Union (ITU), which formulated a plan to implement a global frequency band of 2000 MHz, thus allowing a single, ubiquitous global wireless communication standard[61]. By improving spectral efficiency, 3G technologies allowed network operators to increase network capacity while providing consumers with a wider variety of more sophisticated services. With respect to the 2.5G network, 3G offered enhanced audio and video streaming, significantly increased data speed, a faster web and WAP browsing experience, support for IPTV (Tv over the internet), and support for the Global Positioning System (GPS)[62]. With 3G, there was also a change in the paradigm of how phones were being used. Thanks to higher its characteristics, the 3G network enabled the creation of much more capable and efficient phones. Up until then, phones, although used by the masses, were not capable and people still relied much more on human-to-human interaction. The

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[56] *See* "Evolution of Mobile Wireless technology from 0G to 5G" by Mohammad Meraj ud in Mir and Dr. Sumit Kumar. Published on the International Journal of Computer Science and Information Technologies.
[57] *See* 56.
[58] *See* "Evolution of Cellular Network: From 1G to 5G" by Nikhil Bhandari, Shivinder Devra, and Karamdeep Singh. Published on International Journal of Engineering and Techniques.
[59] *See* 56.
[60] *See* 56.
[61] *See* 56.
[62] *See* 56.

paradigm was profoundly changed when on January 2007, Steve Jobs (Apple's founder and CEO) introduced the iPhone[63]. The iPhone changed how people were using phones. From only voice calls or text messages exchanges, the phone had now become a mobile computer.

In the early 2010s, as networks were becoming more and more integrated, the 4G network was introduced. 4G relied on interoperability between different networks and higher speed data transfer up to 100mps[64]. Ultra-Wide Radio Band (UWB), millimeter wireless, and intelligent antenna are all utilized by the 4G network. In particular, the main applications for 4G include (1) ultra-high-speed internet access, (2) data-intensive interactive user services, and (3) location-based services as providers can collect real-time data on users' location and behavior[65].

Now, as everything around us is being digitalized, there is a need for a new network that can sustain the new needs of the market. So, in early 2019 the 5G mobile network was first introduced by Verizon, in the United States[66]. Figure 16 shows the evolution of the mobile cellular network from 1G to 5G[67].

Figure 16: Evolution of the Mobile Cellular Network, from 1G to 5G
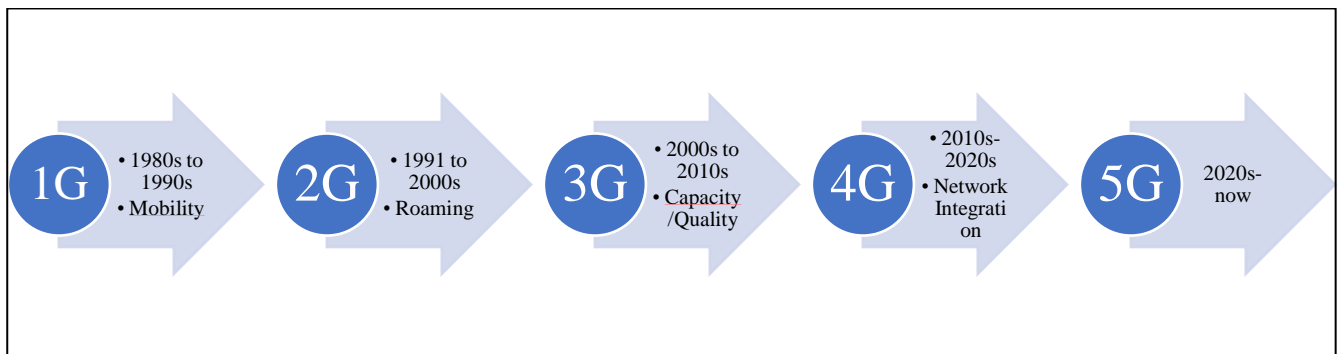
Why 5G?

Beyond better download speeds than 4G LTE, 5G is anticipated to deliver a network that is considerably more responsive and adaptable, allowing for a variety of purposes. 5G is expected to significantly alter how telecommunications technology is used in society, much more than what earlier generations of mobile networks have done[68]. 5G is built on an end-to-end architecture that is

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[63] *See* "When iPhone met world, 7 years ago today" by CNET.
[64] *See* 56.
[65] *See* "Introduction & Features of 4G: A Review" by Rishu Bhatia.
[66] *See* "When was 5G introduced?" by Verizon News Archives.
[67] *See* "Digital Society from 1G to 5G: A comparative Study" by Atul Garg.
[68] *See* "What is 5G?" by Information Technology & Innovation Foundation.

cloud-native and software-based[69]. With flexibility and configuration at the core of its design, 5G will allow mobile operators to support IoT (Internet of Things) use cases and to support ultra-reliable, low latency connections as well as enhanced mobile broadband, unlike earlier generations of mobile networks that were specifically built for delivering communications services like voice and messaging (e.g., 2G) or mobile broadband (e.g., 4G). In addition, 5G will be a crucial enabler for the Internet of Things (IoT), providing the infrastructure and services necessary to connect and effectively manage a vast array of devices[70].

The potential of 5G

Because of 5G, there will be further economic expansion and widespread digitalization of a hyperconnected society, in which everyone has access to the network whenever they need it, as well as a variety of other devices and objects[71]. Every element of our lives will be significantly improved by new use cases created to assist smart cities, smart agriculture, logistics, and public safety organizations. In fact, instead of being a business-to-consumer (B2C) technology, 5G can be regarded as more of a business-to-business (B2B) technology. As it offers advanced management capabilities and increased flexibility by utilizing technological advancements such as software-defined networking (SDN)[72], network functioning virtualization (NFV)[73], and network slicing. This will make it possible to depart from the conventional business solution of offering packages of related services. On the contrary, 5G enables operators to provide unique services utilizing a single physical infrastructure by segmenting the network and giving each piece a specific behavior and set of characteristics in terms of mobility, latency, data rate, etc. This in turn enables the targeting of specific

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[69] *See* "5G Italy White Book: from Research to Market" by Marco Ajmone Marsan, Nicola Blefari Melazzi, and Stefani Buzzi.
[70] *See* 69.
[71] According to a recent report by Accenture (See "The Impact of 5G on the European Economy" by Accenture Strategy, February 2021), the impact of 5G on the European economy will lead to up to €2.0 trillion in additional gross output (sales) growth between 2021 and 2025. In the same time frame 5G will increase European GDP by €1 Trillion, 20 million jobs will be generated across all economic sectors, and there will be multiplier impacts in every industry. Such as, that with every euro generated by the direct impact of 5G on information and communication technologies (ICT), another euro will be generated elsewhere throughout the economy
[72] Using software-based controllers or application programming interfaces (APIs) to communicate with the network's underlying hardware architecture and control traffic is known as software-defined networking (SDN). Through software, SDN can build and manage virtual networks or manage conventional hardware. While software-defined networking offers a new method of managing the routing of data packets through a centralized server, network virtualization enables organizations to segment different virtual networks within a single physical network or to connect devices on different physical networks to create a single virtual network. The benefits of SDN are increased network control with greater speed and flexibility, customizable network infrastructure, and robust network security (*See* "What is Software-Defined Networking (SDN)" by VMware).
[73] Network services that have historically been operated on specialized hardware, such load balancers, routers, and firewalls, can now be virtualized thanks to network functions virtualization (NFV). Because these services are bundled as virtual machines (VMs) running on common hardware, service providers can run their networks on generic servers rather than exclusive ones. By enabling service providers to quickly roll out new network services and applications without needing more hardware resources, NFV increases scalability and agility. (See "What is NFV" by RedHat).

economic or industrial sectors as well as numerous markets. The main characteristics of 5G can be summed up in these 7 points[74]:

1. Flexible and effective network slicing is made possible by a modularized network design, which defines several fundamental network operations.

2. The Service Based Architecture (SBA), which makes it possible for network activities to interact directly through the exposed services

3. Reducing reliance on the Core Network (CN) and the Access Network (AN)

4. Support for "stateless" network functions, which separate the "compute" and "storage" resources, is provided in

5. Support for concurrent access to local and centralized services, which enables access to local data networks and low-latency services,

6. The addition of data analytics tools to improve network automation

7. Separation of the User Plane (UP) and Control Plane (CP), which was already implemented in networks of a previous generation.

Due to their adaptability to a variety of circumstances, 5G deployments can effectively utilize the adoption of technologies like SDN, NFV, and MEC for the deployment, operation, and provisioning of 5G services. End-to-end slicing will be a key component and 5G's main selling point. The latter is made possible because with a wide range of performance requirements, 5G is intended to be a multi-service network that supports many different industry verticals. Cutting the physical network into many discrete logical networks on a per-service basis is essential to achieving this aim. Different verticals can live on the same infrastructure thanks to a technical method called network slicing. Figure 17 shows a graphical representation of network slicing [75].

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[74] *See* 56.
[75] *See* "Softwarization and Virtualization" by Giacomo Verticale and Antonio Capone.

Figure 17: Graphical Representation of Network Slicing
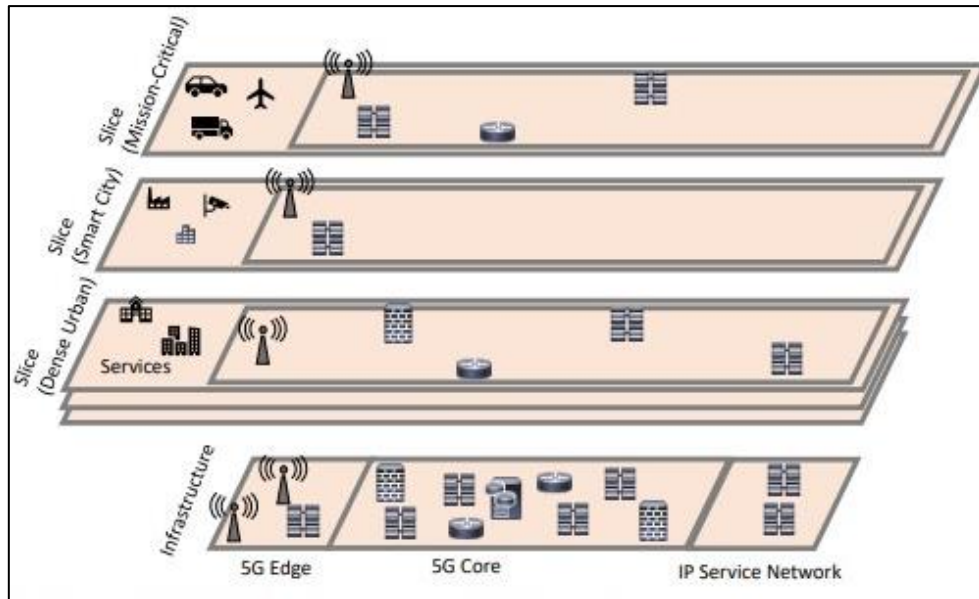
Figure 17, above, shows how different stakeholders can cooperate to provide the final service. To work effectively, network slicing requires the cooperation between infrastructure providers, the mobile service provider (MSP), and the tenant which offers the service to the final users and expresses the requirements of the network slice.

5G Technological Pillars

The paper "Opportunities and Enabling Technologies for 5G Spectrum Sharing" by Maziar Nekovee, outlines the three most important technology innovations brought by 5G[76]:

1. *Enhanced Mobile Broadband:* Enhanced Mobile Broadband (eMBB) is a cutting-edge technology that aims to provide high-speed mobile data connectivity to users. This technology is based on advanced network technologies such as 5G and LTE, which offer faster download and upload speeds, lower latency, and improved network reliability. With eMBB, users can enjoy seamless streaming of high-quality videos, smoother online gaming, faster file downloads, and improved video conferencing. eMBB is expected to be the backbone of future applications that rely on high-speed connectivity such as virtual and augmented reality, IoT, and autonomous vehicles. This technology will help service providers to handle the growing demand for data, enabling them to deliver more data-intensive applications and services to

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[76] *See* "Opportunities and Enabling technologies for 5G Spectrum Sharing" by Mazia Nekovee.

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their customers. The adoption of eMBB will significantly enhance the user experience and pave the way for new and innovative applications and services that were not possible before. Furthermore, eMBB will bring about greater network efficiency and reliability, making it easier for service providers to manage their networks and improve their bottom line. Overall, eMBB is a game-changing technology that promises to revolutionize the way we use mobile devices and the internet. eMBB offers numerous use cases for mobile devices. One of the most significant applications is high-quality video streaming. With eMBB, users can enjoy high-quality video streaming on their mobile devices without buffering or delays. This technology allows for faster download and upload speeds, lower latency, and improved network reliability, making it possible to stream high-quality videos seamlessly. Another exciting use case for eMBB is augmented and virtual reality. With its fast and reliable connectivity, eMBB can enable immersive experiences for users. For example, it can enable virtual tours of museums or allow users to play augmented reality games seamlessly.

2. *Massive Machine Type Communications:* Massive Machine Type Communication (mMTC) is a technology standard that enables large-scale communication between machines and devices. This technology is specifically designed to handle a massive number of devices that are connected to the internet and communicate with each other. mMTC is a crucial technology for the Internet of Things (IoT), as it allows devices to share data in real time, enabling them to work together seamlessly. With mMTC, devices can communicate with each other using low-power networks, which helps to conserve battery life and reduce network congestion. This technology is ideal for use in applications such as smart cities, smart homes, and industrial automation. mMTC will enable devices to share data in real time, allowing them to operate more efficiently and effectively. Furthermore, mMTC will help service providers to manage the growing number of IoT devices, enabling them to deliver more data-intensive applications and services to their customers. In summary, mMTC is a crucial technology that promises to revolutionize the way machines communicate with each other, enabling them to work together seamlessly and efficiently. mMTC has numerous use cases in the realm of IoT. One such application is smart homes. With mMTC, devices in a home can communicate with each other in real time, enabling seamless automation. For example, a smart thermostat can communicate with a smart lighting system to adjust the lights when the temperature changes. mMTC can also be used in industrial automation, allowing machines to communicate with each other to optimize production processes. Another use case for mMTC is smart cities, where sensors and

devices can communicate with each other to enable efficient and sustainable management of resources. Figure 18 shows what a mMTC environment could look like[77].

Figure 18: mMTC Environment
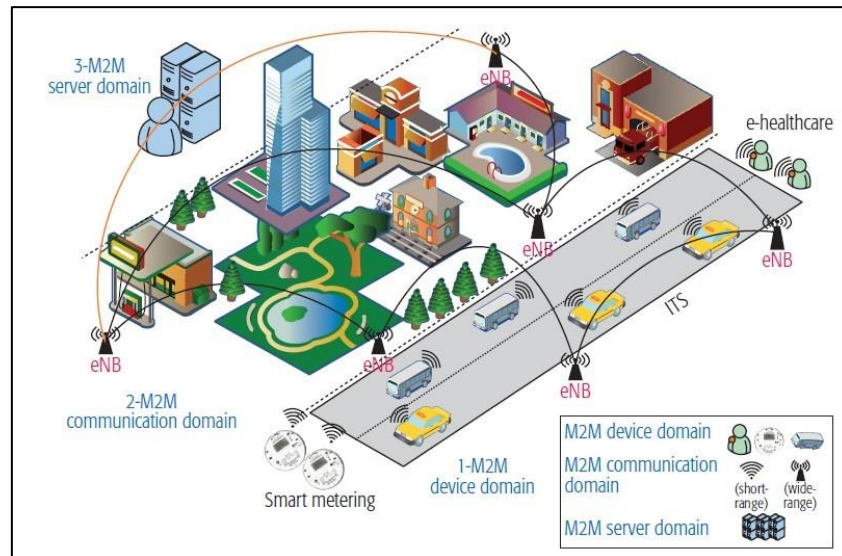
3. *Ultra-reliable and low latency communications:* Low latency refers to the time it takes for data to travel from its source to its destination. In other words, it is the delay between the moment data is sent and the moment it is received. Ultra-Reliable and Low Latency Communications (URLLC) is a technology standard that provides highly reliable and low-latency communication between devices. This technology is critical for applications that require real-time data transmission, such as autonomous vehicles, remote surgery, and industrial automation. URLLC provides a highly reliable communication channel, with an extremely low probability of failure, and very low latency, which is essential for these applications. With URLLC, devices can communicate with each other in real-time, with extremely low latency, and high reliability, ensuring that critical data is transmitted quickly and accurately. This technology is made possible by advanced network technologies such as 5G, which provide highly reliable and low-latency communication channels. URLLC will enable a wide range of innovative applications and services that were previously impossible, making our world more connected, safer, and efficient. Overall, URLLC is a critical technology that will play a significant role in shaping the future of communication, enabling highly reliable and low-latency communication between devices. URLLC is crucial for applications that require real-time data transmission. One of the most significant use cases is autonomous vehicles. With

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[77] *See* "Internet of Things Based Smart Cities: Recent Advances and Challenges" by Yasir Mehmood, Farhan Ahmad, Ibar Yaqoop, and Sghaier Guizani.

URLLC, vehicles can communicate with each other and with the infrastructure in real time, enabling safer and more efficient transportation. Another use case for URLLC is remote surgery. With its low latency and high reliability, URLLC can enable surgeons to remotely control surgical robots with precision and accuracy. Finally, URLLC can be used in industrial automation, where it can enable machines to communicate with each other and with the control system in real time, allowing for efficient and safe operation of machinery.

Furthermore, although it already existed, 5G unlocked the true potential of the Fixed Wireless Access technology. FWA is a technology that uses wireless communication to provide high-speed internet access to homes and businesses. Unlike traditional wired broadband connections, FWA uses radio waves to deliver internet access, eliminating the need for physical cables. This technology offers numerous advantages, including quick and easy installation, faster deployment, and lower infrastructure costs. FWA is particularly useful in rural areas, where it may be challenging to lay fiber optic cables. With FWA, residents and businesses in remote areas can have access to high-speed internet, enabling them to work, study, and access entertainment online. Three primary use cases of FWA include broadband internet connectivity, remote monitoring and management, and temporary internet connectivity for events or emergency response. With its fast and reliable connectivity, FWA has the potential to bring high-speed internet access to underserved communities and enable the development of innovative applications and services. Figure 19 shows what an FWA architecture looks like when put into action[78].

Figure 19: FWA Architecture
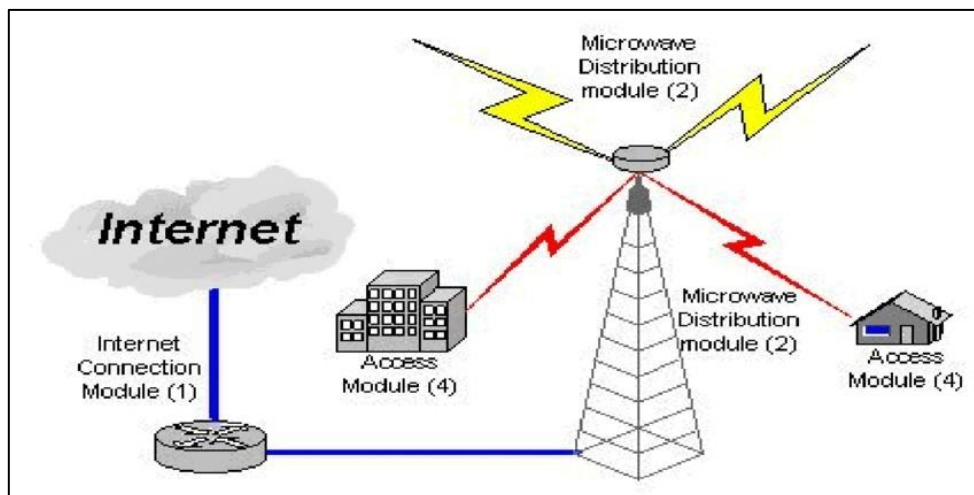
On top of the research by Mr. Nekovee, there are other technologies that can be enabled thanks to the characteristics of 5G, in particular in the fields of AI (i.e., machine learning, digital twins, cognitive

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[78] *See* "Fixed Wireless Access as a veritable Resource for Rural Communities in a Cashless Economy" by Anthony Chukwudi Okwubunne, and Michael O. Awoleye

networks, intent-based network, etc.), industry specific networks (i.e., enhancement of network intercommunications, management, security, etc.), home networks space-air-ground networks, interactive communications (i.e., programmable call applications, collaboration of multi-media communications data flows, etc.),user plane customization, and etc[79].

As these technical features show, 5G is a telecommunications technology created to meet the demands of vertical industries. A group of businesses and clients that are all tied to one another and revolve around a particular specialized industry is referred to as a vertical industry. The automotive, transportation, healthcare, manufacturing, logistics, agricultural, smart cities, and media and entertainment industries are a few examples of verticals[80]. Thus, we can say that 5G creates the needs for new stakeholders. Former networks stakeholders might include equipment suppliers and ECN/S providers. They offer services for software, hardware, and electronic communications. On the other hands, new stakeholder created by the 5G networks could be new vendor suppliers and software developers, neutral hosts, mobile virtual network enablers, system integrators and managed services providers, cloud services providers, and so on[81].

5G Use Cases

The 5G mobile networks enables many use cases for the industry. The deployment of 5G network promises new and futuristic services and experiences for customers and enterprises, and both telecom operators and other industry players are investing heavily in its development. There are already immersive sports viewing and augmented reality applications being built, and businesses are investigating how they can benefit from 5G, with some already deploying smart manufacturing. There is potential for industries to organize themselves into ecosystems that could collectively benefit from 5G networks and related computing infrastructure, and operators could play a key role in bringing corporates and industry verticals together to deliver solutions. There are five distinct models used by operators to deploy 5G technology, including providing gigabit broadband to homes, delivering nationwide mobile experiences, improving efficiency and productivity for corporates with reliable low-latency connectivity, enabling digital industrial ecosystems, and delivering next-generation infrastructure-as-a-service. A good representation of the 5G usage scenario (Figure 20) is provided by EDN Asia based on the research "5G deployment models are crystallizing Opportunities for telecom operators to facilitate new business ecosystems" published by Arthur D. Little (ADL)[82]. The

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[79] *See* "Road to 5G: Introduction and Migration" by GSMA
[80] *See* 79
[81] *See* 79
[82] *See* "5G deployment models are crystallizing Opportunities for telecom operators to facilitate new business ecosystems" published by Arthur D. Little (ADL). ADL is a global management consulting firm that provides strategy, technology and innovation

analysis identifies the most relevant use cases based on the three most important innovations introduced by the 5G Mobile network. The analysis represented in Figure 20[83] is also similar to that of the GSMA and Accenuture[84]. The GSMA[85] summarizes the main use cases in three different categories[86]: (1) Performance Improvements, such as advanced Dl/UL MIMO, enhanced multi-carriers operation, mobile integrated access, evolved duplexing, and time sensitive communications; (2) better management and greater efficiency such as AI/ML data-driven designs, operation & maintenance architecture and management functions, and autonomous networks; (3) enhances for specific use cases, such as edge computing, expanded positioning, extended reality, multicast, non-pubic networks, vehicles mounted relay, personal IoT network, and many others.

Figure 20: 5G Main Use Cases
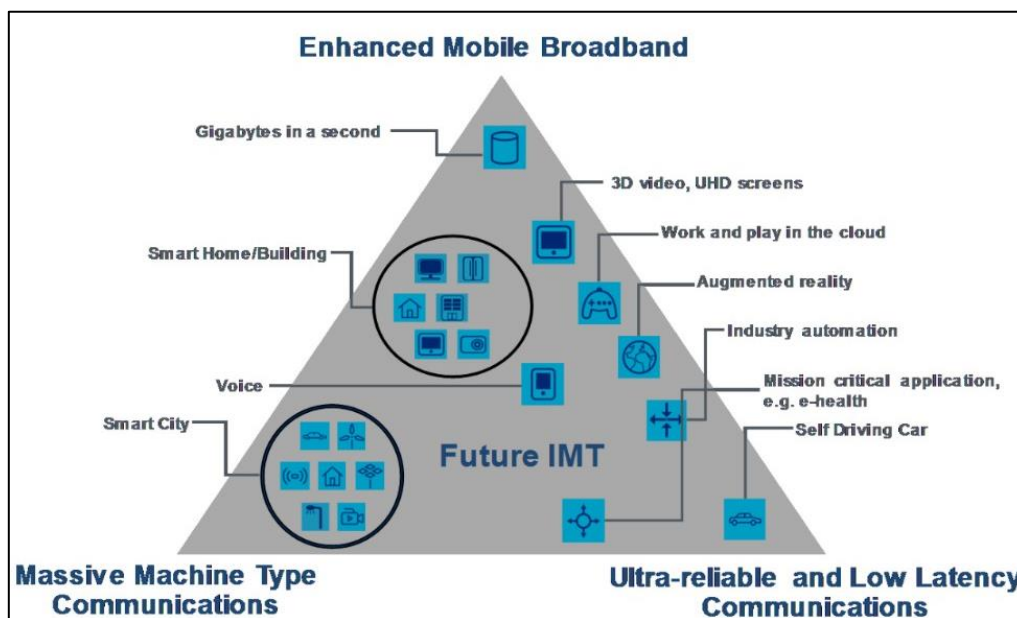
Further, there are multiple use cases of operators working together with companies to implement 5G solutions:

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consulting services to companies and governments. It was founded in 1886 and is headquartered in Boston, Massachusetts, USA. The company works across a variety of industries including healthcare, energy, telecommunications, and transportation, and is known for its focus on technology and innovation.

[83] *See* "The 5 best 5G use cases" by Brian Santo for EDN Asia

[84] *See* "The Impact of 5G on the European Economy" by Accenture

[85] The GSM Association, sometimes known as "the GSMA" or the Global System for Mobile Communications, was once known as Groupe Spécial Mobile. It is a non-profit trade association that advocates for mobile network operators all over the world. Together with its members, the GSMA oversees industry programs with the goal of achieving scalability and interoperability for emerging mobile technologies. Along with several other specialized committees and groups, it also organizes industry working groups that tackle topics including roaming and interconnection, fraud and security, and intellectual property. The GSMA speaks on behalf of its members when advocating for policy and regulatory positions before institutions and governments.

[86] *See* "Advancing the 5G Era Benefits and Opportunity of 5G-Advanced" by GSMA

- Verizon[87]: Verizon has begun offering a B2B solution called Verizon 5G Edge Crowd Analytics focusing on crowd analytics. The solution is based on data collection made possible by wireless sensors deployed throughout a specific venue and 5G Ultra-Wideband which provides bandwidth needed to stream large amounts of data, data analysis with the use of Ai-powered machine learning of the data collected and then stored on the Verizon network, and data representation of the insights generated which will help venue operators make data-driven decisions

- SK Telekom[88]: The SK Telecom 5GX Smart Factory Product Offerings is a strategy which was announced in December 2018, and it provides a custom-made solution for factories to implement 5G. The strategy main produce offering are its T-Live Caster (built-in and subscription-type solution for high-definition video transmission over 5G, real-time video solution with various functions including AI video analytics using smartphones, drones and cameras), Die-Casting Manager (real-time monitoring and analysis solution for casting processes, detects abnormalities and predicts defects), metatron grandview (cloud-based subscription service that remotely monitors operation status of assets, real-time predictive maintenance and monitoring solution), welding quality inspection manager (solution for the real-time identification of internal and external welding bead defects using deep learning analysis), and machine vision solutions (a model used by AI that automatically detects defects in appearances of products, solution automatically takes appropriate actions on production line).

- Vodafone[89]: The Vodafone 5GEM manufacturing trial which was based on a consortium of eight organizations exploring use cases with Vodafone's Mobile Private Networks installed at Ford Dunton facility. The main solutions testes by Vodafone were predictive maintenance, and AR/VR collaborative working. For the former, the company tested the potential of 5G to reduce unexpected downtime of assets and equipment, while for the latter Ford used 5G for remote calls with partners and suppliers, leveraging "digital twins" for experts to design new optimal solutions.

- AT&T[90]:AT&T conducted some trials for 5G applications, in this case with the United States Military. The company started a collaboration with the US Navy to explore 5G edge compute use cases for deployment within their Navy unit. The use cases looked at were unmanned robots, aerial drones, and autonomous underwater vehicles. The trials deployed utilized

[87] *See* 5G edge Crowd Analytics Website by Verizon. Available at: https://www.verizon.com/business/products/5g-edge/crowd-analytics/
[88] *See* "SKT unveils 5G-linked smart factory system" by The Korea Times
[89] *See* "How 5GEM is transforming Ford Manufacturing" by UK 5G
[90] *See* "5G at Sea: AT&T and Naval Postgraduate School to Jointly Research 5G and Edge Computing Solutions" by AT&T

millimeter wave spectrum (39 GHz band) and mid-band LTE. Thanks to these trials, the US Navy expected to achieve faster means of collecting, disseminating, and analyzing data at the edge, improving battlespace awareness.

5G Use Cases in Italy

Italy has always been at the forefront of 5G development in Europe. The country was one of the first in Europe to auction the spectrum frequencies for the 5G Mobile Network[91]. The government raised €6.5bn, far more than the €2bn that was predicted. Tim and Vodafone were the biggest spenders, with an expenditure of €2.407bn and €2.401bn respectively. Also, in 2017 the country conducted different trials to test 5G capabilities. The Minister for Economic Development (MISE) selected five Italian cities, namely L'Aquila, Matera, Bari, Prato, and Milan[92]. The trials were conducted in collaboration with the largest operators in the country, including TIM, Vodafone, Wind Tre, and Fastweb, along with prominent vendors such as Ericsson, Nokia, Huawei, and ZTE[93]. The trials resulted in high network coverage using advanced technologies like "Massive MIMO" antennas that allow for increased antenna directivity and dynamic orientation of radio signals. The trials tested various applications of 5G in healthcare, wellness, security, surveillance, mobility, and industry 4.0. The results indicated that 5G can significantly benefit the healthcare sector by providing high reliability and real-time management of critical situations. Other projects focused on developing innovative solutions for urban mobility, security, and digital tourism. Additionally, 5G Fixed Wireless Access Network (FWA) was shown to have technical and commercial feasibility to replace the traditional FTTH network for Gbps-based connections on millimeter bands. So, the 5G trials in Italy by the government were a significant step towards the development and adoption of 5G technology in the country. The trials helped improve network capabilities, develop new applications, create new business opportunities, and foster collaboration and innovation.

As Italy continues to invest in 5G technology, it is expected to create new opportunities for businesses and individuals and drive innovation in various sectors of the economy[94]. In fact, apart from creating consumer specific 5G offerings, operators, such as TIM and Vodafone, are moving ahead with considerable business and social applications of the new mobile network. TIM, for example, has developed a whole range of tools dedicated to specific smart city use case: TIM Urban Genius which offers optimal support for the management of complex systems such as large cities,

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[91] *See* "L'asta per il 5G è conclusa: Vodafone e TIM prendono la maggior parte delle frequenze, ma anche Iliad fa molto bene" by Giuseppe Tripodi for SmartWorld
[92] *See* "5G revolution and the Italian use cases" by Alessandro Vizzarri and Francesco Bove
[93] *See* 91
[94] *See* "5G Trials in Italy" by Andrea Abrardo

TIM City Point which offers effective territory monitoring services (thanks to cameras and sensors installed by TIM Enterprise on its network infrastructure), or TIM Intelligent Parking which is solution for detecting the occupation status of rest areas and car parks (the solution is based on data analysis and sharing of information acquired and processed by hardware and software elements installed on the road), and other tools specific to the city's security aspects[95]. Similarly, Vodafone is implementing 5G use cases all around the world. In Italy, the company is studying different applications of 5G to improve road safety[96] and connected energy utilities applications[97].

These examples are to show that operators in the country are studying the possible applications of 5G, to test its potential, and to understand in which areas it is better to invest in.

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[95] *See* Smart City Website by TIM Enterprise. Available at: https://www.timenterprise.it/5g-e-iot/smart-city
[96] *See* "5G drives road safety in Italy" by Vodafone
[97] *See* "Vodafone helps Ferroli develop their connected boilers proposition" by Vodafone

Chapter III – VAS: Value-Added Services in the telecommunication industry

The telecommunication industry is an ever-evolving sector that plays a significant role in our daily lives. With the increasing demand for better connectivity and faster communication in an increasingly digitalized society, telecom companies have been striving to provide more than essential services. They are now providing a range of value-added services (VAS) to meet the ever-growing demands of customers[98].

Value-added services exceed the standard voice and data services that telecom companies traditionally offer. These services are designed to enhance the user experience and provide additional services and benefits to the customer. They are also an excellent way for telecom companies to differentiate themselves from their competitors and create customer loyalty. In 2019, Analysys Mason[99] published the research titled "The Future of Telco Monetisation Systems: An Evolutionary Revolution." The study aimed to show the results of a survey of 100 CSPs and in-depth interviews with more than 30 CSPs from all tiers in both emerging and developed markets, a better understanding of CSPs' strategic plans and monetization systems. The survey identified that nearly half of the surveyed CSPs believe that the growing demand for digital services, whether for consumers or businesses (such as smart cities and low-latency gaming), is a critical factor in the evolution of monetization systems. Cost reduction was a top CSP reply since it is a significant driver of change. It was followed closely by the necessity to embrace cloud-native architecture and the introduction of 5G. Moreover, more than a quarter of CSPs know that modifications to their monetization systems will be needed to suit new payment methods and the rising acceptance of unlimited monthly plans. The survey results support that VAS will be increasingly crucial in reshaping the typical telecom business model[100].This chapter will explore the main types of value-added services that telecom companies provide. We will look at their benefits to both the customer and the company and the challenges of providing these services. We will also examine specific use cases for the different value-added services analyzed. In this paper, we will not explore every possible VAS application for a telecom company but rather the most relevant ones. For a telco company the most prominent VAS application are:

- Internet of Things and Edge Computing
- Financial Services and Mobile Payments

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[98] *See* "Key Sector Trends in Telecoms Enterprise Market" by EY
[99] Analysys Mason is the world's leading management consultancy focused on Technology Media & Telecommunication (TMT). Analysys Mason is owned by Datatec Limited, also known as Datatec Group, a South Africa-based multinational information and communications technology (ICT) services group
[100] *See* 99

- Cloud Gaming
- The Metaverse

Internet of Things and Edge Computing

The definition of IoT can be broad, but the GSMA defines IoT as "The Internet of Things (IoT) refers to the use of intelligently connected devices and systems to leverage data gathered by embedded sensors and actuators in machines and other physical objects." In other words, IoT refers to the ecosystem of connected devices around us that can gather data and automate certain functions using sensors and enhanced connectivity. The IoT sector offers mobile operators a wealth of opportunities. Operators are crucial in supplying connectivity for many IoT applications. For example, many IoT devices are mobile (i.e., vehicles, cargo containers, airport equipment, and construction machines), thus needing reliable connectivity. The GSMA estimated the IoT devices market to be worth \$1,104bn by 2025[101]. Microsoft and the IDC research state that more than 42bn IoT devices will be used by 2025[102], producing 90 zettabytes (1 zettabyte = 1 trillion gigabytes) of data[103]. The typical person will engage in more than 5,000 digital exchanges daily. Thus, the GSMA identifies three different roles operators must be able to achieve to take advantage of the IoT value chain.

First (1), the operator must be central to the IoT foundation, which means that the operator must support the general IoT functionality with its core capabilities (i.e., mobile networks and infrastructures).

Second (2), operators must be service providers in the IoT value chain to add value and expand in new areas.

Third (3), operators must provide solutions by supporting end-to-end and vertical-specific solutions. Figure 3.1 shows the ideal pathways for operators to become leaders in the IoT industry[104]. Operators can give the clients ever-more-sophisticated services at each stage of the path, which raises their value within the ecosystem. Operators are already familiar with some of the roles[105]. IoT connection is the beginning point for mobile carriers, and many of them currently offer some form of cloud computing infrastructure for IoT applications. However, additional roles (such as ecosystem

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[101] *See* "Opportunities in the IoT: Evolving roles for mobile operators" by GSMA
[102] *See* "IoT Signals Report 2019" by Microsoft. The information was published on "Edge Computing and 5G" by Infosys.
[103] *See* "IDC: Expect 175 zetabytes of data worldwide by 2025" by IDC. The International Data Corporation (IDC) is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer technology markets. The information was published on "Edge Computing and 5G" by Infosys.
[104] *See* 103
[105] *See* 103

orchestration and vertical specialization) will be novel for many operators[106]. Benefits will vary depending on the part. Many functions can grow the customer base by offering services to other IoT ecosystem participants, improving competitive positioning, and allowing the operator to capture value throughout the entire value chain. They will produce direct revenues for the services provided. Also, Figure 21 provides specific examples of what roles operators must act on per each step of the IoT journey and ecosystem.

Figure 21: How to become leaders in IoT
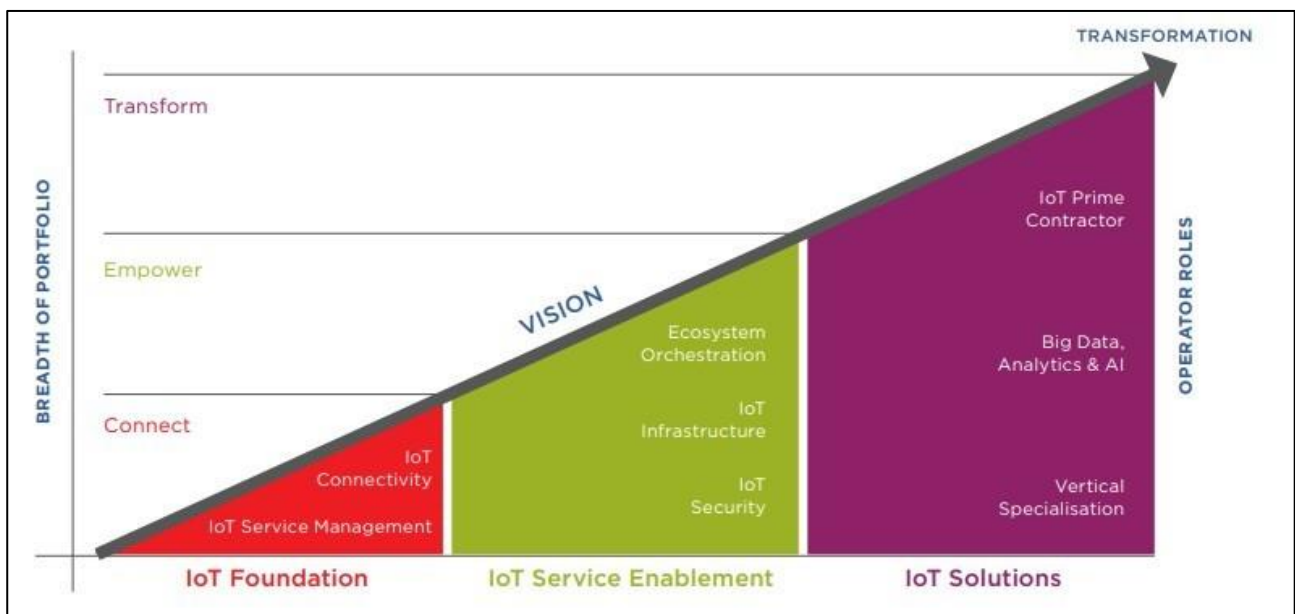
When we talk about IoT, we must also talk about Edge Computing as an enabler for many IoT applications, thus a key element to telecom success in the IoT field. The concept of "edge computing" is one of the most critical enablers of 5G technologies and their requirements. The idea can be divided into three parts: cloud, fog layer, and edge computing[107]. Cloud computing is an architecture business uses to store and process data in a centralized location that is remote from various devices and sites. As a result, people and gadgets can access powerful processing and storage resources from anywhere in the world. Organizations profit from being able to remove site-specific hardware, data storage, and computing power. Fog Computing, like cloud computing, offers the ability to offload processing and storage power generated from the devices. Instead, it does it in a closed area, meaning that the LAN is where intelligence is in the Fog architecture, which is like a local cloud. As a result, the Fog architecture can offer specialized cloud-like services to a focused network, managing data from numerous endpoints dispersed across various locations inside the same LAN and serving as their

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[106] *See* 103

[107] *See* "Edge Computing" by Axon Partners Group. Axon Partners Group ('Axon') is an international investment and consulting firm founded in 2006. Axon specializes in ITC related areas (i.e., edge computing, 5G, cloud, etc.)

coordinator and gateway. Edge computing, which often occurs within or at the boundary of access networks, is an even more decentralized cloud architecture than Fog. It offers execution resources (computation and storage) with adequate connectivity (networking) relatively close to the data source[108].

As a result, edge computing directly positions knowledge and processing power at the "edge" of networks. Due to the difference in architecture, there are no longer any economies of scale because the edge device is dedicated to fewer devices. However, it does have one crucial benefit: speed. The term "Edge computing" describes the distributed paradigm of computing. It moves computation and data storage closer to the device or data source that needs them the most. The cloud arrives at the device itself; information is not processed on the cloud or passed through faraway data centers. With the prevalence of contemporary ICT developments like data analytics and the Internet of Things, this distribution lowers the lag time. It conserves backhauling capacity, both of which are in high demand[109]. Figure 22 shows what an Edge Computing architecture could look like[110].

Figure 22: What EDGE Computing looks like
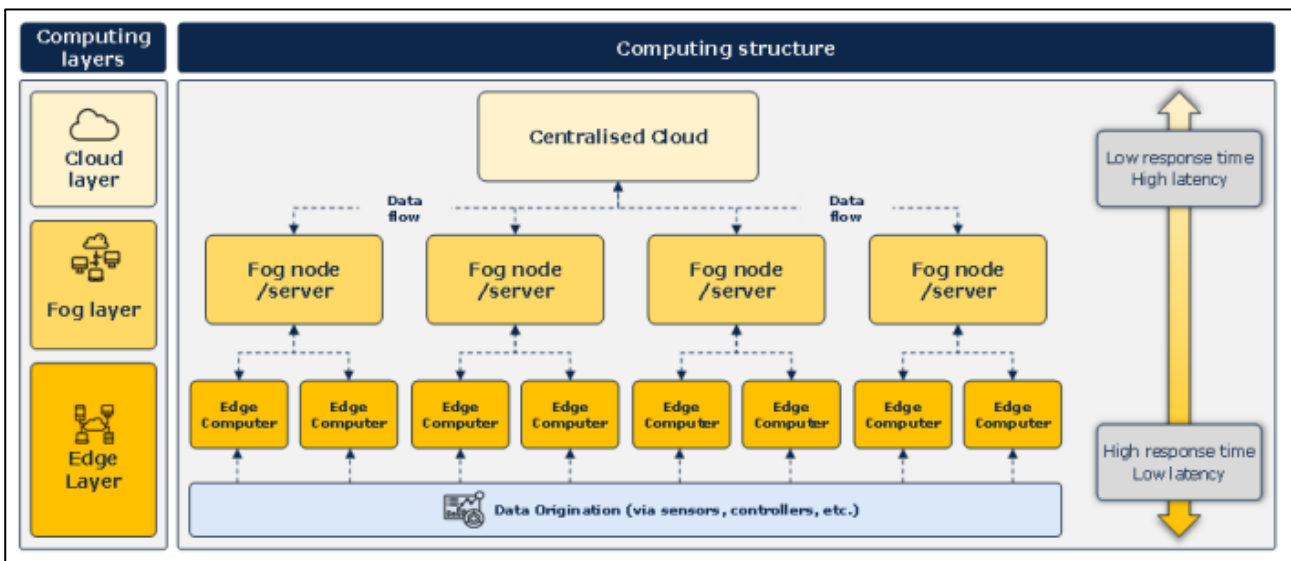
There are many use cases applications for edge computing, with the main ones being[111]:

- Autonomous vehicles: To function effectively, self-driving cars require the ability to absorb, learn, and respond to information in real-time without connecting to a distant cloud. This need for instantaneous processing power has led to edge computing architecture. Estimates suggest that self-driving cars generate up to 3.6 terabytes of data per hour from a cluster of cameras

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[108] *See* 107
[109] *See* 107
[110] *See* 107
[111] *See* 107

and other sensors. Edge computing can provide dedicated processing power to all the car's sensory devices while remaining connected to and moving with the vehicle, ensuring that the self-driving car can always make quick and accurate decisions and enhancing the safety and reliability of the technology.

- Industrial automation has revolutionized manufacturing by creating machines that can sense, detect, and learn things without programming. The next phase of industrial automation, Industry 4.0, is expected to be further enhanced by the rollout of the 5G service. This high-speed, low-latency wireless connection is anticipated to eliminate traditional wired connections to robotic assemblers, allowing quicker updates and enabling products to reach the market faster. The role of edge computing in Industry 4.0 is critical. Edge computing can centralize the intelligence of automated machines by utilizing high-speed 5G connectivity. By doing so, the manufacturing process can become even more efficient, with devices working together in real-time, enhancing the speed and accuracy of production.

- Augmented Reality/Virtual Reality: A significant amount of processing power is required to create entire virtual worlds or overlay digital images and graphics convincingly onto the real world. While phones can deliver this power, the trade-off is concise battery life. Edge computing addresses this obstacle by seamlessly moving the processing out of the device, giving the effect of high-power, wearable computation. Edge computing does this without sacrificing latency, as a traditional cloud would do, resulting in a smoother user experience and seamless transition between the real and digital worlds. With the help of edge computing, augmented and virtual reality can become even more immersive, with users feeling like they are genuinely interacting with a digital environment.

Telecom companies and the financial services industry

The financial sector is much different than telecommunication, so it might be hard to understand the role telecom companies could play in this sector[112]. According to research by Statista, the digital payments industry will generate just over $10.5tn in payments by 2025 (a 14% increase since 2020), with the total being split between digital commerce and mobile pos payments[113]. And as of 2021, the total number of registered fintech in the world has increased by a staggering 117% since 2018, from 12,131 to 26,346[114]. Fintech is term used to describe the financial technology industry which consists of companies that use technology to provide financial services or that offer technology

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[112] *See* "Fintech: Emerging Trends" by Sudhir Kumar Pant
[113] *See* "FinTech Report 2021 –Digital Payments" by Statista
[114] *See* "Number of fintech startups worldwide from 2018 to 2021, by region" by Statista

services to financial institutions. These firms utilize technology to facilitate financial transactions for both businesses and consumers[115].Fintech leverages emerging technologies like cloud computing, blockchain, artificial intelligence, machine learning, data analytics, and robotics to offer financial services at a reduced cost for a better value proposition[116]. Thus, this shows telcos' opportunity to become active players in the financial services ecosystem.

But what are the specific benefits for the two industries to join forces? Four key elements make it an attractive opportunity[117]:

1. User insights: telecom companies have access to unique data insights that enable them to personalize products and services for their partners (this could range from assisting with credit ratings to more straightforward tasks like auto-filling basic information such as an address). By leveraging their vast customer data, telecom companies can help reduce friction in financial transactions, making it easier for customers to engage in commerce. These personalized services can benefit customers with limited access to financial services, such as those in developing countries. Telecom companies can improve financial inclusion and promote economic growth by providing tailored financial solutions.

2. Customer identity and authentication: telecom companies can verify identities remotely using solid credentials, such as two-factor SMS verification. They have a strategic advantage in finance and payments, contributing to embedded finance with existing infrastructure and automated authentication solutions.

3. Reach & Infrastructure: Telecom companies possess vast customer bases that fintech can tap into to expand their own customer base. In addition, telecom companies can offer their extensive network infrastructure to fintech, enabling them to improve their services' reach and scalability.

4. User Experience: The user experience is a significant factor that can discourage the unbanked and newcomers to digital services. Telecom companies have the tools to overcome this challenge by offering innovative solutions that streamline processes and enhance the customer support experience. They can leverage their existing customer support channels, collaborate with banks, and provide user-friendly services such as biometric authentication, voice banking, and in-store kiosks. By prioritizing user experience, telecom companies can foster greater adoption of digital financial services and contribute to the growth and development of the finance and payments industry.

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[115] *See* "An introduction to fintech: Key sectors and trends" by S&P Global Market Intelligence
[116] *See* 112
[117] *See* "Embedded finance – the time is now" by Mobile Word Live

There are already some examples of successful partnerships between telecommunications and the financial industry. The most relevant one is Orange Bank[118]. Orange Bank is a mobile banking service launched by Orange, a French multinational telecom operator. The bank provides a range of financial services, including current accounts, savings accounts, loans, and insurance, to its customers. Orange Bank operates entirely online, with no physical branches, and offers a simple and intuitive mobile banking app that allows customers to manage their accounts and transactions on the go. As a telecom operator, Orange has leveraged its vast network and customer base to expand into the finance and payments industry. Orange Bank offers competitive rates, low fees, and innovative features that appeal to digital-savvy consumers. Orange's extensive customer support infrastructure and brand reputation for reliability and trust also support the bank's growth and adoption. Other famous examples include Turkcell's Parcel[119] and Movistar Money[120]. Turkcell's Paycell is a mobile payments service that caters to consumers and merchants, making it easier to complete online and in-person transactions such as bill payments, mobile money transfers, payments with QR codes, and car fuel purchases. As the pandemic increased the popularity of e-commerce and cashless payments in 2020, Paycell's mobile payments business saw substantial growth. Telefónica launched Movistar Money, a consumer loan service, in April 2019. The service enables its Spanish contract customers to obtain credit up to €3,000 within 48 hours without initial fees or documentation. The telecom operator partnered with CaixaBank Group to provide financial loans for 24, 36, or 42 months, ranging from €1,000 to €3,000. This is not the first time Telefónica has collaborated with CaixaBank. The two companies previously partnered to offer financing products for devices. Movistar Money is an extension of this partnership.

Telecom companies and the world of gaming

Video games have become a significant part of global culture and are competing with other forms of entertainment, such as movies, literature, and the arts, for people's free time. Gabe Newel, the owner of Valve, a company that develops, publishes, and distributes video games digitally, noted that when Dota 2 releases an update, the internet traffic worldwide increases by 2% to 3%. Netflix has said that Fortnite, an online video game, poses a more significant threat to its platform than HBO[121]. The Mobile Games market is expected to see substantial growth in revenue over the next few years. According to projections, revenue in the market will reach $286.50bn in 2023, with an

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[118] *See* "Orange Bank: The first telecom-bank" by Jean-Bernard Mateu for Réalités Industrielles
[119] *See* "Mobile payments and telco financial services – Top 5 examples" by STL Partners
[120] *See* 119
[121] *See* "Skin in the game - How telecom operators can win with gaming" by strategy&

annual growth rate of 7.08% between 2023 and 2027[122]. This growth will generate a projected market volume of $376.70bn by 2027. The number of users in the Mobile Games market is also expected to increase, with an estimated 2.32bn users by 2027. And, according to research by Analysys Mason, by 2025, it is projected that 30% of smartphones worldwide will be 5G-enabled, and spending on mobile gaming will increase from $75bn in 2020 to $138bn[123]. This growth is due to the higher-value content that 5G will provide and the emergence of new cloud-based gaming services that will cater to new segments of consumers, including those interested in mixed reality (AR and VR) experiences. Also, Analysys Mason has estimated that 5G will generate up to $12.5bn of retail revenue in 2025, which operators can target by focusing on mobile cloud gaming revenue and XR gaming revenue[124]. So, cloud gaming is a crucial element of this growth, but what is it? Cloud gaming can be defined as any service where the game is processed remotely in the cloud instead of locally on a console. Figure 23 shows a clear representation of what cloud gaming looks like[125].

Although cloud gaming has existed for some time, the first successful example was the Nvidia Grid, which was later rebranded GeForce Now[126]. With GeForce Now, users can stream games from the cloud to their devices, including desktop computers, laptops, tablets, and mobile phones. The service is available on various platforms, including Windows, macOS, Android, and iOS. GeForce Now offers a library of games that users can access through a subscription service, and it also allows users to play games they own from other digital stores like Steam and Epic Games. The service uses Nvidia's powerful graphics processing units (GPUs) to deliver high-quality visuals and performance to players, even on devices that might not have the necessary hardware to run the games locally. Other famous examples are the Xbox Game Pass Ultimate, PlayStation Now, and Amazon Luna[127].

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[122] See "Mobile Games – Worldwide" by Statista
[123] *See* "How can telecoms operators conquer the mobile gaming industry?" by Analysys Mason
[124] *See* 122
[125] *See* "Gaming as a Service (GaaS)" by AMD. Advanced Micro Devices, Inc., commonly abbreviated as AMD, is an American multinational semiconductor company based in Santa Clara, California, that develops computer processors and related technologies for business and consumer markets.
[126] *See* "Best Cloud Gaming Services: Xbox Game Pass, GeForce Now and More" by CNET
[127] *See* 126

Figure 23: Cloud Gaming
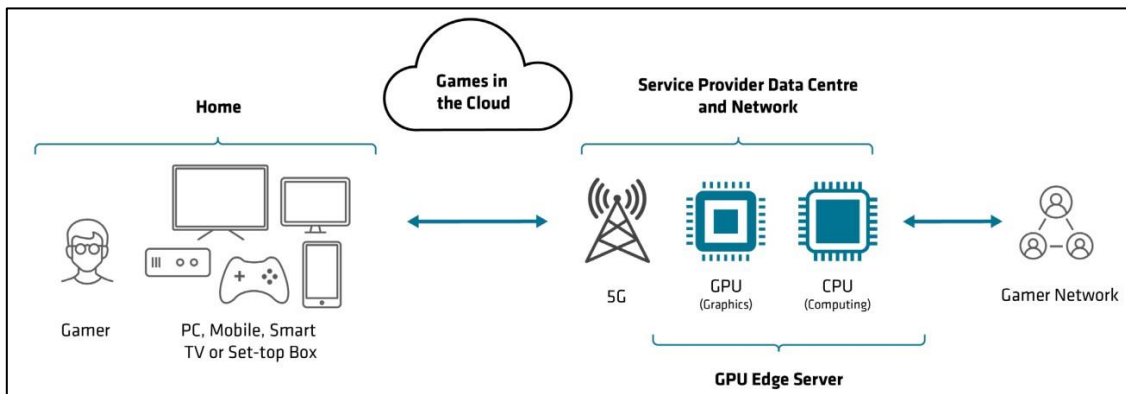
As you can see, a telecom provider is central to cloud gaming, providing the necessary infrastructure for the system to operate. Furthermore, there are other roles that an operator cloud play in the mobile gaming industry[128]:

- Sales channel partner: By offering gaming as a value-added service or reselling third-party or own-branded services, operators can enhance their core consumer proposition. Operators have a direct relationship with consumers and control over the network, which could enable them to become gaming service providers. This would allow them to offer own-branded consumer products or resell third-party services and devices. Over the next 2 to 3 years, operators can use these services to educate consumers about the benefits of 5G services and encourage them to migrate to these faster and more advanced options.

- Service aggregator: Operators may consider offering services through their consumer platform and infrastructure by acting as service aggregators. Operators have a wealth of experience in aggregating and distributing content, especially video, and selling services through a subscription model. This expertise is highly valued by third-party gaming service providers, who seek partnerships with operators to provide such capabilities.

- Infrastructure-as-a-Service (IaaS) provider: Operators can capitalize on the growth of 5G-enabled gaming by targeting the B2B opportunity and developing a mobile edge computing (MEC) proposition. This can be achieved through partnerships with other operators and public cloud providers. As next-generation gaming ecosystems mature, operators should leverage their MEC and end-to-end network management capabilities to monetize the gaming service providers' demand for quality-of-service assurance. This would enhance their role as a go-to-market partner. Operators can also use gaming as the initial large-scale application to develop MEC capabilities.

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[128] *See* 122

- Ecosystem development partner: Operators can collaborate with gaming service providers to expedite the advancement of the next-generation gaming ecosystem, including new devices, XR content, and supporting infrastructure. In addition to offering these providers a go-to-market partner, operators can educate consumers on the value of 5G and the gaming experience it can show. Operators may assume one or more roles in this segment, depending on their profile, long-term strategy, and risk appetite.

Telecom and the Metaverse Opportunity

The concept of a metaverse has been gaining traction in recent years, with the advancement of technology making it increasingly possible. As we move closer to this virtual world, telecom companies can capitalize on the trend by leveraging their new connectivity technology and infrastructure. High-speed connectivity and low latency are vital for creating a seamless metaverse experience allowing users to explore virtual environments, interact with others, and access services seamlessly. As a result, telecom companies have an essential role in developing the Metaverse, and they could reap significant rewards by investing in this emerging market. The Metaverse is a seamless convergence of our physical and digital lives, creating a virtual community where we can work, play, relax, transact, and socialize[129].

The Metaverse is still early in its evolution, and there is no singular, all-encompassing definition to which people can turn. Themes of what the Metaverse is and could be, however, are emerging. The critical point is that there is no one virtual world but many worlds which are taking shape to enable people to deepen and extend social interactions digitally. This is done by adding an immersive, three-dimensional layer to the web, creating more authentic and natural experiences. The Metaverse even promises to facilitate accessibility from the comfort of the home, breaking down boundaries and democratizing access to crucial goods, services, and experiences[130].

But, to run, the Metaverse requires some key technologies[131]:

- Local compute for a truly immersive experience: The Metaverse is designed to offer users a fully immersive virtual experience. To achieve this, there must be simultaneous audiovisual information exchange between numerous users and the virtual world at any given time. However, for such an immersive experience, significant local computing is necessary. This means that the Metaverse will require a remarkable improvement in performance by several

[129] *See* "Opportunities in the metaverse - How businesses can explore the metaverse and navigate the hype vs. reality" by JP Morgan, and *see* "Seven ways telecom operators can power the metaverse" by EY

[130] *See* "Demystifying the Consumer Metaverse" by World Economic Forum

[131] *See* "The Metaverse: What's in it for Telcos?" by Arthur D. Little

orders of magnitude. The computational efficiency needed for the Metaverse is around 1,000 times greater than what is typically available today, with edge data centers present at almost every node of a telecom network. Besides vast computing power, the Metaverse will require real-time rendering and artificial intelligence (AI) computing capabilities.

- Ultra-low-latency communications for a lag-free experience: The Metaverse necessitates complete, instantaneous, and mutual information exchange among users. To create a practical and lag-free experience that allows users to fully engage with the Metaverse, new communication methods with low latency (between one to five milliseconds) must be developed. Moreover, 5G ultra-low-latency communication is needed to support true immersion. This presents a significant challenge, as seen with Meta's struggle to implement some use cases due to inadequate low latency. To handle new data streams, networks require significantly increased throughput, including their Internet backbones. This can be achieved through fiber and 5G that provide multi-gigabit networks and innovative technologies that optimize latency, such as 5G "slicing."

- Enhanced cloud computing for interactions on a mass scale: In the Metaverse, users will be coming in and out constantly, even extending into the real world, similar to how it works in Pokémon Go. Therefore, cloud computing server farms must ensure the Metaverse is always available. Currently, multiplayer online games can only handle up to a few hundred players at most, which is still manageable. However, cloud computing performance must improve significantly to support a genuinely global Metaverse. To achieve this, telcos must invest in persistent cloud compute capacity and persistent data transfer.

- Analytics & AI capabilities to facilitate telcos' activities: Telcos must also focus on identity, billing, and transaction management as analytics and AI converge with the Metaverse. The Metaverse raises concerns about customer data management, ownership, and safe and secure transactions. Telcos will likely be more involved than enabling infrastructure as they create new revenue streams and monetization opportunities. An analytics and AI layer will be needed to support data management and payment capabilities.

Currently, there are many different metaverse platforms, but only a few are created by telecom companies. The most successful use case is SK Telekom (SKT) ifland in South Korea [132]. In 2021, SKT expanded its AIVERSE by launching ifland, a metaverse platform allowing users to meet in virtual spaces and use customizable avatars and virtual items. SKT has a unique advantage in taking a first-mover approach to the Metaverse because its domestic consumers are highly receptive to virtual worlds, more so than consumers in most other countries. This is partly due to SKT's previous

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[132] *See* "SK Telecom's AIVERSE illustrates a potential role for operators as metaverse aggregators" by Analysys Mason

initiatives and long-established presence in building virtual worlds, such as launching Cyworld in the early 2000s. Other operators who are new to this aspect of the Metaverse and have not made significant investments in this area will face barriers in terms of both cost and culture if they aim to replicate SKT's approach. Therefore, the best strategy for these operators may be to partner with SKT. In May 2022, SKT announced an agreement with Deutsche Telekom to launch a version of ifland in Germany. If the initial launch is successful, both companies are open to establishing a joint venture to pursue metaverse opportunities across DTAG's European footprint. Operators outside of this footprint may also wish to consider partnering with SKT to take advantage of its expertise and experience in the virtual world[133].

But it must also be said that for the Metaverse to be genuinely fully immersive as it is being discussed, some technological advances are still required[134]. Still, telecom operators need to start taking a role in this industry to gain a better advantage in the future.

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[133] *See* 132
[134] *See* "Network requirements for the metaverse: towards 6G and a Universal Digital Fabric" by Analysys Mason

Chapter IV – Analysis of The Findings: How To Become Ecosystem Enablers

Methodology

This research paper is based on a qualitative type of method of research. The data has been gathered through different interviews and has been analyzed through the use of a thematic framework approach. The objective of the interviews was to gather important qualitative data from experts of the telecommunication industry in order to better understand the state of the telecommunication sector apart from what can be found online/on the papers. The interviewees have been chosen based on their backgrounds and expertise concerning the telecom industry. In particular, all the interviewees are current, or have been, telecom executives. The objective of the interviews was to gather information from experts of the industry in regard to the topic arisen from the research question. The analysis process is made of three different phases:

1. Phase 1: Data Collection
2. Phase 2: Data codification
3. Phase 3: Thematic Map
4. Phase 4: Results

Phase 1: Data Collection

The Data Collection phase was accomplished by conducting different interviews with experts in the Italian telecommunications industry. In this case, an expert in the telecommunications sector is defined as someone who has been part of or is in some way connected directly to the industry. A total of five different interviews were conducted. Table 4.1 shows a summary of the interviewees and their backgrounds:

Table 6: List of Interviewees and their background

Francesco Donadio Business Development & Wholesale Offer @Retelit	**Professional Background:** • Former Business Development Director @PA Evolution • Former Chief Technology Officer @In.I.T Srl • Former Remedy AR System Developer @Etnoteam **Educational background;** • Bachelor's Degree in engineering @Università degli Studi di Perugia • Professional Management Course @Università Ca' Foscari Venezia

Anonymous Respondent Head of Technology Communication & Standardization	**Professional Background:** • Former Head of Research, Innovation, and Technology regulation for a telecom operator **Educational background:** • Ph.D. in Computer Science and Telecommunication • Bachelor's in computer science and Electronic Engineering
Irene Pipola Partner, Italy TMT Leader @EY	**Professional Background:** • Former Head of Commercial Operation Strategy & Development @Vodafone • Former Project Leader @BCG **Educational background:** • MBA @Columbia Business School • Bachelor's degree in chemical engineering @Università Degli Studi di Napoli Federico II
Marco Salera Partner, MED Business Transformation & Innovation Solution Leader @EY	**Professional Background:** • Former Consulting & Strategy Head Products IGEM @Accenture • Former Managing Director @Accenture **Educational background:** • Bachelor's in business administration @Università Sapienza di Roma
Silvestro Demarinis Senior Manager, TMT @EY	**Professional Background:** • Former Manager @BetweenSpa • Former Analyst @H3G **Educational background:** • Master's in economics of Telecommunications @Università degli Studi di Padova • Bachelor's Degree in Engineering of Telecommunications @Università di Pisa

The questionnaire was developed based on the main topics of the research question: what challenges the telecommunications sector is facing, what are the main assets that a telecommunication company owns, and how can a telecommunication company embrace the concept of beyond the core to renew its business model. Based on this assumption, the following questionnaire was developed:

1. Overall, telecom sector difficulties
2. A telecom company's traditional asset
3. The "beyond the core" services opportunities

So, based on these themes, the following questionnaire was developed:

1. What are the current challenges that Italian telecom operators are encountering in the ever-changing environment of the telecom sector?
2. What are the core competencies and strengths of Italian telecom operators that can be leveraged to create new revenue streams beyond connectivity, and how can these be further developed?
3. When discussing 5G and VAS, which business streams are the most significant in their potential impact on the industry, and what factors should companies consider when evaluating which streams to pursue?

4. What are some of the most effective strategies and techniques other industries have successfully used to generate new revenue streams, and how can Italian telecom operators apply them to their businesses?

5. As the telecommunications industry continues to evolve and adapt to emerging technologies and changing consumer needs, new regulations will likely be introduced to address new challenges and opportunities in the market. What specific types of regulations can we anticipate in the future, and how might these regulations impact the strategies and operations of Italian telecom operators?

As you can see, the first question investigates the major difficulties the telecom sector is facing and their cause, then the second question is aimed at defining the foundational assets a typical telecom company possesses. Furthermore, the last three questions are related to the concept of beyond core in terms of the services opportunity for a telco, what some of use cases or examples are to follow, and what kind of environment is needed to succeed.

Finally, the interviews were conducted in Italian, so each transcript was translated to align it with the language used in this paper.

Phase 2: Data Codification

Qualitative data analysis involves interpreting unstructured or semi-structured data, such as interviews, observations, or open-ended survey responses. Unlike quantitative data, which can be easily analyzed using statistical methods, qualitative data requires a more interpretive approach to uncover meaning and understanding. Categorizing and coding the data is a critical step in this process. Categorization involves sorting the data into groups or categories based on commonalities or differences, which may be derived from research questions or the data itself. Once the data has been categorized, it can be coded by assigning labels or tags to reflect its meaning or content. Codes may be descriptive, identifying specific topics or themes, or interpretive, capturing participants' underlying meaning or perspective. These steps help researchers identify patterns and themes, make comparisons, and draw conclusions based on the data while ensuring the rigor and validity of the analysis. For this work, we followed three steps to code the transcripts, as shown in Figure 24[135].

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[135] *See* "Thematic Analysis Approach: A Step-by-Step Guide for ELT Research Practitioners" by The Open University

1st Order Concept
- First we identify 1st order concepts
- 1st-order concepts are surface-level meanings that can be directly observed in a transcript, such as keywords or phrases that are repeated or emphasized.

2nd Order Concept
- Second, starting with 1nd order concept, we identify the related 2nd order concept
- 2nd order concepts are abstract or conceptual meanings that require interpretation and inference based on data analysis, such as themes, patterns, or underlying ideas. This involves a more systematic and comprehensive analysis of the transcript, building upon the identification of 1st order concepts

Aggregate Theme
- Third, and last, we identify the aggregate themes arising from the interviews
- Aggregate themes are overarching concepts or categories that emerge from the grouping of similar or equal 2nd order concepts. They provide a higher level of abstraction and generalization than 2nd order concepts and serve as a way to organize and make sense of the data.

From all five interviews, fifty-six quotes were extracted and analyzed. Thirty-six different 1st order concepts were found, which could be grouped into thirteen different second order concepts. Moreover, in the end three aggregate themes were found: Sector Challenges, Traditional Assets, and Beyond Core. Figure 25 shows a summary of results derived from the analysis.

Figure 25: Thematic Analysis Results Summary
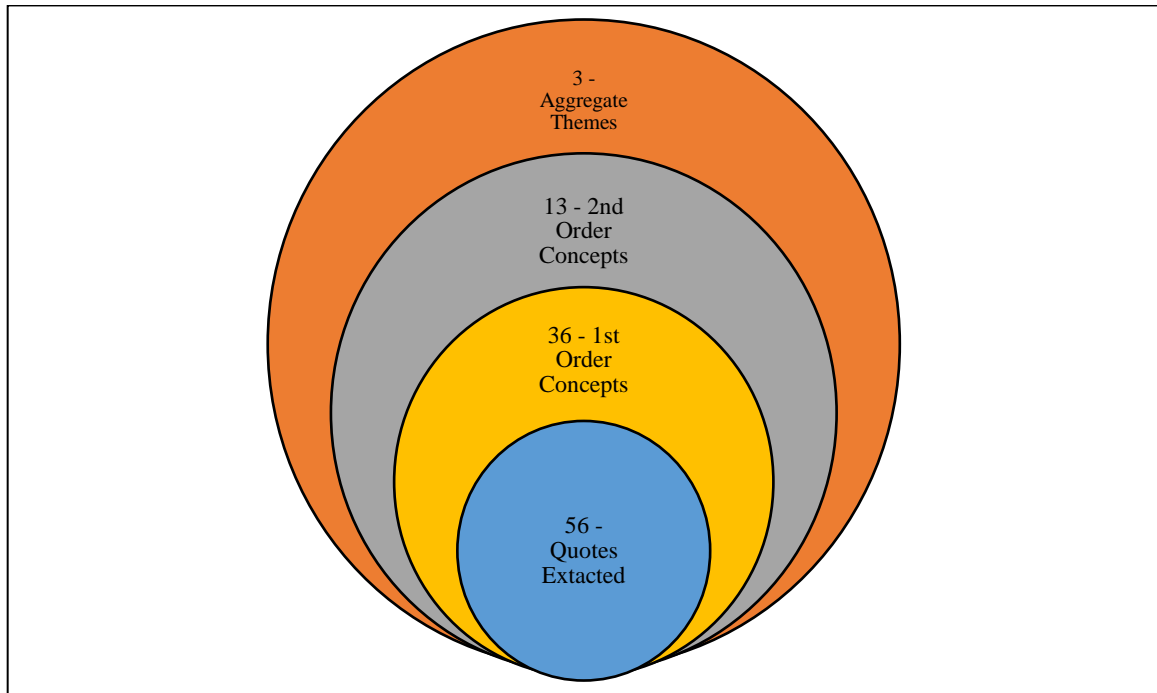
Analysis Findings

Phase 3: Findings and Thematic Map

The findings outlined previously have been inserted in a mind map to better visualize them and see how they are related with each other. Then, we will analyze each macro theme and its related second order concepts. Each second order concepts have been analyzed by utilizing the information found during the interviews and additional material found from other types of sources. Figure 26 shows the thematic map of the findings from the interviews.

Figure 26: Interviews Findings Map
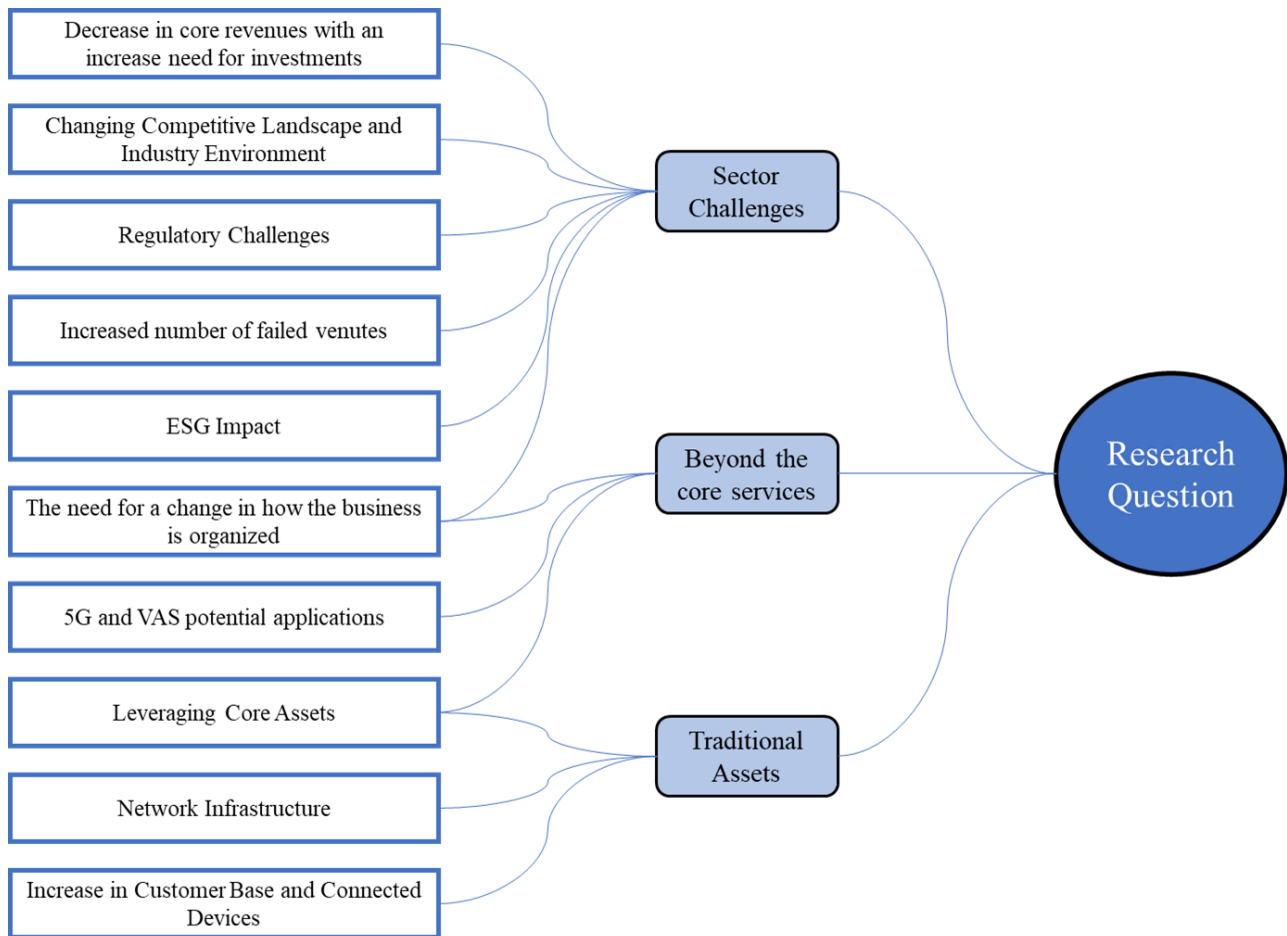
Sector Challenges

All the interviewees agreed that the telecom sector faces severe challenges. More specifically, during the interviews, five factors were identified to be the most critical challenges the sector is facing at the moment:

- a decrease in the core business revenue with an increased need for investments
- changing competitive landscape and industry environment
- regulatory challenges
- the need for a change in how the business is organized
- an increased number of failed ventures over the years.
- the impact of ESG factors

Decrease in the core business revenue with an increased need for investments.

According to the interviewees, currently, this is the most crucial difficulty for the telecom sector. To quote, Mr. Salera described it as "the perfect storm" and continued by saying, "It must have been two decades that it has been descending [revenue from the core business] and infrastructure investment is going up, you have revenues going down even though the number of lines is increasing." Similarly, Mr. Demarinis explained it as "they [telecom operators] are also being asked to make a major commitment from an investment standpoint is going to do the two next-generation networks [i.e., 5G mobile network, and FTTH network] …. but they have a core [business] that tends to contract itself". Both outlined a situation that was explained in Chapter 1. Although the overall number of connected devices and the number of subscriptions (both fixed and mobile) have increased over the years[136], revenues have decreased as a result of higher fixed costs to maintain the already existing infrastructure and higher investment to develop the new one that is required to be on par with the always faster to arrive technological advancements, coupled with a price war resulting with a lower price point and ARPU, and the evolving customer needs (which demand more and more connectivity at cheaper prices). Ms. Pipola perfectly summarized the situation by saying, "[a Telecom Sector] that is shrinking in terms of revenue, in terms of margins, and even wanting, just in terms of brand…and as a result you have a compression of EBIT, further reducing the ability to invest and innovate. So, you have entered a vicious cycle. Telecom Operators need fuel [liquidity]". The brand aspect is something that will be analyzed in the next point. However, this explanation summarizes how the most significant threat for telecom is that they have entered this vicious cycle, which eventually leads to companies making hard decisions for their organizations (i.e., layoffs, delayering, sale of the business unit, etc.) and taking on more debt in order to be able to keep investing (resulting in a weaker financial position, which itself has its negative consequences)[137].

Changing competitive landscape and industry environment

This second aspect might be one of the key causes of the struggle outlined in the previous point. How the competitive landscape, and the industry environment itself, changed over the years has had a significant impact on the incumbent players of the industry. The incumbent telecom players face "external geographical threats" and new competitors from atypical industries. In the first case, the interviewees are referring to Iliad and its entrance into the Italian market in 2021. A "forced

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[136] *See* 29.
[137] *See* 49.

entrance" imposed by the regulator has one of the conditions for the WindTre merger to have a green light. The entrance of the Iliad into the Italian market drastically shaped the industry, as the company's aggressive pricing practices resulted in a "lower average price point," drastically impacting revenues. In the second case, the interviewees refer to various factors reshaping the industry as we know it. First, a respondent outlined how, over the years, telecom operators have faced less influence in the industry regulatory and standardization practices as their once famous research centers were cut and their contribution at a regulation and standardization level decreased. A respondent described the situation as: "In the past, there was a technology structure that had very strong control by the telecom operators (both fixed operators and mobile operators) on the technology they put in place. Because they had the research centers and the operators themselves were the ones that created the international standards, manufacturers had to implement these standards. Now this influence has been lost because the first thing that was cut [as a result of the financial struggles] was R&D, and manufacturers and newcomers in the industry (such as all the tech and digital companies) have become much more powerful than before ". On top of this, you have the industry that is facing external threats such as geopolitical struggles and wars "So anyway there is also the theme of the Ukraine-Russia war that has intensified, or rather reduced, relations, especially with China."

Interestingly enough, due to these struggles, there are also some favorable consequences, as quoted by Mr. Demarinis, "[the struggles] have also produced some upside from our point of view, that is that they [manufacture, in this case tech manufacturers] are also beginning to manufacture something directly in Italy so that we are not dependent on others." Second, the industry is reshaping, with some atypical players entering the market. Taking advantage of wholesale-only companies, whose business is to provide network infrastructure primarily to B2B clients, a vast array of companies is entering the telecommunications industry even though it is a completely unrelated market. For instance, in 2007, Poste Italiane launched PosteMobile[138], a Mobile Virtual Network Operator, which first offered mobile plans to its customer base. First, in 2007 PosteMobile launched its mobile offering utilizing Vodafone's mobile network infrastructure. In 2013 the company changed its network infrastructure provider from Vodafone to WindTre. In 2017, PosteItaliane ventured for the first time in the fixed network offering, by launching its own fixed network plan called PosteCasa (relying on Open Fiber's fixed network infrastructure)[139]. More recently, in 2021, PosteMobile went back to Vodafone for its network infrastructure As Mr. Salera explained, "Poste attacks Wind [and all the other operators] on the core business, which is connectivity, mobile data. Leveraging the fact

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[138] PosteMobile was actually launched in 2007, but the company didn't make real gains until 2017 when it launched its fixed network offering. *See* "Poste Italiane diventa operatore telefonico" by Nicoletta Cottone for Il Sole 24 Ore, and *see* "Poste debutta nella telefonia fissa: nasce PosteMobile Casa" by Andrea Frollà for Corriere Comunicazioni.
[139] *See* "Poste Italiane: accordo con Open Fiber per offerta fibra" PosteItaliane press release.

that it has an infinite customer base and vast distribution network". What he means is that Poste realized that its main assets are its customers, and once you have a large customer base who is pretty loyal, you can leverage it to sell anything to it. So, by taking advantage of the infrastructure provided by other network operators (wholesale only, but even retail operators)[140], Poste can use the network to sell additional services to its customers. The example of Poste might be a first in this industry, but it is expected. We have seen many other companies leveraging their customer base to sell additional services (thus making higher margins) unrelated to their core business. Famous examples can be Apple selling Apple Music on top of the sale of the iPhone[141] or Instagram, which implemented an e-commerce platform in its social networking app[142]. So, one of the critical reasons telecom companies are facing struggles is how the industry is changing, both from a competitive point of view and the structure of the industry itself.

Regulatory Challenges

The telecommunications sector is also facing different regulatory challenges. The principal goal of the regulator is to promote a competitive and stable market that ultimately provides the best benefit possible for the end consumer. Keeping this in mind, the different objectives of the regulator might shift as it depends on the government in place at that moment. At a telecom level, the most important regulatory agencies are in the US (the Federal Communications Commission, FCC[143]), the UK (the Office of Communications, OFCOM[144]), and the EU (Body of European Regulators for Electronic Communications, BEREC[145]). Below BEREC are also the single regulatory agencies of EU member countries, such as AGCOM in Italy. In addition, a great deal of influence is steered not only by telecom regulators but also by the competition authorities themselves (such as the EU

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[140] *See* "La copertura di rete di PosteMobile. A chi si appoggia PosteMobile?" By Orio Milot.
[141] *See* "Apple announces its streaming music service, Apple Music" by Ben Popper for The Verge.
[142] *See* "Instragram adds in-app checkout as part of its big push into shopping" by Casey Newton for The Verge.
[143] The Federal Communications Commission (FCC) is an independent agency of the United States government that regulates various aspects of communications within the country. It was established by the Communications Act of 1934 and is responsible for overseeing interstate and international communications by radio, television, wire, satellite, and cable. (https://www.fcc.gov/).
[144] OFCOM (Office of Communications) is the regulatory authority for communications in the United Kingdom (https://www.ofcom.org.uk/).
[145] BEREC (Body of European Regulators for Electronic Communications) is an EU organization comprising national regulatory authorities. It promotes consistent electronic communications regulation across member states, fostering competition and protecting consumers. BEREC advises on policy, facilitates cooperation, and contributes to the development of the Single Market for electronic communications within the European Union. (https://www.berec.europa.eu/en).

Competition Commission[146], the Competition and Markets Authority in the UK[147], and the Federal Trade Commission in the US[148]).

Moreover, as the telecom sector has become ever more vital as it enables many of the technologies that shape our lives today, the regulator gives a great deal of attention, both from a regulatory and competition perspective. In this context, the telecom industry believes that to benefit the end customer eventually, the regulator might have forgotten about the operators themselves. As a respondant outlined, "the new regulation introduced, especially in Europe, aimed to substantially reduce prices for end customers at the cost of whatever." This thinking can be seen in the regulator's response to potential mergers or its influence on particular companies' decisions. Moreover, during the last few years, operators and regulators have debated the "fair share" topic wildly[149]. Fair share refers to the fact that operators argue that they are being taxed unfairly compared to the companies generating most of the traffic on their networks. The operators argue that companies such as Facebook, Amazon, Netflix, and Google (the famous FANG) are generating over 55% of internet traffic worldwide, making themselves hefty revenues[150].

In contrast, the operators only face increased costs and higher investment needs. However, they are being taxed more. As a respondent said "A huge amount of traffic is generated by the big tech, by Facebook, by Instagram, by Google, by whoever. So, there is this dilemma… the telco says "I have this important high-speed network, but yet who generated all this traffic? They do [i.e., FANG], but I do not generate value [in terms of revenue] from their traffic"". Fair share is not new, but with the recent struggles, it has become ever more important for the operators. A great example of the fair share argument was provided by a respondent: "The video call we are doing right now is generating absolutely nothing for the operators, whereas years ago, a video call made with terminals generated some revenue. Now, all the possible revenue is generated by the service provider whose app we use for this call, not the operator". Still, the real issue with fair share is calculating this possible revenue. How do you develop a good taxation scheme right for everyone? For now, regulators worldwide are studying how to fix the problem in a way that is beneficial to all the stakeholders.

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[146] The European Commission's Competition Directorate-General is responsible for enforcing competition law within the European Union. It ensures fair competition by investigating and preventing anticompetitive practices, such as cartels and abuse of dominant market positions. The Commission reviews mergers and acquisitions to prevent monopolies and protect consumer interests. It promotes a competitive market that benefits businesses and consumers alike. (https://commission.europa.eu/about-european-commission/departments-and-executive-agencies/competition_en).

[147] The Competition and Markets Authority (CMA) in the UK is the primary competition regulator. It enforces competition law, investigates anticompetitive practices, and reviews mergers and acquisitions to protect competition. (https://www.gov.uk/government/organisations/competition-and-markets-authority).

[148] The Federal Trade Commission (FTC) in the United States is an independent agency that enforces consumer protection and antitrust laws. (https://www.ftc.gov/).

[149] *See* "Digital Services Act - Joint Position by the GSMA and ETNO".

[150] *See* "Fair share for network sustainability" by Telefonica.

The need for a change in how the business is organized

Second to last, one of the struggles telecom companies faces is the need for change in their organization and thinking to adapt to an evolving industry. From an organizational point of view, telecom operators are often huge employers with an extended footprint in their respective countries, so any reassessment takes work. However, lately, there has been much drive behind delayering[151]. The term delayering refers to separating the network part of the company from the services part of the company. In other words, the company separates into two different entities, a NetCo and a ServCo (there have been instances where the division included a third entity called OpCo in charge of all the operational aspects of the NetCo). The NetCo solely manages the network infrastructure using the wholesale-only business model. A ServCo is focused only on the services (both fixed and mobile) for B2C customers. Still, ServCo relies on the NetCo infrastructure to offer its services.

The idea behind the model is to take better advantage of a company's assets from a B2B and B2C perspective. Nevertheless, in reality, there is the need to split into two the heavily indebted balance sheet of an average telecom company and create an opportunity for an outside investor to step in with cash[152]. The cash is needed, as outlined before, both to fuel new investments and significantly to lower the debt so that the two entities would be in a better financial position than before. Moreover, something that arose from the interviews is that telecom companies must change how they think. Mr. Salera stated that they must begin to think as an industry as he said, "The problem with telecommunications is that it is a model that does not depend on you alone. It also depends on the competition that's at the country level, and now, even at the international level".

Moreover, Mr. Demarinis outlined how, for example, Open Fiber and TIM are both developing their national network even though the country intends to have one single network to reduce costs, provide an internet connection to all citizens (even those in white areas), and to protect a national asset. He stated, "[TIM and Open Fiber] are burning value because if the plan is to do a single network, the more forward without a clear strategy, the more the time window of efficiency shrinks." So, operators must begin to think as an industry rather than a single entity as they would when the situation was much more favorable for them. Finally, another important aspect of this need to change the operators' thinking is looking at how successful companies are operating now. As an example, a respondent highlighted how "The way the telecom company thinks is… so, I have 10 years to build this network, but if after three years I stop for one year, nothing is lost. I will start again in the fourth year and move on from that. In the digital world, is it not like that? No, it is not like,

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[151] *See* "The Great Delayering: As telcos' Integrated Era Ends, It's Time to Embrace New Strategies" by Bain & Company.
[152] *See* "Delayering: An organizational overhaul for growing Europe's telcos" by McKinsey.

because I cannot say I am going to do the Cloud, build part of it, and then stop". He added, "But you look at Tesla and see that it is completely vertically integrated[153]. The same Amazon, the same Microsoft. Even Apple, pretty much. Even Netflix, whose algorithms are built in-house[154]". To sum up, he means that if a telecom company wants to keep operating successfully in the industry (a digital industry now), it must change its thinking and look at what other successful companies are doing and how they do it.

Increased number of failed ventures over the years

Still, it is not like telecom companies have not tried to change or innovate. They have, but often they have failed at capturing the value they needed. In some cases, it was a deployment failure, while in others, the concepts behind the venture were a failure, to begin with. A great example of this is TIM. Launched in 2010 by Telecom Italia, Cubovision was an IPTV (Internet Protocol Television) service that offered on-demand content and live TV channels[155]. It primarily focused on delivering content through a set-top box to Telecom Italia's fiber-optic network subscribers. Then, in 2013, Telecom Italia rebranded Cubovision as TimVision, aligning it with its TIM brand[156]. TimVision expanded its availability beyond the set-top box and became accessible on various devices, such as smartphones, tablets, and smart TVs (see Image 1). It offered a more comprehensive selection of movies, TV series, and other on-demand content, competing with other streaming services.

Furthermore, in 2019, TimVision was rebranded again, dropping the capital "V" and adopting "TIMvision" as its official name. The service continued to enhance its content library and user experience, aiming to attract more subscribers in the highly competitive streaming market. The operator's strategy is based on bundling TIMvision with its internet offering and other streaming platforms. TIMvision does not produce its content (expect some occasions); instead, it relies on its licensing agreements and bundling offerings to attract customers. Nevertheless, customers have not appreciated this business model. Even though TIMvision bundles different platforms together, the company does not yet produce its own content, thus making it less appealing than competitors. Also, more recently, TIMvision has been in a legal dispute with DAZN against AGCOM. The two companies were found guilty of violating anticompetition rules. The two companies engaged into an agreement where they would bid together for Serie A streaming rights, and DAZN was users who subscribed to DAZN were also obligated to subscribe to TIMvision[157]. The dispute has had negative

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[153] *See* "Electric Vehicles: What's Next VII: Confronting Greenflation" Equity Research by Goldman Sachs
[154] See "How Netflix's Recommendations System Works" by Netflix
[155] See "CuboVision di Telecom Italia: ecco caratteristiche e prezzo" by Webnews
[156] See "Cubovision diventa TIMVIsion: vuole battere Sky Online e Infinity" by Digital Day
[157] *See* "DAZN e TIM annunciano l'accordo di distribuzione che porterà su TIMVISION le partite della Serie A" TIM Press Release.

effects from a brand point of view as the two companies suffered from a lack of trust from user, and a financial point of view as the agreement did not bring as many users as expected to TIMvision. According to many, TIMvision is an example of a failed venture by a telecom company, but there are many others. These failed ventures have drained significant resources and added difficulties to a challenging situation.

The Impact of ESG Factors

One last challenge that the telecom sector is being faced with it's the impact of environmental, social, and governance (ESG) factors as a key consideration for businesses across various industries in recent years. As sustainability and ethical practices take center stage, the telecommunications sector finds itself at the forefront of this paradigm shift. With its far-reaching influence and reliance on vast infrastructure, the telecom industry increasingly recognizes the need to align its operations with ESG principles. In particular, three different ESG topics were identified during the interviews for a telecom company to consider.

First, changing customer habits are a big thing. Ms. Pipola said, "Sustainability has become a topic that has led to different consumers making different choices." For example, this event can be seen in Switzerland, where consumers have been known to choose higher-priced offers because of their more positive impact on the environment with respect to cheaper offers.

Second, one shared fiber network theme is a hot topic in Italy. Having a single fiber network can be substantially positive from a financial aspect as it takes advantage of synergies and cost savings, but also from an environmental perspective as networks have been known to be big polluters, so having one network there would be a less harmful impact on the environment.

Third, and similarly to the second point, an important time being discussed now is the theme of "switch off." The term switch-off refers to the fact that older and less powerful networks are still active (such as 2G or 3G), which take up much energy to operate than newer, more efficient networks, thus polluting more. So, the idea is to switch off, or shut down, these older networks and use only the new ones. For example, at the recent FTTH Conference 2023 in Madrid, Mr. Demarinis spoke about this topic for the Italian sector and outlined how Italy can achieve significant energy savings by transitioning from copper to fiber optic networks[158]. If two fiber networks are maintained, the energy savings could reach approximately 86% of the current consumption. Furthermore, if a single network operated by a wholesale provider, often called the hypothetical single or national network, were established, the energy savings could increase to approximately 94%. In financial terms, these energy

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[158] *See* "Con la rete unica in fibra ottica un risparmio di 111 milioni all'anno" by Milano Finanza

benefits would translate to annual savings of around 103 million euros in the case of two separate networks (as is the current situation) and approximately 111 million euros per year with a single fiber network[159].

Implementing and reaching ESG targets it's a core objective for the telecom industry. But, doing so involves a certain degree of investment and a reassessment of services offerings to meet customer's demand. Thus, although an opportunity, ESG certainly has a big impact on the operation of a telecom company.

Traditional Assets

The second theme identified from the interviews is the core assets that a telecommunication company owns. All the interviewees agreed that two pillars comprise a telecom company's core assets: Infrastructure and Customer Base.

A telecom's network infrastructure is described as the first and most important asset of a telecom company. Because the infrastructure networks enable all the different offerings a telecom company provides. Network infrastructure includes all assets such as active radio-transmission equipment, antennas & cables (i.e., fiber to the cabinet and fiber to the home, feeders), outdoor cabinet, etc.[160]. An example of how companies are focusing more and more on their infrastructure asset is the recent publication of TIM's new strategi plan. The new strategy involves revolutionizing the business structure by separating the company into two separate entities, one for the infrastructures (the NetCo) and one dedicated to the service offering part (the ServCo)[161]. TIM is currently trying to find investors for the newly formed NetCo in order to raise fresh cash to in part pay some debt but also to keep up investments[162]. Furthermore, in more recent times, as the world is becoming more digitalized, there has been a rise in the number of data centers and cloud-enabling infrastructures. In fact, alongside the regulatory and business domains, telecommunications infrastructure is crucial in the current global battle for leadership in digital connectivity. According to a recent study by the Clingendael Institute, 5G and Cloud Computing have been identified as key elements of a country's battle for leadership in digital connectivity[163]. Also, according to Clingendael Institute, the global competition between the United States and China to reach technology supremacy, particularly

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[159] *See* 58
[160] *See* "The Rise of the Netcos" by M&A & Telecom Engineering Center of Excellence (TEE) and Deloitte
[161] *See* "FY'21 Results and 2022-'24 Plan" by TIM Group
[162] *See* 160
[163] *See* "Telecommunications infrastructure – Europe's Digital Decade?" by Brigitte Dekker and Maaike Okano-Heijmans for the Clingendael Institute. The Clingendael Institute, also known as the Netherlands Institute of International Relations Clingendael, is a think tank and diplomatic academy based in The Hague, Netherlands. It is one of the leading institutes in the field of international relations and diplomacy.

regarding 5G networks, has become a significant factor[164]. Both governments have made extraordinary efforts to persuade countries worldwide to align with their respective positions. The US has engaged in a diplomatic campaign since 2018 to convince other nations to avoid using equipment from Chinese tech giant Huawei. Telecommunications infrastructure is the foundation of the modern digital economy and holds strategic advantages for countries' economic and military capabilities. China aims to enhance its technical capabilities, shape standards, and regulations, and strengthen its ability to withstand US sanctions through initiatives like "Made in China 2025"[165]. The technical specifications underpinning digital infrastructure, including 5G networks, are determined by leading technological innovators. While the US led the development of 4G networks, it seems to be lagging in the race for 5G dominance, with European companies Nokia and Ericsson, South Korea's SK Telekom, and Chinese firms Huawei and ZTE having the knowledge and equipment for 5G deployment. Huawei, backed by the Chinese government, is leveraging its substantial presence in 4G and competitive pricing to solidify its global presence. However, concerns about cybersecurity and espionage have hindered Chinese companies' international expansion, with countries like Australia, New Zealand, Japan, Taiwan, and the US opting for European alternatives for their 5G infrastructure. European countries have taken varying approaches, with the UK reversing its decision and altogether banning Huawei, while the Dutch telecommunications provider KPN remains the only European company fully committed to using Huawei's network for its services. Additionally, Cloud computing has emerged as a new infrastructural element that intersects with data governance and falls under the International Telecommunication Union (ITU) mandate. The exponential growth of digital innovation has generated massive data, with 90% of the world's data being created in the last two years[166]. Cloud computing offers on-demand access to hardware, software, databases, storage, and analysis, replacing traditional methods like local corporate data centers. It eliminates the need for costly on-site data centers, provides scalability and global agility, ensures up-to-date services, and offers cost-effective data backup options.

The second core asset on which the interviewees agreed is the customer base. As Mr. Donadio stated, "The most important thing you have is the customer base." Because operator-customer relationships are typically medium to long-term, having a large customer base guarantees steady revenue for a relatively predicted period. Usually, customers engage in long-term contracts and are likely to switch to a new operator if they are unhappy with the service offered. Also, operators are

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[164] *See* 24.

[165] "Made in China 2025" is a strategic industrial policy initiative launched by the Chinese government in 2015. Its goal is to transform China from a manufacturing hub known for low-cost labor and imitation to a global leader in high-tech industries and innovation. The plan focuses on ten key sectors, including advanced information technology, robotics, aerospace, new energy vehicles, biotechnology, and more. *See* "Made in China 2025: Global Ambitions Built on Local Protections" by US Chamber of Commerce.

[166] *See* "The Value of Data" by the World Economic Forum.

known to simplify the signup process, but switching is much longer and painful, leading to decreased customers. The telecom business is all about churn rates; the lower they are, the better it is for the company.

Furthermore, the operator can sell additional services to its customers (such as TIMvision with streaming tv) on top of the traditional fixed and mobile offerings. Moreover, Telecommunication companies manage vast quantities of data generated by their extensive customer base[167]; as Mr. Demarinis explains, "[the core asset] is the customer base and all that is the customer base produces in terms of data." This data encompasses diverse categories, including but not limited to location data, purchase history, financial transactions, web browsing patterns, call records, and text messages. The real question becomes, "How will I enhance the data assets I have in-house?". The volume and variety of this data offer numerous use cases and opportunities for telecommunication companies. Here are a few examples according to research by Arthur D. Little[168]:

1. Retail Site Planning: Telecommunication companies can leverage data communications strategies to assist in retail site planning. By analyzing customer data, population demographics, foot traffic patterns, and purchasing behaviors, they can provide insights to retailers on ideal locations for new stores or expansions. This data-driven approach helps retailers decide where to establish their businesses for maximum visibility and customer reach.

2. Personalized Marketing: Telecom data communications strategies enable personalized marketing campaigns. By analyzing customer data such as call records, browsing habits, and purchase history, telecom companies can create targeted marketing messages tailored to individual customers. This approach allows for more relevant and customized offers, promotions, and recommendations, increasing customer engagement and conversion rates.

3. Real-Time Location-Based Targeting: With the help of data communications strategies, telecom companies can leverage real-time location data to offer targeted advertisements and services. By utilizing location-based services, mobile apps, and geofencing technologies, telecom companies can deliver location-specific content, offers, and notifications to customers near specific points of interest, events, or retail locations.

4. Billboard Placement: Telecom companies can utilize data communications strategies for optimal billboard placement. By analyzing data on traffic patterns, customer demographics, and behavior, they can identify high-traffic areas and strategically position billboards for maximum visibility and impact. This data-driven approach ensures that advertising investments are directed toward locations with the highest potential audience reach.

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[167] *See* "How Telco's use Big Data for Monetization & Revenue Maximization" by Indunil Ramadasa.
[168] *See* "Telecoms data monetization: Reality, not a mirage" by Arthur D. Little.

5. Credit Scoring: Data communications strategies can aid in credit scoring and risk assessment for financial institutions. Telecom companies possess valuable customer call patterns, mobile usage, and payment history data. Financial institutions can evaluate creditworthiness, assess risk profiles, and make informed lending decisions by analyzing this data. Telecom data provides additional insights that complement traditional credit scoring models.

6. Traffic Planning: Telecom data communications strategies are instrumental in optimizing traffic. By collecting and analyzing data from various sources, including GPS data, mobile devices, and traffic sensors, telecom companies can provide drivers with real-time traffic information, congestion alerts, and route recommendations. This data helps improve traffic flow, reduce congestion, and enhance transportation efficiency.

So, the two core assets it can leverage for a telecom operator to exploit monetization opportunities and recover from the sector's difficulties are its network infrastructure and customer base.

Beyond the Core Services

The third aggregate theme from the interviews is the concept of "beyond the core.". The term beyond the core refers to all opportunities outside of the core business (fixed and mobile service offering) that a telecom company can take advantage of. In particular, beyond the core can be referred to new service offerings, reorganization of the company's infrastructure, or new ventures. It signifies the company's strategic decision to venture into new areas or explore additional revenue streams outside its primary focus. During the interviews, different aspects concerning the beyond core theme were discussed: leveraging core assets, 5G and VAS potential applications, possible examples by other operators to follow, and the need for a change in the business organization.

Leveraging Core Assets

As previously mentioned before, operators could take on delayering operations to leverage core assets. A telecom company would be divided between a NetCo and a ServCo by delayering. As seen in Figure 27[169], NetCo would be in charge of the infrastructure part of the organization. Thus, they would manage the cell towers, fiber cables, core mobile infrastructure, and all the IT support-related activities. On the other hand, a ServCo would manage all the client-facing operations, such as stores, account management, and digital channels. Also, ServCo, as a traditional telecom company,

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[169] *See* "A blueprint for telecom's critical reinvention" by McKinsey.

would keep the B2B vs. B2C division, with the former focused on services and data application while the latter focused on over-the-top services and contact centers[170].

NetCos, enjoy several key advantages. Firstly, they have enhanced growth options. Secondly, they gain expanded access to more affordable capital; thirdly, they achieve more significant operational expenditure (OPEX) efficiency[171]. Growth options can be created by creating a diversified portfolio, an increased geographic footprint, and higher utilization of assets. Portfolio diversification can be created by leveraging the widespread deployment of 5G and fiber infrastructure. NetCos also have an expanded geographical footprint as they can go beyond national borders, aiming to achieve grander scale and market penetration. This expansion can be realized through various means, including exploring new site construction or acquiring existing assets. Also, NetCos can unlock the potential of its infrastructure by opening it up to different operators. This entails expanding their wholesale customer base, allowing other companies to utilize their towers or fiber networks. By optimizing the usage of its assets, NetCos can generate additional revenue and enhance its overall financial performance. The second main drive behind creating a NetCo is expanded access to cheaper capital, which refers to the financial advantage NetCo enjoys. Their income predominantly derives from long-term contracts, ensuring a predictable stream of free cash flows. This stable and reliable financial position and simplified operations enable the net cost to access capital at more favorable rates and terms. Lastly, greater OPEX efficiency is achieved through streamlined operations. Netcos typically maintain lean teams and employ simplified core business processes and IT architectures. NetCos benefit from enhanced growth options, expanded access to cheaper capital, and greater OPEX efficiency. These advantages enable them to pursue strategic diversification, expand their market reach, optimize asset utilization, access capital more affordably, and operate with lean and efficient processes.

On the other hand, the future strategy of ServCos is less defined than that of NetCos. To achieve growth in terms of revenue, ServCos will need to enhance its ability to monetize customer relationships. By establishing closer proximity to their customers and forming strategic partnerships with other service providers, ServCos has the potential to expand its revenue models beyond mere connectivity, particularly in the business-to-business (B2B) domain. The separation of network infrastructure could benefit ServCos, allowing them to streamline their operations, foster innovation, and secure the necessary funding to pursue new opportunities. In order to drive their top-line growth, ServCos must focus on deepening their engagement with customers and finding innovative ways to extract value from these relationships. ServCos can tailor their offerings and create differentiated

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[170] *See* 23.
[171] *See* 23.

services beyond basic connectivity by better understanding customer needs and preferences. This may involve developing value-added solutions, such as integrated business communication platforms, cloud services, or IoT solutions, that cater to the specific requirements of their B2B clients.

Additionally, forging strategic partnerships with other service providers can unlock new revenue streams for ServCos. By collaborating with complementary businesses, such as software providers, managed service providers, or digital content providers, ServCos can leverage its existing customer base and infrastructure to offer bundled solutions or value-added services. These partnerships can enhance the customer experience and enable ServCos to tap into adjacent markets and capture additional sources of revenue. Separating network infrastructure from ServCos' operations can bring advantages in simplifying their business structure. By focusing on their core competencies and relying on specialized network infrastructure providers (NetCos), ServCos can streamline their operations, reduce complexities, and allocate resources more efficiently. This streamlined approach enables ServCos to be more agile, innovative, and responsive to market demands, ultimately improving its competitiveness and revenue potential.

Furthermore, the separation of network infrastructure creates opportunities for ServCos to raise the necessary capital to explore new avenues for growth. With a simplified business structure and a clear focus on customer-centric services, ServCos can attract investors and secure funding for strategic initiatives, such as expanding into new markets, investing in advanced technologies, or acquiring innovative startups. This financial flexibility allows ServCos to stay ahead of market trends, drive innovation, and seize emerging opportunities in the ever-evolving telecommunications landscape. In summary, ServCos face the challenge of evolving their revenue models beyond connectivity. By strengthening customer relationships, fostering partnerships, simplifying their operations, and raising the required capital, ServCos can position itself to explore new opportunities, drive innovation, and thrive in the dynamic telecommunications industry.

In Italy, at the date of writing, delayering operations have only been done by WindTre and TIM. At the time of writing, EQT Infrastructure, a subsidiary of EQT, is set to acquire a majority stake (60%) in a newly established company that will take ownership and operate the mobile and fixed network of Italian telecom provider Wind Tre. This transaction values the new company at €3,4bn. The new company's primary focus will be to offer wholesale connectivity services to Wind Tre and other mobile operators in Italy. As a result, it will become the largest provider of mobile network coverage and capacity in the country, playing a crucial role in Italy's digital infrastructure. EQT Infrastructure plans to invest in the company's network and pursue innovative growth opportunities to enhance its services within the Italian digital ecosystem. Additionally, EQT

Infrastructure aims to uphold sustainability practices as part of its agenda[172]. Unlike Wind Tre, the latter is yet to complete a sale of the majority ownership for its NetCo[173].

Figure 27: NetCo vs. ServCo
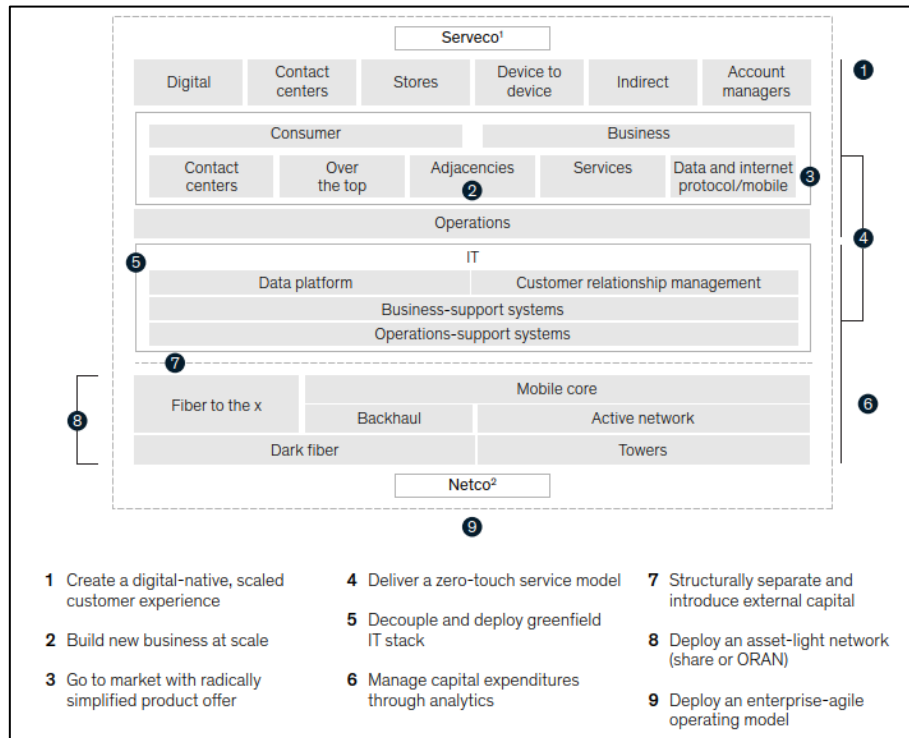
Still, in the end, as Mr. Salera said, the key is to "find creative ways to realize the physical assets you have and then think as a go-to-market for something."

5G Potential Applications

During the interviews, a topic discussed was the impact on the beyond-concept core by 5G and VAS. In addition, many use cases were identified as potential successful applications of the two. As outlined in previous chapters, there are various use cases for 5G applications, but as a respondent explained "In the industry, there is so much expectation on 5G, but these expectations are mostly on B2B applications rather than B2C applications". Similarly, Ms. Pipola said, "The biggest opportunity

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[172] *See* "EQT Infrastructure to acquire a majority stake in Italy's largest mobile network from Wind Tre" Press Release by EQT. EQT is a global investment organization that specializes in infrastructure, private equity, and real estate investments. It was founded in 1994 and is headquartered in Stockholm, Sweden. EQT operates through multiple investment strategies, including EQT Infrastructure, EQT Private Equity, and EQT Real Estate. EQT Infrastructure focuses on investing in and developing infrastructure businesses, such as energy, transport, and telecommunications. EQT Private Equity focuses on acquiring and developing companies across various industries, while EQT Real Estate focuses on real estate investments and development projects. EQT has a broad portfolio of companies and assets across Europe, the Americas, and Asia. The organization aims to create sustainable value by partnering with companies and driving growth and operational improvements.

[173] *See* "KKR offers to buy stake in Telecom Italia's fixed-line business" by Silvia Sciorilli Borelli and James Fontanella-Khan for the Financial Times.

I see is more related to B2B [referring to 5G applications]". They mean that although 5G brings important innovation to the B2C client, the latter will not be greatly impacted as much as a B2B client. Because the typical B2C client usually uses the internet for surfing the net, watching a video, or scrolling on their social media field. So, 5G will surely enhance these activities by bringing faster network connection and more reliable download speeds, thus resulting in a better and more seamless customer experience. However, the B2C customer will not experience the full spectrum of 5G capabilities.

Moreover, 5G is expensive (both to develop and keep it). Adding to the fact that margins on B2C applications are really low and an ARPU that keeps decreasing, it is crucial that operators look at B2B applications in order to generate meaningful revenues from their investments. So, there are more opportunities for 5G on B2B applications than B2C, both from a use case perspective and a financial perspective.

In terms of 5G B2B opportunities, there are many. From the interviews, these are the most important ones that were identified:

- *Industry 4.0:* Industry 4.0, also known as the Fourth Industrial Revolution, refers to integrating advanced digital technologies into manufacturing and industrial processes. It encompasses automation, artificial intelligence, big data analytics, cloud computing, and the Internet of Things (IoT). Industry 4.0 aims to create smart factories and transform traditional manufacturing operations by optimizing efficiency, increasing productivity, and enabling greater customization. 5G technology is crucial in supporting the implementation of Industry 4.0 initiatives. Its high speed, low latency, and massive connectivity capabilities provide a reliable and robust infrastructure that enables real-time data exchange and communication between machines, devices, and systems. Here are some real examples of how telecom companies are leveraging 5G to enhance Industry 4.0:

  o Ericsson and Audi[174]: Ericsson partnered with Audi to deploy a 5G network in one of Audi's production plants. The ultra-low latency and high reliability of 5G enabled wireless connectivity for automated guided vehicles (AGVs) and real-time monitoring of production processes. This implementation increased efficiency, reduced downtime, and improved flexibility in the production line.

  o Deutsche Telekom and OSRAM[175]: Deutsche Telekom, the leading telecom operator, collaborated with OSRAM, a leading lighting manufacturer, to develop a smart factory solution using 5G. They implemented 5G networks to connect various devices and

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[174] *See* "5G in production: Audi and Ericsson take the next step together" Press Release by Audi.
[175] *See* "5G technology in industrial campus networks" Press Release by Deutsche Telekom.

machines in the factory, enabling real-time data collection, analysis, and optimization. This allowed for predictive maintenance, improved energy efficiency, and enhanced production quality, ultimately leading to cost savings and productivity gains.

- o Verizon and Corning[176]: Verizon collaborated with Corning, a leading materials science company, to explore the potential of 5G in smart manufacturing. By leveraging 5G's high bandwidth and low latency, the companies demonstrated how real-time video monitoring, augmented reality (AR), and IoT sensors can improve quality control and optimize manufacturing processes in real time.

- *Smart Cities:* Smart Cities are urban environments that utilize advanced technologies and data-driven solutions to improve the quality of life for residents, enhance sustainability, and optimize the use of resources. These cities leverage interconnected systems, IoT devices, data analytics, and automation to efficiently manage various aspects such as transportation, energy, infrastructure, public safety, and environmental sustainability. 5G plays a crucial role in enabling and enhancing the concept of smart cities. Here is a real example of how telecom companies have leveraged 5G to have a positive impact on smart cities:

- o TIM and Turin[177]: TIM partnered with the city of Turin, Italy, to transform it into a 5G-enabled smart city. The collaboration involved deploying 5G infrastructure and implementing various smart city applications. For instance, TIM and the municipality of Turin introduced 5G-powered solutions like smart mobility, digital healthcare, and augmented reality experiences. These applications leverage the high-speed and low-latency capabilities of 5G to enable efficient transportation management, remote healthcare services, and immersive digital experiences for residents and visitors.

- *Edge Computing:* Already mentioned in previous chapters, Edge computing refers to a distributed computing model where data processing and storage occur closer to the source of data generation rather than relying on a centralized cloud infrastructure. This approach reduces latency and enables faster processing, making it ideal for applications that require real-time data analysis and quick response times. With edge computing, data is processed locally at the network edge, close to end-user devices or IoT devices. Regarding the positive impact of 5G on edge computing, the high-speed and low-latency capabilities of 5G networks are instrumental. Here are a few examples of how real telecom companies are leveraging 5G to enhance edge computing:

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[176] *See* "Verizon and Corning co-innovating with 5G to create factory of the future" Press Release by Verizon.
[177] *See* 92.

- o Verizon and Multi-Access Edge Computing (MEC)[178]: Verizon has been actively exploring the integration of 5G with Multi-Access Edge Computing (MEC). By deploying MEC servers at the edge of their 5G network, Verizon aims to deliver ultra-low latency and high-bandwidth services. This combination enables various edge computing applications, such as autonomous vehicles, augmented reality (AR)/virtual reality (VR) experiences, and real-time analytics for smart cities.

- o Telefónica and Edge Computing[179]: Telefónica has been exploring the potential of 5G and edge computing in several areas. They have deployed edge computing infrastructure in their network to support applications like augmented reality, real-time video analytics, and industrial automation. Telefónica aims to leverage the capabilities of 5G and edge computing to provide enhanced services to their customers across various industries.

- *Smart Home:* A smart home refers to a residence equipped with interconnected devices and systems designed to enhance convenience, efficiency, security, and comfort for its occupants. These devices and systems can be controlled and automated remotely, allowing homeowners to manage various aspects of their homes through a central hub or mobile application. The deployment of 5G networks can significantly impact smart homes by providing faster, more reliable, and low-latency connectivity. Here are some real examples of how telecom companies are leveraging 5G to enhance the smart home experience:

  - o Verizon's 5G Home[180]: Verizon offers 5G Home, a broadband internet service that utilizes 5G technology to deliver ultra-fast speeds and low latency to homes. With 5G Home, homeowners can seamlessly connect and control their smart devices, stream high-definition content, and experience enhanced gaming and virtual reality applications.

  - o AT&T Digital Life[181]: AT&T provides a smart home automation service called Digital Life, which integrates security, energy management, and home automation features. With the introduction of 5G, AT&T aims to enhance the capabilities of Digital Life by enabling faster and more reliable communication between smart devices, resulting in improved security monitoring, energy efficiency, and overall automation experience.

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[178] *See* 5G Edge with Public MEC Website by Verizon. Available at: https://www.verizon.com/business/solutions/5g/edge-computing/public-mec/
[179] *See* Edge Computing Website by Telefonicà. Available at: https://telefonicatech.com/en/insights/edgecomputing
[180] *See* "Verizon expands 5G Home broadband and mobility offerings to more customers" Press Release by Verizon.
[181] *See* "AT&T Digital Life®, Home Security and Automation Service to Launch in Five More Markets" Press Release by AT&T.

- *Autonomous Driving:* Autonomous driving refers to the ability of vehicles to operate and navigate without human intervention. It involves using advanced technologies such as sensors, cameras, artificial intelligence, and connectivity to enable vehicles to perceive their surroundings, make decisions, and control their movements. 5G technology enables and enhances autonomous driving by providing high-speed, low-latency, and reliable communication between vehicles, infrastructure, and the Cloud. The positive impact of 5G on autonomous driving is evident in several aspects: (1) 5G networks provide faster data transfer rates and lower latency, enabling near real-time communication between vehicles and infrastructure. This fast and reliable communication is crucial for autonomous vehicles to receive and process critical information, make quick decisions, and respond to changing road conditions; (2) With 5G connectivity, autonomous vehicles can exchange real-time data about their position, speed, and intentions, allowing them to navigate and interact with other vehicles and pedestrians more effectively. This enables safer driving practices, reduces traffic congestion, and enhances overall road efficiency; (3) 5G enables the deployment of advanced features and services in autonomous vehicles, such as high-definition mapping, over-the-air software updates, and cloud-based analytics. These capabilities allow vehicles to improve performance continuously, adapt to changing environments, and provide a seamless and personalized driving experience. Here are some real examples of how telecom companies are leveraging 5G to enable autonomous driving:
  - Ericsson and Volvo[182]: Ericsson and Volvo collaborated on a project called "Connected Vehicle Cloud" that aimed to leverage 5G connectivity to enable advanced vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. By utilizing 5G networks, vehicles can exchange real-time information, such as traffic conditions, road hazards, and signals, allowing them to make informed decisions and enhance safety.
  - AT&T and Ford[183]: AT&T, a leading telecom company, has partnered with Ford to explore the potential of 5G in enhancing autonomous driving capabilities. The collaboration aims to leverage AT&T's 5G network to enable vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, allowing autonomous vehicles to communicate with each other and the surrounding environment.

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[182] *See* "Volvo Cars and Ericsson achieve first cross-border 5G network vehicular handover" Press Release by Ericsson.
[183] *See* "AT&T brings 5G to Ford EV manufacturing facility" Press Release by AT&T.

o Qualcomm and Ford[184]: Qualcomm collaborated with Ford on the C-V2X (Cellular Vehicle-to-Everything) technology, which utilizes 5G networks to enable direct communication between vehicles, infrastructure, and other road users. This technology allows vehicles to exchange real-time information, such as traffic conditions, road hazards, and emergency warnings, enhancing overall road safety and enabling advanced autonomous driving features.

- *Smart Healthcare:* Smart healthcare is the application of advanced technologies, data analytics, and connected devices to revolutionize the healthcare industry. It aims to improve patient care, enhance operational efficiency, and enable remote healthcare services. Smart healthcare leverages real-time data monitoring, artificial intelligence, telemedicine, and IoT devices to provide personalized, efficient, and accessible healthcare solutions. 5G technology enables and enhances smart healthcare by providing high-speed, low-latency, and reliable connectivity. Here is how 5G can have a positive impact on smart healthcare:

    o Telemedicine and Remote Patient Monitoring: 5G enables seamless, high-quality video consultations between patients and healthcare providers. Doctors can remotely diagnose and monitor patients in real-time, regardless of their location, with low latency and high bandwidth. Real-time data transmissions, such as vital signs, medical images, and patient records, become more efficient with 5G, ensuring accurate and timely healthcare delivery.

        ▪ Example: Verizon collaborated with Medivis[185], a medical augmented reality (AR) company, to develop 5G-powered AR surgical visualization. Surgeons can use AR headsets to overlay patient data and medical images during operations, improving accuracy and efficiency. This technology reduces the need for physical presence, enhances surgical outcomes, and expands access to specialized care.

    o Connected Healthcare Devices and Wearables: 5G enables seamless connectivity among healthcare devices and wearables, facilitating real-time data collection and analysis. These devices can monitor vital signs, track medication adherence, and detect anomalies, providing continuous healthcare monitoring and proactive intervention. The high capacity and low latency of 5G support the large-scale deployment of connected healthcare devices.

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[184] *See* "Qualcomm and Ford Collaborate on C-V2X Global Initiative to Improve Vehicle Safety, Traffic Efficiency and Support for Autonomous Driving" Press Release by Qualcomm.
[185] *See* "Saving lives with mixed reality" Press Release by Verizon.

- Example: AT&T collaborated with OneLife Technologies to develop a wearable device called the OnePulse smartwatch[186]. This device uses 5G connectivity to monitor vital signs such as heart rate, blood pressure, and oxygen levels. The data collected is securely transmitted to healthcare providers, enabling remote monitoring and early detection of health issues.

  o Remote Surgery: With the low latency and high-speed connectivity of 5G, surgeons can perform remote surgeries in real time. The ability to transmit high-resolution video and data in real time enables surgeons to operate on patients in remote areas without needing their physical presence. This can greatly improve access to specialized medical expertise, especially in underserved regions. Telecom companies actively support the development of remote surgery capabilities using 5G.

    - Example: In Italy, Vodafone partnered with San Raffaele Hospital in Milan to demonstrate the potential of remote surgery using 5G technology[187]. The remote surgery project involved a surgeon remotely controlling a robotic surgical system to perform delicate eye surgery on a patient over 10 kilometers away. The high-speed and low-latency capabilities of 5G enabled real-time communication between the surgeon and the robotic system, ensuring precise and timely actions.

  o Enhanced Emergency Services: 5G enables faster and more reliable communication for emergency medical services. Paramedics and emergency responders can transmit real-time patient data to hospitals, including medical records, diagnostic images, and video streams. This facilitates rapid and informed decision-making, reducing response times and improving patient outcomes[188].

- Network Slicing: As mentioned in previous chapters, network slicing is a key feature of 5G technology that allows the creation of multiple virtual networks on a shared physical infrastructure. It enables the customization and optimization of network resources to meet the specific requirements of different services and applications. Each network slice operates as an independent virtual network with its own dedicated set of resources, network architecture, and performance characteristics. With network slicing, a single physical 5G network can be divided into multiple logical networks that cater to various use cases, such as enhanced mobile broadband, massive machine-type communications, and ultra-reliable low-latency

[186] *See* "AT&T's new smartwatch will drive transformation in healthcare" by Rayna Hollander for Insider.
[187] *See* "Vodafone, 5G e realtà aumentata al servizio del San Raffaele" by Ansa.
[188] *See* "5G Network-enabled Smart Ambulance: Architecture, Application, and Evaluation" by Yunkai Zhai, Xing Xu, Baozhan Chen, Huimin Lu, Yichuan Wang, Shuyang Li, Xiaobing Shi, Wenchao Wang, Lanlan Shang, and Jie Zhao.

communications. It enables service providers to allocate resources based on the unique needs of each slice, ensuring optimal performance and quality of service. Here are some real examples of how telecom companies are leveraging 5G to enable network slicing:

- o Vodafone: Vodafone has implemented network slicing to deliver dedicated slices for different use cases[189]. The company, also, developed the first-ever UK 5G network slice[190]. For instance, they provide enhanced mobile broadband slices for high-speed internet connectivity and low-latency slices for applications like autonomous vehicles. They also offer dedicated slices for enterprise customers tailored to their needs, such as guaranteed bandwidth and low latency for critical business operations.
- o Deutsche Telekom: Deutsche Telekom is really optimistic about network slicing[191]. The company, together with Ericsson, the world's first 5G network slicing capability[192].

The use cases outlined above are in par with the information detailed in Chapter II of this research.

Value Added Services (VAS) Opportunities for Telcos

On the other hand, as mentioned before, in terms of B2C opportunities, there are fewer than 5G's. In particular, B2C opportunities are mostly related to Value Added Services The important thing, as Mr. Salera said. "My real asset is not the network but the customer." Hence, companies must always have the customer at the center of their business proposition. For example, operators can upsell customers by adding services to their fixed and mobile offerings. Such as WindTre, which offers Netflix bundled with its fixed internet offering[193], or Fastweb, which partnered with Quixa[194], began offering household and pet insurance paired with its internet offering. Both examples use a co-ownership kind of business model, meaning that each part is responsible for its field of expertise (Fastweb for the fixed network and Quixa for the insurance part), but the data generated by the customer is shared and can be used by each company for upselling opportunities. The main categories of VAS for an operator to invest in are IoT, financial services, gaming, and the metaverse. But, also, as Mr. Demarinis points out, there are other opportunities, in particular related to:

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[189] *See* "Next-generation mobile connectivity" Research by Vodafone.
[190] *See* "Vodafone and Ericsson create first-ever UK 5G network slice" by Steve McCaskill.
[191] *See* "Network Slicing – the key to 5G" Press Release by Deutsch Telekom.
[192] *See* "Deutsche Telekom and Ericsson successfully demonstrate 5G network slicing with on-demand quality of service control for enterprise use cases" Press Release by Deutsch Telekom.
[193] *See* "Super Fibra e Netflix" (https://www.windtre.it/offerte-fibra/super-fibra-netflix/)
[194] *See* "QUIXA Assicurazioni partner di Fastweb con servizi innovativi di assistenza per semplificare la quotidianità di privati, partite IVA e piccole aziende" Press Release by Fastweb.

- Entertainment: In Italy, the most famous example of a telecom entering the entertainment world is TIMvision[195]. As mentioned before, TIMvision is an Italian streaming platform offered by TIM, which provides a wide range of on-demand video content, including movies, TV series, documentaries, and live sports, accessible through various devices such as smartphones, tablets, smart TVs, and set-top boxes.

- Utilities: WindTre and ACEA (a leading Italian utility provider) recently launched WindTre Luce e Gas[196]. WindTre Luce e Gas is a fixed internet offer bundled with the Gas and Electricity plans ACEA offers. The need for such a partnership was born out of WindTre's search for a partner to increase its offering for the customer base (and diversify from its competitors) and ACEA's need to expand its footprint in the country. So WindTre was able to provide its footprint and customer base as ACEA would provide the necessary utility services.

So, in the end, there are great opportunities, both B2C and B2B, but telecom operators must find "their corner" to leverage their assets and diversify from their operators correctly. Otherwise, there might be the risk that 5G will not be taken advantage of enough, making it one of those technologies that will eventually become forgotten. This fear is expressed by Mr. Demarinis when he says, "I have a fear, or a feeling, that it might be one of those technologies, you know, sometimes we have made technology leaps where some technology areas have been important and remembered. But with others, although equally important, we have just gone through them without remembering".

Changing Business Organization to leverage core assets and create new revenue streams

The last and most important topic concerning the beyond core macro theme is the need for a change in how a telecom business is organized to take advantage of new opportunities that can help fight the overall difficult situation the sector is facing. But what does it mean to change the organization of the business? During the interviews, three different ways of thinking were identified:

1. Delayering: As already mentioned previously, delayering refers to the separation of a telecom company into two different new entries, a NetCo (dedicated to all the network infrastructure) and a ServCo (dedicated to all the client-facing operations, focused on service offerings. The ServCo relies on the NetCo for the network infrastructure). This particular type of organization benefits from financial and operational benefits. From a financial standpoint, it unlocks new opportunities for investors to come in and bring cash, and from an operation standpoint, it makes everything lean and agile. Interviewees explain it: "Some operators have started to

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[195] *See* 154 and 155.
[196] *See* Wind Luce e Gas (https://www.windtre.it/offerte-windtre-luce-gas/).

separate the network from the services, and there are two CEOs, two different companies, two completely different entities. What is happening? They are simply shifting costs from revenues and differentiating them". The operator must also change its role by enabling this new organizational structure. On one part, the NetCo becomes a system integrator that provides the infrastructure and the IT Support required for the services to run smoothly. On the other side, the ServCo becomes a managed services type of business that handles all the client-facing operations and offerings while relying on the infrastructure of the NetCo. But, to successfully switch into these new roles, the operators must quickly adapt as "[the operator] is not used to being lean like a system integrator can be, and you imagine how hard such shift can be for a company." To sum up, delayering is a great opportunity for telcos, but the operator must reinvent some of its operations to be done successfully. Because, in the end, the challenge to implementing a delayering strategy is not financial. The two separate businesses are attractive financial opportunities. The problem is the implementation of the two businesses.

2. Consolidation: Another topic of discussion is convergence. Consolidation is not new; the telecom business has been known to have been keen toward consolidation as such an operation provides financial incentives for the ones doing it. The latest big convergence operation in Italy was the merger of Wind and 3 in 2016. The merger resulted in the creation of WindTre, establishing the company as the third-biggest operator in Italy. But also, the WindTre merger led to the imposed entrance of Iliad into the market. And as outlined in previous chapters, this forced entrance negatively impacts the industry. Outside of Italy, important convergence operations are the acquisition of Sprint Mobile by T-Mobile in 2020[197] and EE by BT Group in 2015[198]. The acquisition of Sprint by T-Mobile was a major consolidation in the US telecommunications industry. T-Mobile, one of the leading wireless carriers in the country, acquired Sprint, the fourth-largest carrier, in April 2020. The deal aimed to create a stronger competitor to rivals AT&T and Verizon. The acquisition was expected to lead to improved network capabilities, expanded coverage, and enhanced competition in the US wireless market. It also positioned T-Mobile as a leader in deploying 5G technology, enabling it to offer advanced services and drive innovation in the telecommunications industry. The acquisition value was reported to be more than $59b[199]. Moreover, the acquisition of EE (formerly Everything Everywhere) by BT Group was a significant transaction in the telecommunications industry in the United Kingdom. BT Group, a leading provider of telecommunications

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[197] *See* "US judge clears T-Mobile's $59bn Sprint takeover without conditions" by Kadhim Shubber and Ortenca Aliaj for the Financial Times
[198] See "BT seals £12.5bn deal to buy EE" by Daniel Thomas and Arash Massourdi for the Financial Times
[199] *See* 197.

services, acquired EE, the largest mobile network operator in the UK, in January 2016. The acquisition aimed to combine BT's fixed-line services expertise with EE's mobile communications strength. By bringing together their respective capabilities, the acquisition aimed to create a converged telecommunications company capable of offering customers integrated mobile, broadband, and TV services. The acquisition of EE by BT Group was seen as a strategic move to strengthen BT's market position and expand its offering to customers. It allowed the company to provide bundled services, attract new customers, and compete more effectively in the rapidly evolving telecommunications market. Additionally, integrating EE's mobile network infrastructure provided BT with a solid foundation for developing and deploying advanced technologies such as 5G. The reported value for the transaction was £12.5bn[200].

To recap, although a great opportunity for operators to consolidate, take advantage of synergies, and strengthen their assets, there is always the threat of the regulator that steps in and makes it a less attractive opportunity in the end. In 2015, the GSMA outlined these different factors that should be considered when assessing the case of an in-country merger of two European telecom operators (such factors can also be applied more broadly ad a worldwide level)[201]:

a. Focus on investments: With regard to investment, the current approach of the European Commission in evaluating mergers primarily focuses on short-term price increases. Subsequently, the analysis considers potential efficiency gains and long-term investment to offset predicted price increases. However, data indicates that investments in mobile markets have a more substantial impact on outputs and prices in the mobile industry compared to other sectors. These dynamic efficiencies resulting from investments are not typically accounted for in standard analyses like GUPPIs (Gross Upward Pricing Pressure Indexes). This distinction arises because major technological advancements occur approximately every 7-8 years in mobile, unlike the longer intervals seen in many other industries. Considering the substantial potential benefits for consumers, such as lower prices resulting from increased investment in the mobile industry, it is vital to meticulously evaluate the impact of a merger on the affected parties' incentives and capacity to invest. A more comprehensive and holistic examination of the merger's impact on market performance over an extended period is necessary to achieve this. By adopting this approach, regulators can adequately

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[200] *See* 198.
[201] *See* "Assessing the case for in-country mobile consolidation" by GSMA.

assess a merger's long-term implications and potential benefits, aligning with the dynamics and investment requirements specific to the mobile industry.

b. GUPPIs: GSMA's research highlights the need for further development in how competition authorities calculate and utilize predicted price increases. While these predictions serve as a useful starting point, they require refinement to capture the intricacies of competition in mobile markets effectively. Reliance solely on these tools cannot reliably predict the impact of mobile mergers on prices. The research did not find any evidence to support the fundamental prediction of the current GUPPI framework used by competition authorities, which suggests that unit prices in 3-player mobile markets are consistently higher than those in 4-player markets. This observation challenges the effectiveness of competition authorities' existing tools and inputs. While this does not imply that mergers will never result in higher prices, it does indicate that the current approaches used by competition authorities do not adequately account for the factors influencing mobile market performance. Therefore, there is a need to reconsider and enhance the methodologies and factors considered in calculating GUPPIs to provide more accurate assessments of the impact of mobile mergers on prices. This will allow competition authorities better to understand the dynamics and drivers of mobile markets and make more informed decisions regarding mergers in the industry.

c. Enhanced consideration of remedies: Remedies are designed to address the anticipated competition issues that may arise from a merger. However, the remedies prescribed may prove unsuitable if these problems are not accurately identified from the outset, such as when relying on GUPPIs in mobile mergers. Moreover, certain remedies may hinder the realization of the very benefits that could arise from the merger. In the context of mobile mergers, remedies that reduce the merging parties' incentives or ability to increase investment can negatively impact consumers in the relevant market and potentially discourage beneficial mergers in other countries. Therefore, it is crucial to carefully assess the potential implications of remedies to ensure they align with the objectives of promoting competition and maximizing consumer welfare. An example of remedies is the forced entrance of a fourth operator following the merger of Wind and 3.

3. Vertical Integration vs. Partnerships: The last topic in regard to changing the business organization of telecom was the debate between vertical integration and partnerships when it comes to offering added solutions that go beyond the core business of telecom. The debate

revolves around the quest to monetize the end solution a telecom network enables. To monetize new solution the telecom company can either integrate or partner with a company which offers this end solution.
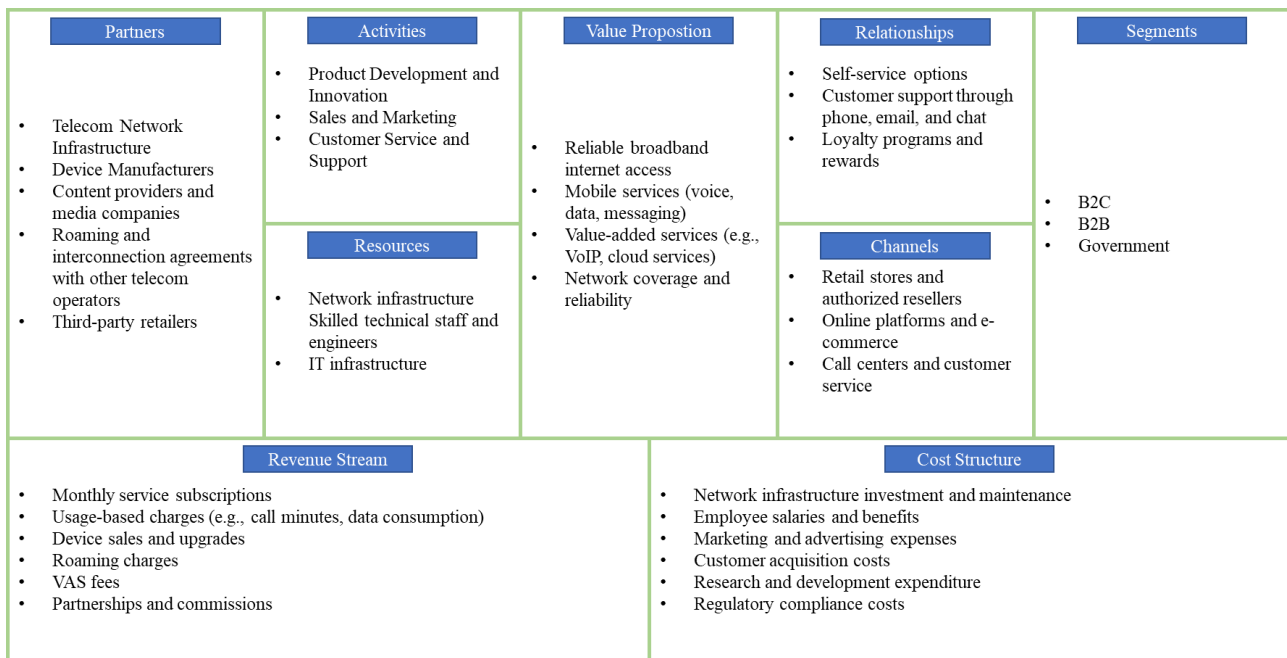
Results

The Traditional Telecom Business Model

In the telecom industry there are different kinds of business model based on the structure of the player in question. In particular, the two main types of business models are:

- Retail
- Wholesale

The retail business model

The retail business model revolves around providing mobile and fixed network services to both B2C and B2B customers. The value proposition for a retail telecom company is to provide reliable broadband internet access to its customers (in other words, provide fixed and mobile internet offerings), and value-added services opportunities in addition to their core business segments. To do so, the retail telecom company has many partners, with the main ones being device manufacturers, telecom network infrastructure providers (if they aren't already), and third-party retailers (which couples with a typically large footprint of a retail operator, help sell the company's telecom offering). The retail telecom principal activities revolve around offering connectivity services to its customers, device sales, and the customer support necessary to assist customer in case of technical problems or other kind of needs. By offering a wide range of telecom products, reliable network infrastructure, and value-added services, the company aims to meet customer needs, stand out from competitors, and create satisfaction. Building customer relationships is achieved through personalized support, loyalty programs, and rewards, fostering engagement and retention. To deliver its offerings, the company relies on key resources such as telecom network infrastructure, IT infrastructure, and a skilled workforce. And, from a financial perspective, operational costs mainly encompass network maintenance, customer support, marketing, and advertising. On the contrary, the main revenue streams are derived from subscription fees, device sales, value-added service fees, and partnerships. Figure 28 shows what the business model canvas of a typical retail-focused telecom company looks like.

Figure 28: Business Model of a Retail Telecom Company

Partners	Activities	Value Propostion	Relationships	Segments
• Telecom Network Infrastructure • Device Manufacturers • Content providers and media companies • Roaming and interconnection agreements with other telecom operators • Third-party retailers	• Product Development and Innovation • Sales and Marketing • Customer Service and Support **Resources** • Network infrastructure Skilled technical staff and engineers • IT infrastructure	• Reliable broadband internet access • Mobile services (voice, data, messaging) • Value-added services (e.g., VoIP, cloud services) • Network coverage and reliability	• Self-service options • Customer support through phone, email, and chat • Loyalty programs and rewards **Channels** • Retail stores and authorized resellers • Online platforms and e-commerce • Call centers and customer service	• B2C • B2B • Government

| Revenue Stream	Cost Structure
• Monthly service subscriptions • Usage-based charges (e.g., call minutes, data consumption) • Device sales and upgrades • Roaming charges • VAS fees • Partnerships and commissions	• Network infrastructure investment and maintenance • Employee salaries and benefits • Marketing and advertising expenses • Customer acquisition costs • Research and development expenditure • Regulatory compliance costs

In Italy, the main examples of retail focused telecom operators are TIM, Vodafone, WindTre, Fastweb and Iliad.

The wholesale-only business model

The wholesale-only business model focuses on providing telecom services and infrastructure to other companies, rather than directly to end customers. As a result, the business model is characterized by scalable network infrastructures, top-notch customer support highly customizable solution as the value propositions. These value propositions aim to meet the needs of retail telecom companies, differentiate the wholesaler from competitors, and foster strong partnerships. The business model is also characterized by a high dependence on partnerships, often with telecom network infrastructure providers, device manufacturers, and retail telecom companies. The partnerships ensure access to reliable network infrastructure, a diverse range of devices, and distribution channels. To enable the value proposition, wholesale only telecom companies are characterized by activities such as nurturing partner relationships, maintaining network infrastructure, and managing wholesale sales and distribution. The customer segments of a wholesale-only telecom company primarily consist of retail telecom companies (or as we have seen in some cases, any company which has a large customer base and wats to take advantage of it by adding connectivity as one of its services offerings). Customer relationships are built through effective partner relationship management, which involves dedicated account managers and support. Interaction channels include

personalized customer support, an online B2B platform for streamlined wholesale transactions, sales representatives, and participation in industry events and conferences. The cost structure involves expenses related to network maintenance and upgrades, customer support, as well as marketing and advertising efforts. Revenue streams are derived from wholesale service fees, device sales to retail partners, licensing and partnership fees, and customization and integration fees. Figure 29 shows what the business model canvas of a typical wholesale only telecom company looks like.

Figure 29: Business Model of a Wholesale-only Telecom Company
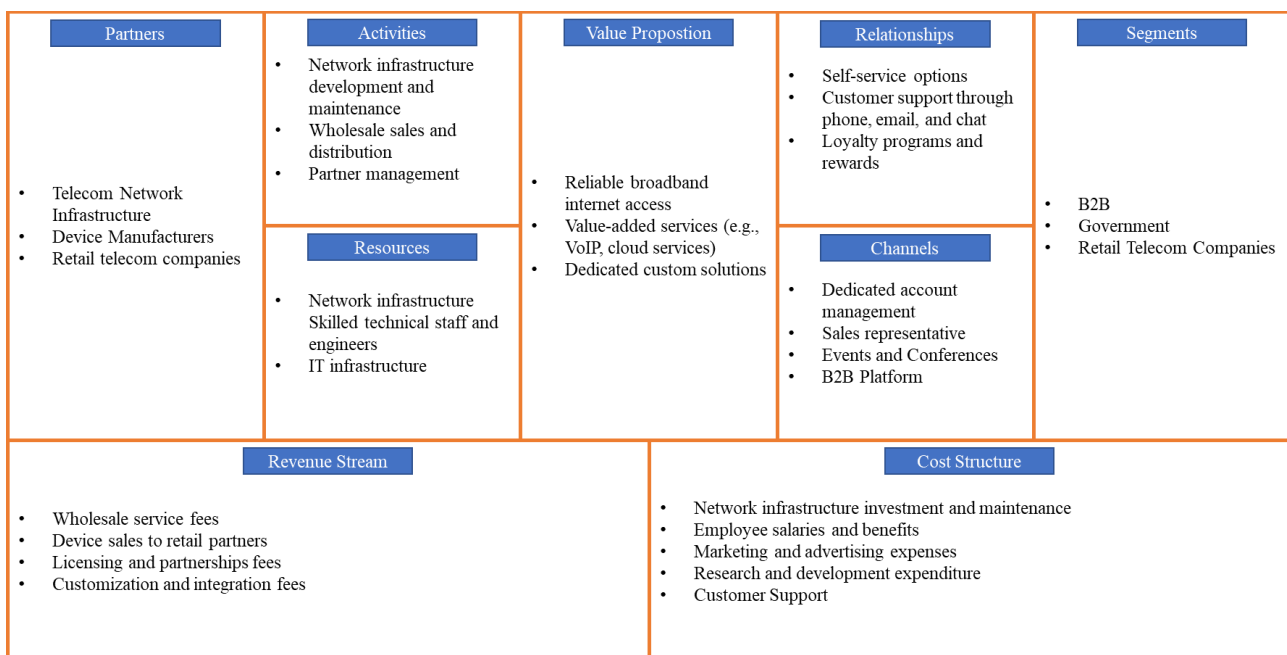
In Italy, the main examples of retail focused telecom operators are Open Fiber and Retelit.

The problem of the Value Chain

By interpreting the data from the interviews, the main problem for telecom operator is that of capturing value. Telecom operators have huge customer base and relatively strong infrastructure, but they find it difficult to monetize on these assets. As an example, between 2010 and 2020, the digital industry witnessed significant growth, with its global revenue increasing from around $2.9tn to over $6.3tn[202]. However, the revenue generated from global connectivity only accounted for a small portion of this growth, capturing less than 2%[203]. In contrast, digital services such as e-commerce and online advertising experienced remarkable growth, expanding five-fold and contributing to nearly 80% of the overall ecosystem growth[204]. The remaining value was predominantly captured by mobile

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[202] *See* "Transforming the telecom value chain – a platform business model" by Kearney.
[203] *See* 202.
[204] *See* 202.

phones and cloud infrastructure players, who benefited from the exponential rise in cloud adoption and the prevalence of hyper-scaled platform business models. Although telecom operators are responsible for providing the connectivity which enable all the different kind of services, they are unable to gain significant gain from it. Thus, the problem relies on the value chain. Figure 30 shows[205] a simplified value chain for a telecom company.

Figure 30: The Telecom Value Chain (simplified)

The hardware providers are companies such as Apple, Samsung, LG, Microsoft, and so on. These companies are responsible for designing and manufacturing devices such as smartphones, laptops, tablets, and so on. They produce the hardware required to access all the different kind of digital solutions. Then, there are the connectivity provider, which are responsible for the infrastructure and the connectivity needed to enable digital services. Lastly, there are the different applications enabler. The applications enablers are companies such as the FANG, who offer digital services on digital devices thanks to the connectivity provided by telecom operators. There are also some successful cases of companies producing hardware and then also selling services on top of the devices (i..e, Apple with its services offerings on top of the iPhone sales), but it is unlikely to find a telecom company who has an integrated value chain.

And that's where the other debate starts. Currently, if we take a look at the most successful companies in the world, we are talking about companies who have a almost fully (if not fully) integrated value chain. For example, Tesla, the world's leader in electric vehicle manufacturing, can find the reason for its success behind an almost fully integrate value chain. From lithium extraction to vehicle delivery[206]. Another good example is Amazon, whose shipping operations are becoming more and more integrated rather than relying on third parties such as FedEx. Amazon, now, even has its own airline (PrimeAir)[207]. Digital companies are even more integrated as they can easily develop

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[205] *See* "The Internet Value Chain 2022" by GSMA. The graphic is a representation of the information found in the report.
[206] *See* "2022 Impact Report" by Tesla.
[207] *See* "Amazon now running 164 flights a day to deliver stock in US" by Dave Lee for the Financial Times.

in-house tools and infrastructure to offer their digital services. To be more concrete, integration of the value chain has advantages, such as:

- *cost efficiency* - integration allows for better cost control and efficiency throughout the value chain; by owning and managing each stage, companies can eliminate costs associated with outsourcing or relying on external suppliers
- *quality control* - with integration, companies have greater control over the quality of their products or services; they can ensure consistent standards across all stages of the value chain, resulting in improved customer satisfaction and brand reputation)
- *faster solution deployment* – integration enables faster decision-making and responsiveness to market changes; companies can streamline communication and coordination between different stages, leading to quicker innovation, product development, and adaptation to customer needs
- *competitive advantages* - a fully integrated value chain can provide a competitive edge by creating barriers to entry; companies that control the entire process from production to distribution can differentiate themselves through unique offerings, enhanced customer experiences, or cost leadership

On the contrary there are some risks to having a fully integrated value chain, such as:

- *becoming too capital intensive* - developing and maintaining an integrated value chain requires significant financial investment; companies need to allocate resources for acquiring or developing infrastructure, technology, and human capital across multiple stages, which may strain financial resources
- *increasing operational complexity* - integration allows for better cost control and efficiency throughout the value chain; by owning and managing each stage, companies can eliminate costs associated with outsourcing or relying on external suppliers

In the end, as Demarinis outlines "who provides the vertical solution to do gaming or to do telemedicine or to do Industry 4.0; there are so many different players that provide such solution, but it is not the operator; therefore, either the operator specializes and also becomes the provider of the platform, or he remains only the provider for connectivity", the operator must learn to become the provider of the platform, or in other words, leverage its connectivity asset to monetize on the end solutions.

<u>The need to become an ecosystem enabler</u>

The answer to the problem of the value chain, and to the different challenges found during the interviews, rely on the need for a telecom company to become ecosystem enablers. As Mr. Salera said, the real answer is an ecosystem-based business model "Ecosystem model based on not buying the others but collaborating with them. Because to acquire another business, there will never be the money to buy it and then complete a merger. They have to find the right equation, but sometimes you buy and team up". In fact, what companies should be asking is: Should I buy another business to integrate in a certain industry and offer an additional end solution (in the form of a VAS) to my client? Or should I, instead, partner with this company? When aiming to become an ecosystem enabler, companies have the option of either acquiring another company in the ecosystem or forming a partnership with it. Acquiring a company offers advantages such as increased control, access to expertise, an expanded customer base, and synergies. It allows for seamless integration, specialized knowledge transfer, and immediate access to a wider audience. However, acquiring a company also comes with disadvantages, including high acquisition costs, integration challenges, potential competitive backlash, and diverted focus from core activities. On the other hand, forming a partnership with another company in the ecosystem provides benefits such as complementary capabilities, reduced financial risk, faster time-to-market, and flexibility. Partnerships enable companies to leverage each other's strengths, share resources, and expedite product launches. However, partnerships also have their drawbacks. These include limited control, potential misalignment in goals or processes, the risk of dependency on a partner, and concerns regarding intellectual property protection. The decision between acquiring a company or forming a partnership depends on factors such as strategic objectives, financial considerations, cultural fit, and the specific dynamics of the ecosystem. Careful evaluation of these factors is crucial to determine the most suitable approach for companies aspiring to become ecosystem enablers. For example, if a telecom operator wants to offer insurance as a VAS, would it make sense to buy an insurance company or to partner with it? Or, if a telecom operator wants to leverage its customer base and sell VAS such as utilities, would it make sense to buy a utility company or partner with it? In the end, it all comes down to the financial aspects, but more importantly to the fit. Is the target company the right fit? Is the brand similar? Managers must ask themselves these types of questions before deciding how to pursue their ecosystem.

According to a report by BCG, the key ingredient behind the success of many thriving business ecosystems lies in the presence of three interrelated flywheels (Figure 31)[208]. These flywheels work in a mutually reinforcing manner to propel the ecosystem forward. Firstly, there is the growth flywheel, which operates on the basis of indirect network effects. As the number of customers within the ecosystem increases, it strengthens the value for both orchestrators and contributors, and reciprocally, this growth further bolsters the ecosystem's value. Secondly, the data flywheel operates on the foundation of learning effects. It harnesses the expansion of users to generate a greater volume of valuable data. This data is then utilized to enhance the value proposition offered by the ecosystem, attracting more users in the process. Finally, the cost flywheel relies on economies of scale. It leverages the growth of the ecosystem to distribute fixed costs across a larger base, thus reducing unit costs and fostering more growth.

*Figure 31: BCG's Three Flywheels*
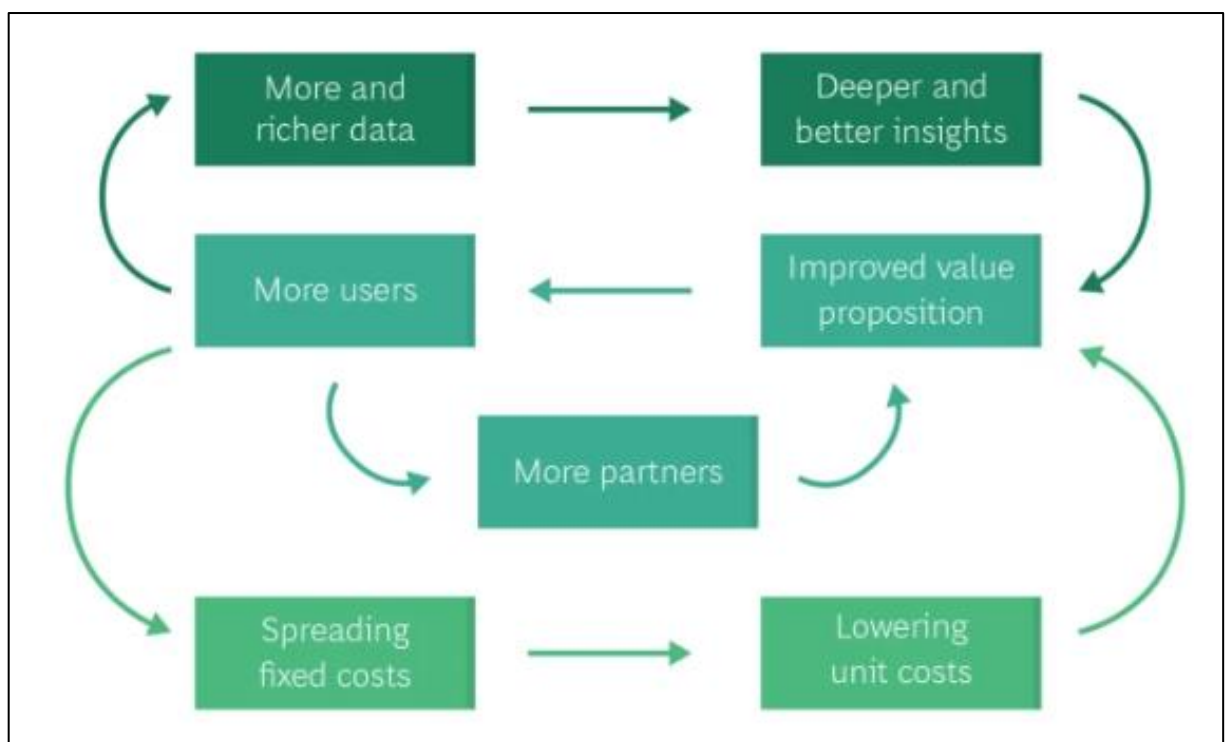
Lastly, during the interviews a point was made to find the right tool which telecom operators can use to put into perspective their core assets coupled with the different ecosystem they are part of. And then, be able to choose in which ecosystems to invest in, acquire, or partner. A solution to this need is the Daisy Business Model. The Daisy Business Model is nothing more than a graphical

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[208] *See* "What is your business ecosystem strategy" by Ulrigh Pidun, Martin Reeves, and Balazs Zoletnik for the BCG Henderson Institute.

representation of a company's assets and the different verticals in which the company is invested in. Figure 32 showcases what the Daisy Business Model would look like.

Figure 32: The Daisy Business Model
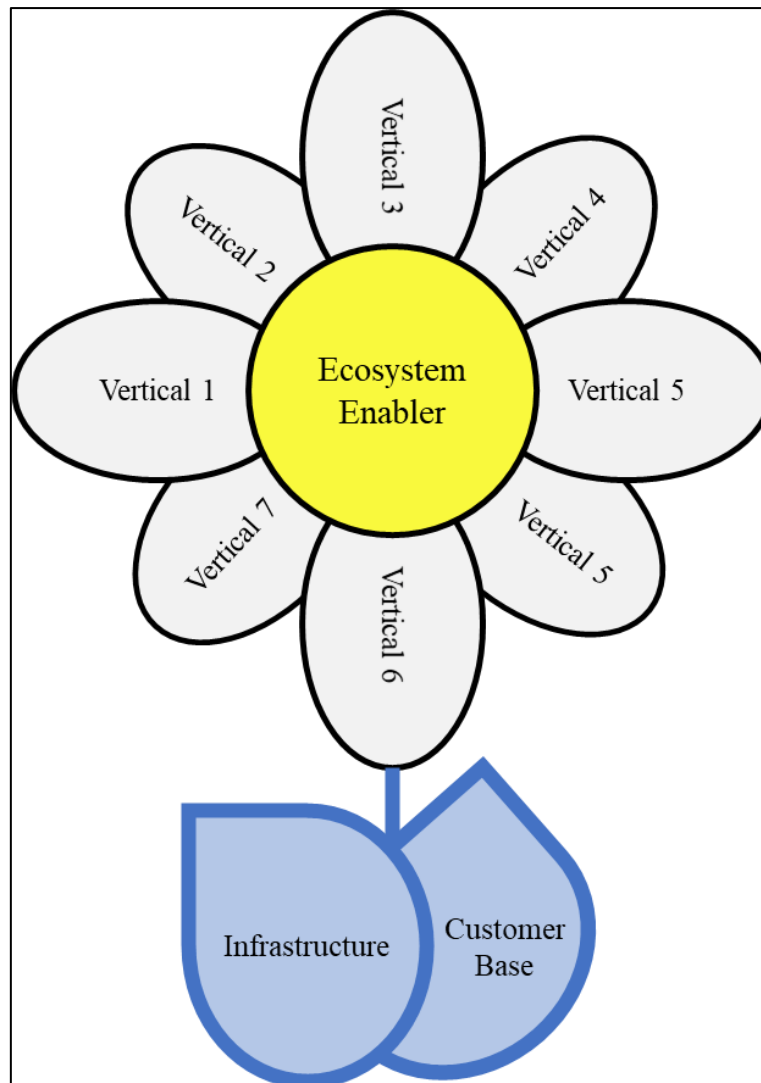
There are four distinct components to the Daisy Business Model:

- the Leaf,
- the Stem,
- the Yellow Disk,
- and the Petals

The Leaf symbolizes the telecom company's core assets, encompassing its infrastructure and customer base. The Stem represents the telecom operator's business model canvas, serving as the foundation for the company to evolve into an ecosystem enabler. The Yellow Disk represents the company itself, positioned at the center as the ecosystem enabler, leveraging its assets and the various elements of its business model. Additionally, the Petals are the different vertical industries in which

the operator wants to enter, and they serve as a way to better understand the industry environment and with which companies to partner with or which companies would make a right target for an acquisition.

For instance, if the telecom operator intends to enter the entertainment industry, the entertainment vertical would be represented as a petal within the broader ecosystem. Within this petal, one would find various entities operating in the entertainment industry that form part of the telecom operator's ecosystem. At this stage, the operator enjoys flexibility in deciding how to establish its presence in the entertainment realm, be it through partnerships with existing players, developing in-house solutions, or even acquiring established entities within the entertainment industry.

Conclusion

In summary, based on both the quantitative (in terms of the financial analysis conducted in Chapter 1) and qualitative research (related to the data analyzed from the interviews in Chapter 4) presented in the previous chapters, telecom companies can revitalize their business models and adapt to the evolving market context by leveraging their traditional assets, including infrastructure and customer base. Currently, telecom companies are facing various challenges, primarily due to the decline in revenues from their core business offerings, coupled with higher investment needs, resulting in a lower ability to invest and increase revenues. Additionally, operators are being impacted by a changing competitive landscape and new factors such as ESG, which have a significant impact on their business. Furthermore, operators are going through an innovation phase where 5G and Value-Added Services are seen as the next big opportunities to leverage their assets and overcome the aforementioned difficulties. However, operators are encountering difficulties in leveraging these new technologies and overcoming the sector's challenges. Consequently, even though operators are the enablers of the digital value chain (Figure 4.8), they are unable to generate as much value as they should.

Operators have been attempting to implement vertical solutions, but they have not been successful in leveraging their assets and generating new revenue streams because they have struggled to (1) implement effective go-to-market solutions, (2) provide customizable solutions, and (3) master the customer experience aspect. Regarding the first point, as observed in the analysis of the value chain, telecom operators are failing to implement the best go-to-market practices as they attempt to become ecosystem enablers, thereby changing their business models to be more flexible and dynamic. Secondly, in order to capitalize on the broader B2B opportunities facilitated by 5G and VAS, operators need to offer a higher degree of customization in their solutions to meet customer needs. However, at present, operators are unable to do so as their business models still rely on standard mobile and fixed plans, and their organization does not support a higher degree of customizable solutions. Thirdly, as a result of the second point, with a higher degree of customizable solutions, a higher degree of customer experience is also required. Operators need to excel in the entire customer experience, from pre-sales to post-sales. When implementing B2B solutions, operators need to establish dedicated customer support solutions, as the needs of a B2B customer differ from those of a typical B2C customer. Consequently, because operators have not been able to implement these factors, they have not successfully leveraged their assets to generate new revenue streams.

Hence, there is a need to rethink the business model and become ecosystem enablers, as highlighted by the results of this research. Telecom companies must become ecosystem enablers by

leveraging their core assets to successfully implement 5G or VAS-related solutions in specific industry verticals they choose to pursue. When investing in a particular industry vertical, operators must always consider the right go-to-market strategy to integrate the required know-how for the industry and to adopt the appropriate go-to-market solution. An operator's go-to-market decision must be based on the characteristics of a certain vertical. In other words, when the industry is alike, or close to, an operator's core business, the latter might prefer to develop in-house know how and assets. On the other hand, if the industry is not "close to" the operator's core business, the latter might prefer to either acquire or partner with a certain company to establish a position in a determined vertical sector. Lastly, to help them in their strategy, telecom companies can utilize the Daisy Business Model as a graphical tool to showcase their core assets, business model, and the different vertical industries in which they operate, or intend to. The Daisy Business Model is a tool that can help in strategic decision making and showcase how a company acts as an ecosystem enabler.

Bibliography

Abrardo, A. (2020). *5G Trials in Italy*. https://www.5gitaly.eu/2018/wp-content/uploads/2019/01/5G-Italy-White-eBook-5G-trials-

    in-Italy.pdf

Accenture Strategy. (2021, February). *The Impact of 5G on the European Economy*. Accenture.

    https://www.accenture.com/content/dam/accenture/final/a-com-migration/manual/r3/pdf/pdf-144/Accenture-5G-WP-EU-

    Feb26.pdf?tlaAppCB

AG, D. T. (2019). *Network Slicing – the key to 5G*. Www.telekom.com. https://www.telekom.com/en/company/details/network-

    slicing-the-key-to-5g-364200

AG, D. T. (2020, July 8). *5G technology in industrial campus networks*. Www.telekom.com.

    https://www.telekom.com/en/company/details/5g-technology-in-campus-networks-556692

AG, D. T. (2021, October 15). *Deutsche Telekom and Ericsson successfully demonstrate 5G network slicing with on-demand quality*

    of service control for enterprise use cases. Www.telekom.com. https://www.telekom.com/en/media/media-

    information/archive/new-success-in-5g-network-slicing-638544

AGCOM. (2022a, September 29). *Relazione Annuale 2022*. AGCOM.

    https://www.agcom.it/documentazione/documento?p_p_auth=fLw7zRht&p_p_id=101_INSTANCE_FnOw5lVOIXoE&p_

    p_lifecycle=0&p_p_col_id=column-

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    NSTANCE_FnOw5lVOIXoE_assetEntryId=27520162&_101_INSTANCE_FnOw5lVOIXoE_type=document

AGCOM. (2022b, December 28). *Osservatorio sulle comunicazioni n. 4/2022*. AGCOM.

    https://www.agcom.it/documentazione/documento?p_p_auth=fLw7zRht&p_p_id=101_INSTANCE_FnOw5lVOIXoE&p_

    p_lifecycle=0&p_p_col_id=column-

    1&p_p_col_count=1&_101_INSTANCE_FnOw5lVOIXoE_struts_action=%2Fasset_publisher%2Fview_content&_101_I

    NSTANCE_FnOw5lVOIXoE_assetEntryId=29146821&_101_INSTANCE_FnOw5lVOIXoE_type=document

Ajmone Marsan, M., Blefari Melazzi, N., & Buzzi, S. (2019). *64. 5G Italy White Book: from Research to Market*. 5gitaly.eu.

    https://www.5gitaly.eu/2019/en/5g-italy-book-2/

AMD. (2022). *Gaming as a Service*. AMD. https://www.amd.com/system/files/documents/gaas-service-brief.pdf

ANSA. (2021, November 8). *Vodafone, 5G e realtà aumentata al servizio del San Raffaele - InnovAzione digitale*. ANSA.it.

    https://www.ansa.it/innovazione_5g/notizie/tecnologia/2021/11/08/vodafone-5g-e-realta-aumentata-al-servizio-del-san-

    raffaele_061c5f85-f702-4326-a7b9-c58bd008498a.html

ASSTEL. (2022). *Rapporto sulla filiera delle Telecomunicazioni in Italia*. ASSTEL. https://www.asstel.it/wp-

    content/uploads/2023/03/rapporto-sulla-filiera-delle-telecomunicazioni-2022.pdf

AT&T. (2014, March 17). *"AT&T Digital Life®, Home Security and Automation Service to Launch in Five More Markets | AT&T."*

    About.att.com.

https://about.att.com/newsroom/att_digital_life_home_security_and_automation_service_to_launch_in_five_more_markets .html

AT&T. (2021a, September 16). *5G at Sea with AT&T and the Naval Postgraduate School*. AT&T Press Release.

https://about.att.com/story/2021/5g_at_sea.html

AT&T. (2021b, October 26). *AT&T Brings 5G to Ford EV Manufacturing Facility*. About.att.com.

https://about.att.com/story/2021/ford-manufacturing-facility.html

Audi. (2020, February 18). *5G in production: Audi and Ericsson take the next step together*. Audi Media Center. https://www.audi-mediacenter.com/en/press-releases/5g-in-production-audi-and-ericsson-take-the-next-step-together-12578

Axon Partners Group. (2023). *Edge Computing*. Axon Partners Group. https://axonpartnersgroup.com/insights/

Bain & Company. (2023). *The Great Delayering: As Telcos' Integrated Era Ends, It's Time to Embrace New Strategies*. Bain & Company. https://www.bain.com/how-we-help/the-great-delayering-as-telcos-integrated-era-ends-time-to-embrace-new-strategies/

Baroudy, K., Dexeus, C., & Travasoni, A. (2023, February 23). *Europe telco growth: Organizational overhaul | McKinsey*. Www.mckinsey.com. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/delayering-an-organizational-overhaul-for-growing-europes-telcos

Bhandari, N., Devra, S., & Singh, K. (2017). Evolution of Cellular Network: From 1G to 5G. *International Journal of Engineering and Techniques*, *3*(5). https://oaji.net/articles/2017/1992-1515158039.pdf

Bhatia, R. (2020, March 23). *Wayback Machine*. Web.archive.org. https://web.archive.org/web/20200323173229/https://www.ijert.org/research/introduction-features-of-4g-a-review-IJERTCONV3IS10054.pdf

Brenneis, E. (2020, January 6). *5G drives road safety in Italy*. Www.vodafone.com; Vodafone IoT. https://www.vodafone.com/business/news-and-insights/blog/gigabit-thinking/5g-drives-road-safety-in-italy

Cambini, C. (2016). Market Evolution and Regulation in the Italian Telecommunications Industry | Telsoc. *Telsoc.org*, *4*(4). https://telsoc.org/journal/ajtde-v4-n4/a72

Carvalho Ribeiro, J., CR Budden, G., & Manuel Vaz, P. (2021). *The rise of Netcos*. Deloitte Portugal. https://www2.deloitte.com/pt/en/pages/technology-media-and-telecommunications/articles/the-rise-of-netcos.html

Chapell, C., & Gabriel, C. (2023, April 6). *Network requirements for the metaverse: towards 6G and a Universal Digital Fabric*. Analysys Mason. https://www.analysysmason.com/research/content/reports/metaverse-6g-universal-digital-fabric-rma16-rma08/

Chukwudi Okwubunne, A., & O. Awoleye, M. (2012, April). *Fixed Wireless Access as a Veritable Resource for Rural Communities in a Cashless Economy*. ResearchGate. https://www.researchgate.net/publication/260752499_Fixed_Wireless_Access_as_a_Veritable_Resource_for_Rural_Communities_in_a_Cashless_Economy

CK Hutchison Holdings Limited. (2022). *2021 Annual Report*. CK Hutchison Holdings Limited.

   https://doc.irasia.com/listco/hk/ckh/annual/2021/ar2021.pdf

Cottone, N. (2023). *Poste Italiane diventa operatore telefonico - Il Sole 24 ORE*. Ilsole24ore.com.

   https://st.ilsole24ore.com/art/SoleOnLine4/Tecnologia%20e%20Business/2007/11/poste-mobile.shtml

Cutrone, G. (2009, December 16). *CuboVision di Telecom Italia: ecco caratteristiche e prezzo*. Webnews.

   https://www.webnews.it/cubovision-di-telecom-italia-ecco-caratteristiche-e-prezzo/

Dawadi, S. (2020, December). *Thematic Analysis Approach: A Step by Step Guide for ELT Research Practitioners*. ResearchGate.

   https://www.researchgate.net/publication/350975059_Thematic_Analysis_Approach_A_Step_by_Step_Guide_for_ELT_R
   esearch_Practitioners

Dekker, B., & Okano-Heijmans, M. (2020). *Europe's Digital Decade? Navigating the global battle for digital supremacy
   Clingendael Report*. The Clingendael Institute. https://www.clingendael.org/sites/default/files/2020-
   10/Report_Europes_digital_decade_October_2020.pdf

Englung, K. (2022, January 21). *Seven trends that will shape enterprise technology in 2022*. Www.ey.com.

   https://www.ey.com/en_us/technology-sector/seven-trends-that-will-shape-enterprise-technology-in-2022

EQT. (2023, May 12). *EQT Infrastructure to acquire a majority stake in Italy's largest mobile network from Wind Tre*.

   Eqtgroup.com; EQT. https://eqtgroup.com/news/2023/eqt-infrastructure-to-acquire-a-majority-stake-in-italy-s-largest-
   mobile-network-from-wind-tre/

Ericsson. (2021, May 28). *Volvo Cars and Ericsson achieve first cross-border 5G network vehicular handover*. Www.ericsson.com.

   https://www.ericsson.com/en/news/2021/5/volvo-cars-and-ericsson-in-connected-car-milestone

Fadel, H., El Mir, J., & Yaacoub, J. (2020). *Skin in the game: How telecom operators can win with gaming*. Strategy&.

   https://www.strategyand.pwc.com/m1/en/reports/2020/skin-in-the-game.html

Farber, D. (2014, January 9). *When iPhone met world, 7 years ago today*. CNET. https://www.cnet.com/tech/tech-industry/when-
   iphone-met-world-7-years-ago-today/

Fastweb. (2022, June 28). *QUIXA Assicurazioni partner di Fastweb con servizi innovativi di assistenza per semplificare la
   quotidianità di privati, partite IVA e piccole aziende*. Fastweb.it. https://www.fastweb.it/corporate/media/comunicati-
   stampa/quixa-assicurazioni-partner-di-fastweb-con-servizi-innovativi-di-assistenza-per-semplificare-la-quotidianita-di-
   privati-partite-iva-e-piccole-aziende/

Fastweb. (2023, February 9). *Fastweb announces financial results for fiscal year 2022: 38th consecutive quarter of growth for
   customers, revenues and margins*. Fastweb.it. https://fastweb.it/corporate/media/comunicati-stampa/fastweb-annuncia-i-
   risultati-economico-finanziari-del-2022-clienti-ricavi-e-margini-in-crescita-per-il-38mo-trimestre-consecutivo/?lng=EN

Finanza, M. M. (2023, April 19). *Con la rete unica in fibra ottica un risparmio di 111 milioni all'anno - MilanoFinanza News*. MF
   Milano Finanza. https://www.milanofinanza.it/news/con-la-rete-unica-in-fibra-ottica-un-risparmio-di-111-milioni-all-anno-
   2599114

Freyberg, A., & Tybus, M. (2021, June 2). *Transforming the telecom value chain—a platform business model*. Kearney.

    https://www.kearney.com/industry/telecommunications/article/-/insights/transforming-the-telecom-value-chain-a-platform-

    business-model

Frollà, A. (2017, April 10). *Poste debutta nella telefonia fissa: nasce PosteMobile Casa*. CorCom.

    https://www.corrierecomunicazioni.it/telco/poste-debutta-nella-telefonia-fissa-nasce-postemobile-casa/

G. Verticale, & Capone, A. (2018). *Softwarization and Virtualization*. Semantic Scholar.

    https://www.semanticscholar.org/paper/Softwarization-and-Virtualization-Verticale-

    Capone/3bf230e0513891cae2de7999002cff46e9272986

Gaibi, Z., Jones, G., Pont, P., & Vaidya, M. (2021, April 28). *A blueprint for telco transformation | McKinsey*. Www.mckinsey.com.

    https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/a-blueprint-for-telecoms-

    critical-reinvention

Garg, A. (2014, February). *Digital Society from 1G to 5G: A Comparative Study*. ResearchGate.

    https://www.researchgate.net/publication/263657708_Digital_Society_from_1G_to_5G_A_Comparative_Study

Gartner. (2023). *Definition of Telecommunications Services - Gartner Information Technology Glossary*. Gartner.

    https://www.gartner.com/en/information-technology/glossary/telecommunications-

    services#:~:text=Gartner%20Glossary%20Information%20Technology%20Glossary%20T%20Telecommunications%20Se

    rvices

George, S. (2019, July 30). *IoT Signals report: IoT's promise will be unlocked by addressing skills shortage, complexity and security*.

    The Official Microsoft Blog; Microsoft. https://blogs.microsoft.com/blog/2019/07/30/iot-signals-report-iots-promise-will-

    be-unlocked-by-addressing-skills-shortage-complexity-and-security/

Gröne, F., Gupt, U., & Abdel Samad, R. (2018). *Commoditization in the wireless telecom industry*. Strategy&.

    https://www.strategyand.pwc.com/gx/en/insights/2018/grasping-differentiated-straw/grasping-at-differentiated-straws-

    v2.pdf

Grunin, L. (2022, September 29). *Best Cloud Gaming Services*. CNET. https://www.cnet.com/tech/gaming/best-cloud-gaming-

    services/

GSMA. (2015). *Assessing the case for in-country mobile consolidation A report prepared for the GSMA*.

    https://www.gsma.com/publicpolicy/wp-content/uploads/2015/05/Assessing_the_case_for_in-

    country_mobile_consolidation.pdf

GSMA. (2018a, April 23). *Road to 5G: Introduction and Migration Whitepaper*. Future Networks.

    https://www.gsma.com/futurenetworks/resources/road-to-5g-introduction-and-migration-whitepaper/

GSMA. (2018b, September 28). *Opportunities in the IoT: Evolving roles for mobile operators*. GSMA.

    https://www.gsma.com/iot/resources/iot-opportunities-report/

GSMA. (2022). *Advancing the 5G Era Benefits and Opportunity of 5G-Advanced*. https://www.gsma.com/futurenetworks/wp-

    content/uploads/2022/09/Advancing-the-5G-Era-Whitepaper_20220920.pdf

GSMA. (2023). *Embedded finance - the time is now*. Mobile World Live. https://www.mobileworldlive.com/embedded-finance-the-time-is-now/

GSMA, & ETNO. (2021). *Digital Services Act Joint Position by the GSMA and ETNO*. https://etno.eu//downloads/positionpapers/gsma%20etno%20dsa%20position%20paper%202021_04_27.pdf

GSMA, & KEARNEY. (2022, May). *The Internet Value Chain 2022*. GSMA. https://www.gsma.com/publicpolicy/wp-content/uploads/2022/05/Internet-Value-Chain-2022-1.pdf

Hollander, R. (2019, March 1). *AT&T's new smartwatch will drive transformation in healthcare*. Business Insider. https://www.businessinsider.com/att-onepulse-smartwatch-medical-wearable-lte-2019-3?r=US&IR=T

Howdle, D. (2018). *Worldwide Mobile Data Pricing League | Cost of 1GB in 230 countries - Cable.co.uk*. Cable UK. https://www.cable.co.uk/mobiles/worldwide-data-pricing/

iliad Group. (2022, March 22). *iliad Group – Consolidated financial statements*. Iliad Group. https://iliad-strapi.s3.fr-par.scw.cloud/Annexes_Consos_2021_220322_Eng_1789a8965a.pdf

Information Technology & Innovation Foundation. (2018). *What Is 5G?* Information Technology & Innovation Foundation. https://www2.itif.org/2018-tech-explainer-5g.pdf

Infosys. (2019). *EDGE COMPUTING AND 5G*. Infosys. https://www.infosys.com/about/knowledge-institute/insights/Documents/edge-computing.pdf

Ji-hye, J. (2018, December 20). *SKT unveils 5G-linked smart factory system*. Koreatimes. https://www.koreatimes.co.kr/www/tech/2023/01/129_260725.html

JP Morgan. (2022). *Opportunities in the metaverse*. JP Morgan. https://www.jpmorgan.com/content/dam/jpm/treasury-services/documents/opportunities-in-the-metaverse.pdf

Lee, D. (2021, September 1). Amazon now running 164 flights a day to deliver stock in US. *Financial Times*. https://www.ft.com/content/ec355eb5-8dbd-4293-9a21-46fc09d2ed2d

Loozen, T., & Baschnonga, A. (2022, May 10). *Seven ways telecom operators can power the metaverse*. Www.ey.com. https://www.ey.com/en_gl/telecommunications/seven-ways-telecom-operators-can-power-the-metaverse

Mateu, J.-B. (2017). Orange Bank : la première telco-banque. *Annales Des Mines - Réalités Industrielles*, *Novembre 2017*(4), 60. https://doi.org/10.3917/rindu1.174.0060

Mehmood, Y., Ahmad, F., Yaqoob, I., Adnane, A., Imran, M., & Guizani, S. (2017). Internet-of-Things-Based Smart Cities: Recent Advances and Challenges. *IEEE Communications Magazine*, *55*(9), 16–24. https://doi.org/10.1109/mcom.2017.1600514

Meraj ud in Mir, M., & Kumar, S. (2015). Evolution of Mobile Wireless Technology from 0G to 5G. *International Journal of Computer Science and Information Technologies*, *6*(3). https://ijcsit.com/docs/Volume%206/vol6issue03/ijcsit20150603123.pdf

Milot, O. (2023, January 23). *A chi si appoggia PosteMobile? La copertura di rete di PosteMobile, tra Wind e Vodafone*. UpGo. https://www.upgo.news/rete-appoggio-postemobile/

Mohr, G., Goddard, M., Tazi, A., Pankert, G., Kerr, M., Khan, S., & Meige, A. (2022, October 18). *The metaverse: What's in it for telcos? | Arthur D. Little*. Adlittle.com. https://www.adlittle.com/en/insights/viewpoints/metaverse-what%E2%80%99s-it-telcos

Moller, C. (2021, April 16). *How 5GEM is transforming Ford manufacturing*. Uk5g.org. https://uk5g.org/updates/read-articles/how-5g-transform-manufacturing-5GEM-Ford/

Naldi, M. (2016, October). *An HHI-based analysis of the H3G-Wind merger*. ResearchGate. https://www.researchgate.net/publication/309014509_An_HHI-based_analysis_of_the_H3G-Wind_merger

Nekovee, M. (2019). *Opportunities and Enabling Technologies for 5G Spectrum Sharing*. https://arxiv.org/ftp/arxiv/papers/1902/1902.07573.pdf

Newton, C. (2019, March 19). *Instagram adds in-app checkout as part of its big push into shopping*. The Verge; The Verge. https://www.theverge.com/2019/3/19/18271840/instagram-checkout-shopping-facebook-business

Open Fiber. (2019, July 1). *FTTC e FTTH, qual è la differenza?* Open Fiber. https://openfiber.it/media/news/differenza-fttc-e-ftth/

Open Fiber. (2023, March 14). *Open Fiber approved the consolidated financial statements 2022*. Open Fiber. https://openfiber.it/en/open-fiber-world/press-releases/financial-statements-open-fiber-2022/#:~:text=Rome%2C%2014%20March%202023%20%E2%80%93The%20Board%20of%20Directors

Pant, S. K. (2020). *Fintech: Emerging Trends*. Papers.ssrn.com. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3763946

Pezzali, R. (2014, May 12). *Cubovision diventa TIMVision: vuole battere Sky Online e Infinity*. DDay.it. https://www.dday.it/redazione/13126/cubovision-diventa-timvision-vuole-battere-sky-online-e-infinity

Pidun, U., Reeves, M., & Zoletnik, B. (2022, March 8). *What Is Your Business Ecosystem Strategy?* BCG Global; BCG Henderson Institute. https://www.bcg.com/publications/2022/what-is-your-business-ecosystem-strategy

Popper, B. (2015, June 8). *Apple announces its streaming music service, Apple Music*. The Verge. https://www.theverge.com/2015/6/8/8729481/apple-music-streaming-service-wwdc-15

Poste Italiane. (2020, July 23). *Poste Italiane: accordo con Open Fiber per offerta fibra*. Www.posteitaliane.it. https://www.posteitaliane.it/it/comunicati/posteitalianeacco-1476522966287.html

published, S. M. (2022, March 16). *Vodafone and Ericsson create first-ever UK 5G network slice*. TechRadar. https://www.techradar.com/news/vodafone-and-ericsson-create-first-ever-uk-5g-network-slice

Ramadasa, I. (2022, September). *How Telco's use Big Data for Monetization & Revenue Maximization*. ResearchGate. https://www.researchgate.net/publication/363843746_How_Telco%27s_use_Big_Data_for_Monetization_Revenue_Maximization

RedHat. (2019). *What is NFV?* Redhat.com. https://www.redhat.com/en/topics/virtualization/what-is-nfv

Retelit. (2021, June 6). *RELAZIONE FINANZIARIA SEMESTRALE AL 30 GIUGNO 2021* . Www.retelit.it. https://www.retelit.it/public/CMS/Files/7911/Relazione-finanziaria-semestrale-al-30-giugno-2021.pdf

Rydning, J. (2022, May). *Worldwide IDC Global DataSphere Forecast, 2022–2026: Enterprise Organizations Driving Most of the Data Growth*. IDC. https://www.idc.com/getdoc.jsp?containerId=US49018922

S&P Global Market Intelligence. (2016). *An introduction to fintech: Key sectors and trends*. S&P Global Market Intelligence. https://www.spglobal.com/marketintelligence/en/documents/an-introduction-to-fintech-key-sectors-and-trends.pdf

Santo, B. (2017, August 25). *The 5 best 5G use cases*. EDN. https://www.edn.com/the-5-best-5g-use-cases/

Sciorilli Borrelli, S., & Fontanella-Khan, J. (2023, February 2). KKR offers to buy stake in Telecom Italia's fixed-line business. *Financial Times*. https://www.ft.com/content/ea7e8a8d-7fa9-4654-8312-0e372eea0619

Scott, M. (2021). *How can telecoms operators conquer the mobile gaming industry?* Analysys Mason. https://www.analysysmason.com/contentassets/e5cbc60b4f6c4e6b8664e1a23e1a860c/analysys_mason_operators_mobile_gaming_apr2021_rdvs0.pdf

Scott, M., & Bruff, O. (2022). *SK Telecom's AIVERSE illustrates a potential role for operators as metaverse aggregators*. Analysys Mason. https://www.analysysmason.com/contentassets/829d29f0aace4558810a8270afa70173/analysys_mason_sk_telecom_metaverse_jul2022_rdvs0_rdmy0_rdmm0.pdf

Shubber, K., & Aliaj , O. (2020, February 12). *Subscribe to read | Financial Times*. Www.ft.com; Financial Times. https://www.ft.com/content/b67503a2-4cd2-11ea-95a0-43d18ec715f5

Statista. (2019). *Number of Fintech startups globally by region 2019 | Statista*. Statista; Statista. https://www.statista.com/statistics/893954/number-fintech-startups-by-region/

Statista. (2022, November 17). *Topic: Mobile gaming market worldwide*. Statista. https://www.statista.com/topics/7950/mobile-gaming-market-worldwide/#topicOverview

Statista. (2023, May 16). *Topic: Fintech*. Statista. https://www.statista.com/topics/2404/fintech/#statisticChapter

STL Partners. (2021, April). *Mobile payments and telco financial services – Top 5 examples*. STL Partners. https://stlpartners.com/articles/consumer/mobile-payments-telco-financial-services/

Taga, K. (2017, June 26). *5G deployment models are crystallizing | Arthur D. Little*. Www.adlittle.com. https://www.adlittle.com/en/insights/viewpoints/5g-deployment-models-are-crystallizing

Taga, K., Dadhic, L., Opitz, M., Abril, J., Rajeswaran, A., & Prince, P. (2018, November 15). *Telecoms data monetization: Reality, not a mirage | Arthur D. Little*. Arthur D. Little. https://www.adlittle.com/en/insights/report/telecoms-data-monetization-reality-not-mirage

TATA Communications. (2019). *PORTFOLIO: VOICE DYNAMICS OF THE 2-SIDED TELCO MODEL RETAIL TELECOMS SUCCESS WITH WHOLESALE INNOVATION 2*. https://www.tatacommunications.com/wp-content/uploads/2019/03/CS-retail-wholesale-telecoms-whitepaper.pdf

Telefónica. (2022, October 20). *Fair share for network sustainability*. Telefónica. https://www.telefonica.com/en/about-us/public-policy-and-regulation/public-positioning/fair-share-for-network-sustainability/

Tesla. (2023). *2022 Tesla Impact Report*. Tesla Inc.

Thomas, D., & Massoudi, A. (2015, February 5). BT seals £12.5bn deal to buy EE. *Financial Times*. https://www.ft.com/content/9a74a0ec-ac6c-11e4-9aaa-00144feab7de

TIM Group. (2022a). *FY'22 Results and 2022-'24 Plan*. TIM Group.

TIM Group. (2022b, March 3). *Risultati FY 2021 e Piano 2022-'24*. Www.timgroup.tit.

TIM Group. (2023). *DAZN e TIM annunciano l'accordo di distribuzione che portera' su TIMVISION le partite della Serie A*. Gruppotim.it. https://www.gruppotim.it/it/archivio-stampa/corporate/2021/CS-TIM-DAZN-26-03-21-ITA.html

Tripodi, G. (2018). *L'asta per il 5G è conclusa: Vodafone e TIM prendono la maggior parte delle frequenze, ma anche Iliad fa molto bene*. SmartWorld. https://www.smartworld.it/operatori/frequenze-5g-asta-conclusa-bande-194151.html

U.S. Chamber of Commerce. (2017). *GLOBAL AMBITIONS BUILT ON LOCAL PROTECTIONS MADE IN CHINA 2025: High-End Numerical Control Machinery Next-Generation IT Biomedicine Aviation Equipment Agricultural Machinery New Materials New-Energy Vehicles Electrical Equipment Robotics Medical Devices Advanced Rail High-Tech Maritime Vessel Manufacturing*. https://www.uschamber.com/assets/documents/final_made_in_china_2025_report_full.pdf

Verizon. (2019a, October 23). *Verizon and Corning co-innovating with 5G to create factory of the future*. Verizon News Archives. https://www.verizon.com/about/news/verizon-corning-co-innovating-5g

Verizon. (2019b, December 6). *When was 5G introduced?* Verizon News Archives. https://www.verizon.com/about/our-company/5g/when-was-5g-introduced

Verizon. (2021a, February 15). *Saving lives with mixed reality*. Www.verizon.com. https://www.verizon.com/about/our-company/fourth-industrial-revolution/saving-lives-mixed-reality

Verizon. (2021b, August 11). *Verizon expands 5G Home broadband and mobility offerings to more customers*. Www.verizon.com. https://www.verizon.com/about/news/verizon-5g-home-broadband-mobility-offerings

Verizon. (2023). *What is Fixed Wireless Access (FWA)? Definition, Meaning & Explanation*. Verizon News Archives. https://www.verizon.com/about/blog/fixed-wireless-access

Vizzarri, A., & Bove, F. (2020). *5G revolution and the Italian use cases*. CEUR Workshop Proceedings. https://ceur-ws.org/Vol-2694/p8.pdf

VMware. (2022, August 9). *What is Software-Defined Networking (SDN)? | VMware Glossary*. VMware. https://www.vmware.com/nordics/topics/glossary/content/software-defined-networking.html

Vodafone. (2021a). *Next-generation mobile connectivity*. Vodafone. https://www.bing.com/ck/a?!&&p=21133fe6d46ad604JmltdHM9MTY4NTc1MDQwMCZpZ3VpZD0yNzY1ZDY4My1hOWQxLTY3Y2YtMWVkNi1jNDBjYThiYTY2NDAmaW5zaWQ9NTE5Mw&ptn=3&hsh=3&fclid=2765d683-a9d1-67cf-1ed6-c40ca8ba6640&psq=%e2%80%9cNext-generation+mobile+connectivity%e2%80%9d+Research+by+Vodafone&u=a1aHR0cHM6Ly93d3cudm9kYWZvbmUuY29tL2J1c2luZXNzL21lZGlhL3RvY3ZtZW50LzE1MDg4ODExMTY2NzgvbmV4dC1nZW5lcmF0aW9uX21vYmlsZV9jb25uZWN0aXZpdHkucGRm&ntb=1

Vodafone. (2021b, December 22). *Vodafone helps Ferroli develop their connected boilers proposition*. Www.vodafone.com. https://www.vodafone.com/business/news-and-insights/case-studies/vodafone-helps-ferroli-develop-their-connected-boilers-proposition#:~:text=Knowing%20that%20Vodafone%20is%20a%20market%20leader%20in

Vodafone. (2022, May 17). *Vodafone Group announces Full Year 2022 results*. Vodafone.com.

      https://www.vodafone.com/news/corporate-and-financial/vodafone-group-full-year-2022-results

World Economic Forum. (2023, January 18). *Demystifying the Consumer Metaverse*. World Economic Forum.

      https://www.weforum.org/reports/demystifying-the-consumer-metaverse

World Economic Forum (2017, September 22). *The value of data*. World Economic Forum.

      https://www.weforum.org/agenda/2017/09/the-value-of-data/

Yuzawa, K., Bhandari, N., Delaney, M., Galliers, G., Fang, F., Muthiah, C., Lee, G., Cai, A., Zhang, J., Ryung Kim, K., Joshi, V.,

      Harada, R., Muramatsu, H., & Shin, S. (2022, March 9). *Electric Vehicles: What's Next VII: Confronting Greenflation*.

      Goldman Sachs. https://www.goldmansachs.com/intelligence/pages/electric-vehicles-whats-next-vii-confronting-

      greenflation.html

Zhai, Y., Xu, X., Chen, B., Lu, H., Wang, Y., Li, S., Shi, X., Wang, W., Shang, L., & Zhao, J. (2021). 5G-Network-Enabled Smart

      Ambulance: Architecture, Application, and Evaluation. *IEEE Network*, *35*(1), 190–196.

      https://doi.org/10.1109/mnet.011.2000014

Sitography

http://www.ijetjournal.org/

https://about.att.com/category/all_news

https://fastweb.it/corporate/?lng=EN

https://investors.vodafone.com/

https://link.springer.com/

https://www.accenture.com/it-it

https://www.adlittle.com/en

https://www.agcom.it/

https://www.analysysmason.com/

https://www.bain.com/it/

https://www.bcg.com/

https://www.berec.europa.eu/en

https://www.cable.co.uk/

https://www.ckh.com.hk/en/ir/

https://www.cnet.com/news/

https://www.ericsson.com/en/newsroom

https://www.ey.com/en_gl

https://www.fcc.gov/

https://www.ft.com/

https://www.ftc.gov/

https://www.gartner.com/en

https://www.goldmansachs.com/intelligence/series/goldman-sachs-research/

https://www.gruppotim.it/en/investors.html

https://www.gsma.com/

https://www.idc.com/

https://www.ieee.org/

https://www.ijcsit.com/

https://www.jpmorgan.com/insights/research

https://www.kearney.com/industry/telecommunications

https://www.mckinsey.com/

https://www.microsoft.com/it-it/

https://www.nasdaq.com/Nasdaq.com

https://www.ofcom.org.uk/

https://www.refinitiv.com/en

https://www.researchgate.net/

https://www.retelit.it/en/investors/

https://www.sciencedirect.com/

https://www.sktelecom.com/en/press/press.do

https://www.ssrn.com/index.cfm/en/

https://www.statista.com/

https://www.strategyand.pwc.com/

https://www.telefonica.com/en/communication-room/press-room/

https://www.t-mobile.com/news

https://www.tradingview.com/

https://www.verizon.com/about/news-center

https://www.vivendi.com/en/shareholders-investors/shareholders-and-investors-in-a-nutshell/

https://www.weforum.org/

https://www2.deloitte.com/us/en/insights.html

Appendix

Table 7: Electronic communications markets - Total revenues

billions of €	2017	2018	2019	2020	2021
Fixed Network Services	16,41	16,46	16,22	15,60	15,40
Mobile Network Services	15,81	14,76	13,85	13,05	12,44
Total	*32,22*	*31,21*	*30,07*	*28,65*	*27,84*

Source: AGCOM

Table 8: The electronic communications markets - Final expenditure of residential and business users

billions of €	2017	2018	2019	2020	2021
Fixed Network Services	12,77	12,72	12,79	12,07	11,75
Mobile Network Services	13,73	12,66	11,83	10,90	10,42
Total	*26,49*	*25,37*	*24,62*	*22,97*	*22,17*
as a % of total revenue	*82%*	*81%*	*82%*	*80%*	*80%*

Source: AGCOM

Table 9: The markets for electronic communications - User expenditure on fixed and mobile network services by operator

Operator	2021 (%)
TIM	41,2
Vodafone	18,7
Wind 3	17,8
Fastweb	10,6
Iliad	2,8
PostePay	1,3
Other	7,6
Totale	*100,0*

Source: AGCOM

Table 10: Fixed network markets - Broadband and ultrabroadband access by technology

in %	2017	2021
FTTC	13,4	54,7
DSL	78,3	21,9
FTTH	2,8	14,2
FWA	5,5	9,1
Totale	*100,0*	*100,0*

Source: AGCOM

Table 11: Fixed network markets - Market shares: final expenditure per fixed network operator

Operator	2021 (%)
Tim	51,6
Fastweb	17,9
Vodafone	10,7
Wind Tre	7,9
BT Italia	1,6
Eolo	1,5
Other	8,8
Totale	*100,0*

Source: AGCOM

Table 12: Mobile network markets - Market shares: final expenditure per mobile network operator

Operator	2021 (%)
Wind Tre	28,9
Tim	29,6
Vodafone	27,7
Iliad	6,0
MVNO	7,8
Totale	*100,0*

Source: AGCOM

Figure 33: TIM - Revenue vs ARPU (2016-2021)
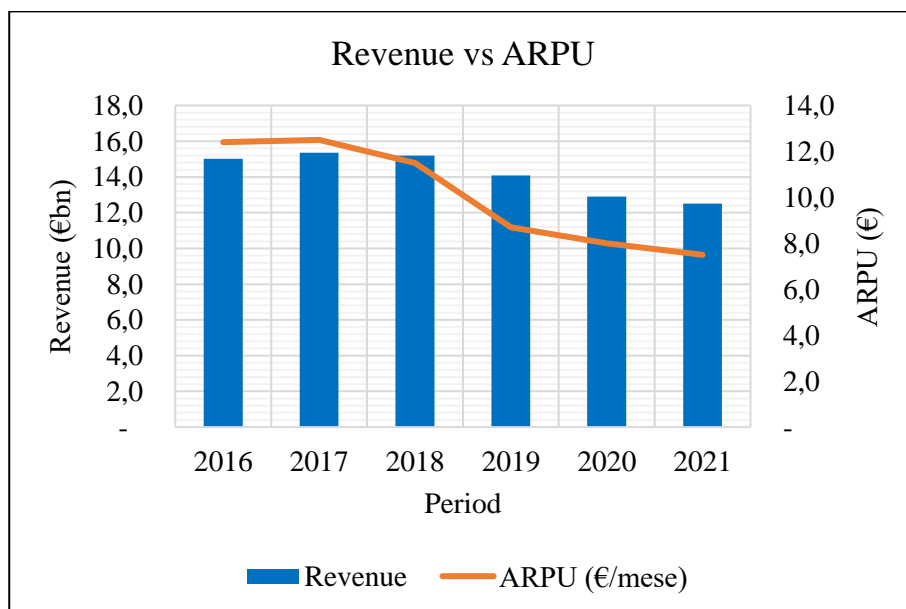
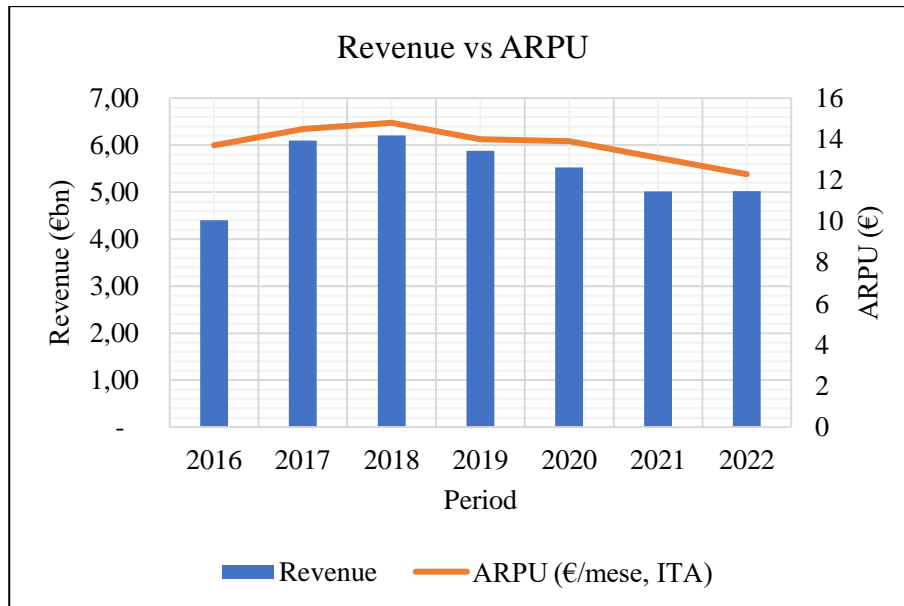*Source: Data obtained from Refinitiv and TIM Annual Reports. See Table 13.*

Table 13: TIM: Revenue vs ARPU (2016-2021)

TIM Domestic (€/m)	2016	2017	2018	2019	2020	2021
Revenue	15,0		15,2	14,1	12,9	12,5
EBITDA	6,7	6,2	6,2	5,3	5,3	3,7
% EBITDA on Revenue	45%	40%	41%	38%	41%	30%
ARPU (€/onth)	12,4	12,5	11,5	8,7	8,0	7,5

Source: Data obtained from Refinitiv and TIM Annual Reports.

Figure 34: Vodafone - Revenue vs ARPU (2016-2022)

Source: Data obtained from Refinitiv and Vodafone Annual Reports. See Table 14.

Table 14: Vodafone - Revenue vs ARPU (2016-2021)

Vodafone Italy (€/m)	2016	2017	2018	2019	2020	2021	2022
Revenue	4,4	6,1	6,2	5,9	5,5	5,0	5,0
Service Revenue	3,7	5,2	5,3	5,0	4,8	4,5	4,4
EBITDA	1,5	2,2	2,3	2,1	2,1	1,6	1,7
% Ebitda on Rev.	34%	37%	38%	37%	37%	32%	34%
ARPU (€/mese, ITA)	13,7	14,5	14,8	14	13,9	13,1	12,3

Figure 35: WindTre - Revenue vs ARPU (2016-2021)
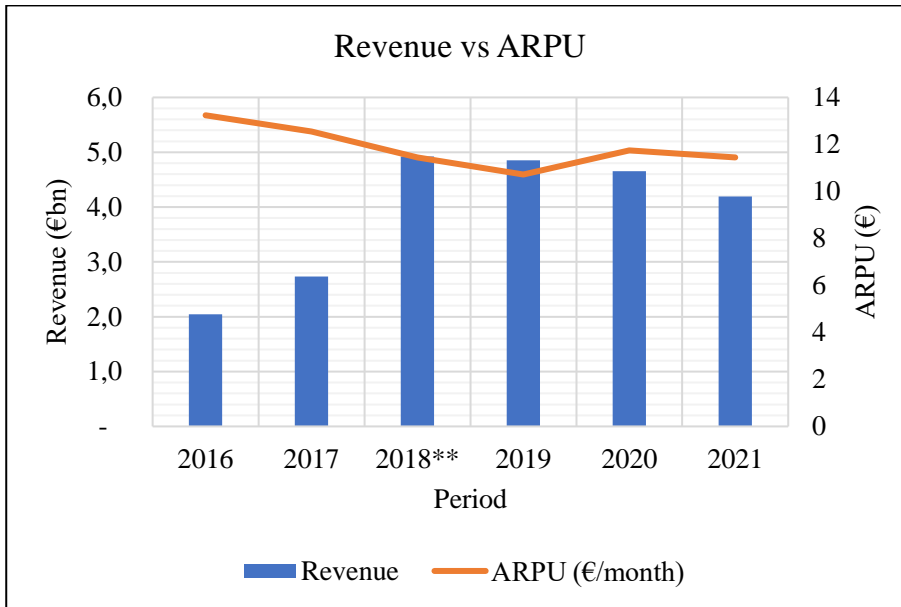
Source: Data obtained from Refinitiv and CK Hutchinson Annual Reports. See Table 15.

Table 15: WindTre - Revenue vs ARPU (2016-2021)

WindTre (€/m)	2016	2017	2018	2019	2020	2021
Revenue	2,0	2,7	4,9	4,9	4,7	4,2
EBITDA	0,5	1,1	2,0	2,1	2,0	1,7
% on Revenue	24%	40%	41%	43%	43%	41%
ARPU (€/month)	13,24	12,55	11,44	10,72	11,75	11,44

Table 16: The dynamics of EBITDA and CAPEX in TLC Operators

billions of €	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
EBITDA	16,6	15,5	13,4	11,6	11,2	11,9	11,8	11,6	11,0	10,0	8,9
CAPEX	5,9	6,2	5,5	6,0	6,6	6,5	7,2	7,0	7,6	7,4	7,2
Licenses	3,9	0,0	0,0	0,0	0,6	0,0	1,8	1,9	0,3	0,1	0,6
EBITDA - CAPEX	6,8	9,3	7,9	5,6	4,0	5,4	2,8	2,7	3,1	2,5	1,1
As a % of EBITDA	59%	40%	41%	52%	64%	55%	76%	77%	72%	75%	88%

Source: "Rapporto sulla filiera delle Telecomunicazioni in Italia Edizione 2022" by ASSTEL

Dissertation Summary

Introduction

The telecom sector is facing significant challenges in the era of digitalization and technology reliance. While big tech companies have experienced substantial growth, the telecom sector needs help to generate consistent revenues. The decline is evident in decreased revenues from core business activities and the need for significant infrastructure investments. The research explores how Italian telecom operators can leverage their traditional assets to diversify and create new revenue streams beyond connectivity. The study combines quantitative analysis of financial data with qualitative insights from interviews with telecom executives. Three key themes emerged: sector challenges, traditional assets, and beyond-core services. The research is structured into four chapters, covering the industry overview, emerging trends like 5G and Value-Added Services (VAS), and an analysis of interview findings. The findings highlight the need for telecom companies to change their business models, leverage core assets, embrace 5G and VAS, and become ecosystem enablers to generate new revenue streams.

Chapter I – Background and Market Context

The Italian telecommunications market is one of the largest in Europe, characterized by intense competition and a high penetration rate of mobile and fixed-line services. The telecommunication market is changing significantly due to evolving technologies, consumer demands, and regulatory developments. While the market has experienced growth and innovation, it has also faced challenges such as declining revenues and increased competition. The main Players in the Italian Telecommunications Market are:

- Telecom Italia (TIM): Telecom Italia, also known as TIM, is the largest telecommunications company in Italy. It operates in fixed and mobile network sectors and offers residential and business customers a wide range of services.
- Vodafone Italy: Vodafone is a multinational telecommunications company and a key player in the Italian market. It provides mobile, fixed-line, and broadband services to customers nationwide.
- WindTre: WindTre results from a merger between Wind and H3G, combining their mobile network services. It is the second-largest mobile operator in Italy and also offers fixed-line services.

- Fastweb: Fastweb is a major player in the fixed-line segment, particularly in the business market. It provides residential and corporate customers broadband, voice, and data services.

- Iliad Italy: Iliad is a French telecommunications company that entered the Italian market in 2018. It gained a significant market share through its aggressive pricing strategies, offering competitive mobile services to consumers.

- Open Fiber: Open Fiber is an infrastructure company focused on deploying fiber-optic networks across Italy. It primarily provides wholesale access to its network infrastructure, enabling other operators to deliver high-speed broadband services.

Moreover, the market is regulated mainly by two authorities. The Italian Competition Authority (AGCM) ensures fair market competition, prevents anti-competitive practices, and protects consumer rights. It monitors market dynamics and takes actions to promote a level playing field. And the Authority for Communications Guarantees (AGCOM) is the independent regulatory entity overseeing the telecommunications sector. It ensures compliance with regulations related to licensing, interconnection, quality of service, consumer protection, and other aspects of the industry.

Italy's fixed network services segment has seen an overall decline in revenue over recent years. Revenues have decreased by 6.1% since 2017, while total expenditure has declined by 8%. This decline can be attributed to reduced fixed voice services as consumers increasingly rely on messaging apps. However, fixed data services revenue has increased due to higher data consumption, especially after the COVID-19 pandemic, which increased remote work and data-intensive activities. Broadband and ultra-broadband accesses have also increased, driven by adopting FTTC, FTTH, and FWA technologies. Despite the revenue decline, both residential and enterprise user expenditures have decreased. Four main players dominate the market, while smaller operators cater to specific customer segments or geographical areas not covered by the larger players.

Similarly, Italy's mobile network services segment has experienced a decline in revenue despite an increase in the number of SIMs and usage of mobile services. Revenue has fallen by 21% since 2017, and total expenditure has decreased by 24% (Figure S.1). SIMs have increased, with a significant rise in machine-to-machine (M2M) SIMs. Average daily data traffic has also increased. However, revenues in mobile network services have decreased, with residential users' expenditure declining by 26% and enterprise users' revenue falling by 16% since 2017. The market is largely controlled by three major players, a smaller player, and several smaller mobile virtual network operators (MVNOs).

The Italian telecom sector has experienced a decline in core business services over recent years. Total revenue and cost have steadily decreased due to structural changes and changing consumer preferences. The market has a high degree of concentration with a few dominant players, leading to

stagnant competition, increased barriers to entry, and lower prices (Figure S.2). While this price decreases benefits consumers, it negatively impacts operators as they face higher costs to improve subscription plans and add value-added services. Fixed-line services have seen upgrades with the growth of FTTC-FTTH coverage, but overall expenditure in the fixed-line market has decreased. Mobile network services have seen increased data revenue but a decline in SMS revenue due to reliance on third-party messaging apps. The average revenue per user and SIM have fallen, and operators focus on increasing data and value-added services. EBITDA and CAPEX have suffered the most, limiting investment capabilities (Figure S.3). Italy has one of the lowest costs per GB of mobile data globally. While customers benefit from affordable services, telecom companies face challenges.

Chapter II – 5G

The evolution of mobile connectivity has seen significant advancements over the years. It started with introduction of the first commercial cellular network, 1G, which enabled wireless phone calls and data transfers. However, 1G had limited security and low data rates. The subsequent generations, such as 2G and 3G, brought improvements like text messaging, higher security standards, enhanced audio and video streaming, faster web browsing, and support for GPS. The advent of smartphones, particularly with the introduction of the iPhone, revolutionized how people used mobile devices, turning them into portable computers. The 4G network improved connectivity with higher speeds and enabled applications like ultra-high-speed internet access, data-intensive services, and location-based services. In 2019, 5G was introduced, offering faster download speeds and a more responsive and adaptable network. It is designed to support a variety of purposes and is built on a cloud-native and software-based architecture. 5G enables IoT, providing the infrastructure for a hyperconnected society. It brings economic expansion, digitalization, and new use cases for smart cities, smart agriculture, logistics, and public safety organizations. The three main technological pillars of 5G are:

- Enhanced Mobile Broadband (eMBB),
- Massive Machine Type Communications (mMTC), and
- Ultra-Reliable and Low Latency Communications (URLLC).

eMBB focuses on high-speed mobile data connectivity, supporting virtual and augmented reality applications. mMTC enables large-scale communication between machines and devices, which is crucial for IoT applications. URLLC provides highly reliable and low-latency communication, essential for real-time applications like autonomous vehicles and remote surgery. 5G also unlocks the true potential of Fixed Wireless Access (FWA), offering high-speed internet access through wireless

communication. FWA is particularly useful in rural areas where laying fiber optic cables may be challenging.

Due to its technical capabilities, 5G caters to various industry verticals and creates opportunities for new stakeholders like software developers, cloud service providers, and system integrators. Overall, the evolution of mobile connectivity has led to the emergence of 5G, a transformative technology that promises to bring significant advancements and new possibilities for industries, individuals, and society.

Chapter III – VAS

The telecommunication industry constantly evolves to meet the growing demand for better connectivity and faster communication. Telecom companies now offer value-added services (VAS) to go beyond traditional voice and data services and enhance the user experience. VAS helps telecom companies differentiate themselves and build customer loyalty.

One of the significant VAS areas is the Internet of Things (IoT) and Edge Computing. IoT refers to the ecosystem of connected devices that gather data and automate functions using sensors and enhanced connectivity. Telecom operators play a crucial role in providing connectivity for IoT applications, and they can also offer value-added services throughout the IoT value chain. Edge computing, a critical enabler of 5G technologies, complements IoT by decentralizing cloud architecture and bringing processing power closer to devices, reducing latency and improving efficiency. Use cases for IoT and edge computing include autonomous vehicles, industrial automation, and augmented reality/virtual reality.

Telecom companies can also play a role in the financial services industry. With the rise of digital payments and the fintech industry, telecom companies can leverage their unique data insights, customer identity verification capabilities, reach and infrastructure, and focus on user experience to provide value in financial services. By partnering with financial institutions or launching mobile banking services, telecom companies can offer personalized financial solutions, improve financial inclusion, and contribute to economic growth.

Gaming is another area where telecom companies can provide value-added services. Video games have become a significant part of global culture, and the mobile gaming market is projected to experience substantial growth. With the advent of 5G and cloud gaming services, telecom companies can offer high-value content and cater to new segments of consumers interested in mixed reality experiences. Cloud gaming allows games to be processed remotely in the cloud instead of locally on a console, providing flexibility and accessibility to gamers.

Telecom companies have a unique opportunity to play a crucial role in developing and expanding the Metaverse. With their existing infrastructure and expertise in providing connectivity, they can enable seamless and high-speed communication between users, devices, and virtual environments. Telecom companies can offer the necessary network capabilities to support the immersive experiences and real-time interactions that the Metaverse requires. Moreover, telecom companies can provide value-added services within the Metaverse ecosystem. They can offer virtual reality headsets, augmented reality glasses, and other hardware devices to enhance the user experience. Additionally, they can develop and provide Metaverse-specific applications and platforms that enable users to create, share, and monetize their virtual content.

Overall, telecom companies are embracing value-added services to reshape their business models and meet customers' evolving needs. By exploring IoT and edge computing, financial services, and gaming, telecom companies can differentiate themselves, drive revenue growth, and create a better user experience.

Chapter IV – Analysis of The Findings: How to Become Ecosystem Enablers

Analysis

This research paper utilizes a qualitative methodology, collecting data through interviews and analyzing it using a thematic framework approach. The objective is to gain qualitative insights from telecom industry experts regarding the state of the telecommunications sector beyond what is available online. The interviews were conducted with current or former telecom executives, and the analysis process consisted of four phases: data collection, data codification, thematic mapping, and results. In the data collection phase, five interviews were conducted with experts in the Italian telecommunications industry. The questionnaire focused on challenges telecom operators face, core competencies and strengths of these companies, opportunities for beyond-the-core services, and strategies for generating new revenue streams.

The interviews were conducted in Italian and translated for this paper. The data codification phase involved analyzing the qualitative data from the interviews. The researchers categorized and coded the data to identify patterns, themes, and concepts. A total of 58 quotes were extracted and analyzed, resulting in 36 first-order concepts that could be grouped into 13 second-order concepts. Three aggregate themes emerged from the analysis: Sector Challenges, Traditional Assets, and Beyond Core (Figure S.4).

<u>Sector Challenges</u>

According to interviews conducted with industry experts, the telecom sector is currently facing severe challenges. The five most critical challenges identified are:

- Decrease in core business revenue with an increased need for investments: Telecom companies are experiencing declining revenue from their core business while the demand for infrastructure investments is rising. This creates a challenging situation where costs are high, but payments are decreasing due to price wars, lower average prices, and evolving customer needs.

- Changing competitive landscape and industry environment: The telecom industry has witnessed significant changes in its competitive landscape and industry structure. New competitors from atypical sectors, such as tech and digital companies, have entered the market. Additionally, regulatory and standardization practices have shifted, reducing the influence of telecom operators. External threats like geopolitical struggles and wars further impact the industry.

- Regulatory challenges: The telecom sector faces regulatory challenges from various regulatory agencies and competition authorities. Regulators often prioritize the interests of end consumers, potentially paying attention to the operators' needs. There is an ongoing debate about the fair share of taxes, as operators argue that companies like Facebook, Amazon, Netflix, and Google generate a significant portion of internet traffic but contribute little to operator revenues.

- Need for a change in how the business is organized: Telecom companies must adapt their organizational structures and thinking to keep up with an evolving industry. Delayering, separating networks and services into different entities, is one approach being adopted. Operators must also think collectively as an industry and learn from successful companies in other sectors to remain competitive.

- Increased number of failed ventures over the years: Telecom companies have tried to innovate and adapt but have faced challenges in capturing the expected value. Failed ventures can be attributed to deployment failures or flawed concepts. For example, Telecom Italia's Cubovision/TIMvision service struggled to attract customers due to a lack of original content and faced legal disputes.

The telecom sector must address these challenges to navigate a rapidly changing environment and ensure sustainable growth and profitability.

<u>Traditional Assets</u>

The interviews highlighted two core assets of a telecommunications company: infrastructure and customer base.

The network infrastructure, including equipment and cables, is crucial for providing services and has become even more significant with the rise of digitalization. The battle for leadership in digital connectivity, particularly in 5G networks, has led to competition between countries like the United States and China. While Chinese companies like Huawei have made strides in 5G deployment, cybersecurity concerns have hindered their international expansion. Cloud computing has also emerged as an important infrastructure element, offering on-demand access to hardware, software, storage, and analysis. It provides scalability, cost-effectiveness, and data backup options, replacing traditional data centers.

The customer base is considered a valuable asset due to the long-term relationships and steady revenue it can provide. Telecom companies can offer additional services to customers and leverage the data generated by their extensive customer base for various purposes. This data can be utilized in retail site planning, personalized marketing, real-time location-based targeting, billboard placement, credit scoring, and traffic planning. By analyzing customer data and demographics, telecom companies can provide insights and targeted solutions to retailers, advertisers, financial institutions, and transportation systems.

<u>Beyond the Core</u>

The concept of "beyond the core" in the telecom industry refers to opportunities outside the core business that companies can explore. This includes new service offerings, reorganizing infrastructure, and pursuing new ventures. Operators can leverage their core assets by dividing the company into a NetCo, which manages infrastructure, and a ServCo, which handles client-facing operations. NetCos have advantages such as growth options through diversification, expanded geographical reach, access to cheaper capital, and operational efficiency. ServCos must focus on monetizing customer relationships and exploring B2B opportunities to generate meaningful revenue. Strategic partnerships with other service providers can unlock new revenue streams for ServCos.

The interviews also discussed the potential applications of 5G and value-added services (VAS). 5G is expected to have a greater impact on B2B applications than B2C applications. Important 5G B2B opportunities include Industry 4.0, smart cities, edge computing, smart homes, autonomous driving, smart healthcare, and network slicing. These applications rely on 5G's high speed, low

latency, and massive connectivity capabilities. Regarding VAS, operators can focus on upselling customers by adding services to their offerings. Examples include bundling streaming services, insurance, or utility plans with internet offerings. VAS opportunities for operators include IoT, financial services, gaming, the Metaverse, entertainment, and utilities.

Telecom operators must find their niche and leverage their assets to diversify and take advantage of the opportunities 5G and VAS present. Failure to do so may result in underutilizing 5G technology.

Results

The telecom industry consists of two main business models: retail and wholesale. Retail telecom companies provide network services to both individual and business customers, focusing on offering reliable broadband internet access and value-added services. They partner with device manufacturers, infrastructure providers, and third-party retailers. On the other hand, wholesale-only telecom companies provide telecom services and infrastructure to other companies rather than end customers. They focus on scalable network infrastructures and customizable solutions for retail telecom companies, forming partnerships to access reliable infrastructure and devices.

Telecom operators face the challenge of capturing value in the value chain. While they provide connectivity for various digital services, they need help to monetize them effectively. Other industries, such as digital services and cloud infrastructure, have experienced significant growth and captured most of the value. Telecom operators have a fragmented value chain, with hardware providers, connectivity providers, and application enablers. To address this issue, telecom companies must become ecosystem enablers, integrating themselves into the broader digital ecosystem and leveraging their connectivity assets to monetize end solutions.

Becoming an ecosystem enabler involves acquiring companies or forming partnerships within the ecosystem. Acquisitions offer increased control, expertise, and customer base but come with high costs and integration challenges. Partnerships provide complementary capabilities, reduced financial risk, and faster time-to-market, but they involve limited control and potential misalignment. The decision between acquisition and partnership depends on strategic objectives, financial considerations, and ecosystem dynamics. Successful business ecosystems rely on three interrelated flywheels: growth, data, and cost. These flywheels work together to drive the ecosystem's value and growth. The Daisy Business Model also provides a graphical representation of a telecom operator's assets, verticals, and ecosystem (Figure S.5). It helps operators understand their core assets, identify

vertical industries to enter, and determine whether to acquire or partner with companies in those industries.

Conclusion

Based on the research conducted in previous chapters, telecom companies in Italy face challenges due to declining revenues and increased investment needs. They can revitalize their business model by leveraging their infrastructure and customer base to adapt to the changing market. However, operators need help generating as much value as they should, and they need to overcome these challenges by embracing 5G and Value-Added Services (VAS) and creating a more dynamic and flexible business model. Partnerships are the best way for operators to leverage their assets and know-how. By becoming ecosystem enablers and implementing solutions in specific industry verticals, telecom companies can capture more value and adapt to the sector's evolving needs. The Daisy Business Model is proposed as a graphical tool to showcase their core assets and business model.

Figures

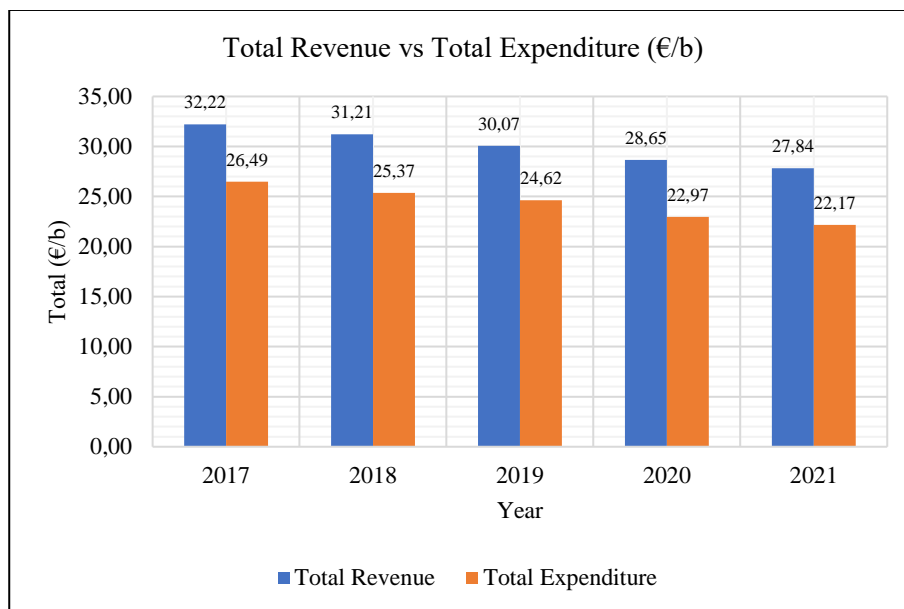*Figure S.1: Total Revenue vs Total Expenditure*

Figure S.2: General Price Index vs Telecommunication Price Index

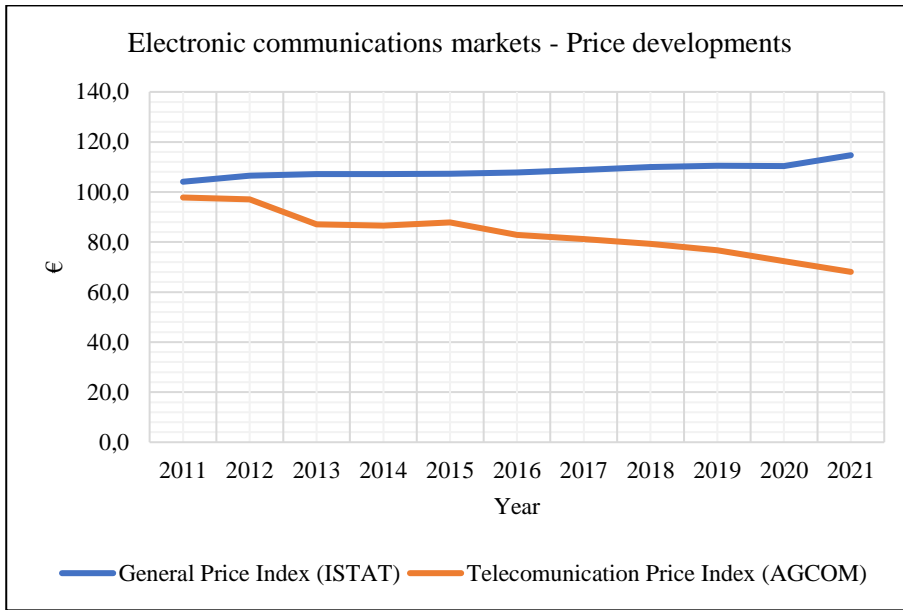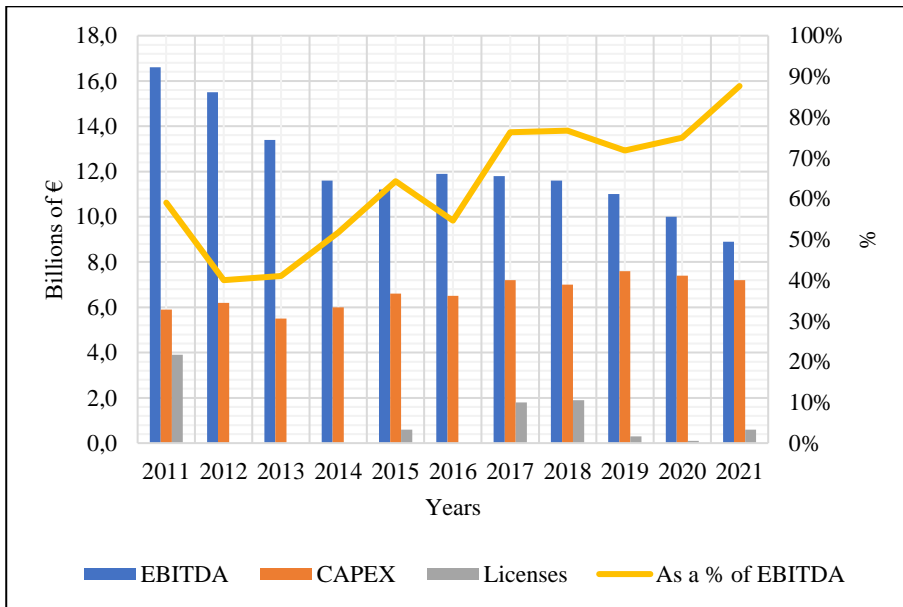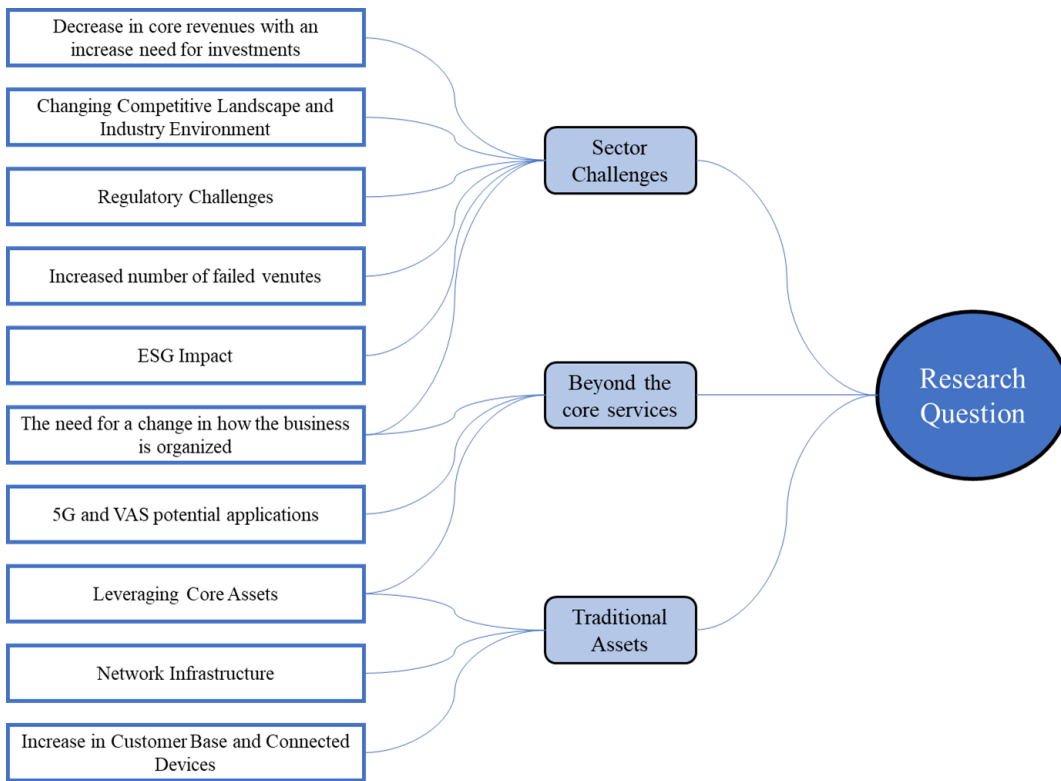*Figure S.3: The dynamics of EBITDA and CAPEX in TLC Operators*

Figure S.4: Findings Thematic Map

Figure S.5: The Daisy Business Model