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**Building the NGA infrastructure:
An analysis of the Open Fiber Spa’s business model**

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INTRODUCTION

The purpose of this research work is to analyze the special business model implemented by Open Fiber Spa, which is revolutionizing the Italian telecommunications market.

The first chapter focuses on the current situation of the development of the ultra-broadband network in Italy, comparing it with the objectives of the Digital Agenda for Europe; poring over the national framework and strategy for the deployment of the NGA infrastructure. An appendix follows with a copper switch-off analysis.

In the second chapter, there is a painstaking analysis of the Italian wholesale-only operator Open Fiber Spa; analysis that examines its business model and the main success factors with which it is dragging Italy towards the Gigabit Society, creating day after day a digital highway that brings fiber directly to homes, businesses and public administrations.

The chapter ends with two further insights in the appendix:

- Is the risk premium for investments in FTTH networks comparable to option pricing theory?
- The implementation of FTTH technology in the Ancona area.

The thesis ends with a final overview of the stakeholders on the advantages and disadvantages of a hypothetical and exclusive Tim-Open Fiber network. In the appendix to the third chapter, there is a forecast on the future of Telcos and their business models, taking into consideration a series of new drivers that could influence them.

INTRODUZIONE

Lo scopo di questo lavoro di ricerca è quello di analizzare lo speciale modello di business implementato da Open Fiber Spa che sta rivoluzionando il mercato italiano delle telecomunicazioni.

Il primo capitolo si enuclea sulla situazione attuale dello sviluppo della rete a banda ultra-larga in Italia, confrontandola con gli obiettivi dell'Agenda Digitale europea e approfondendo poi il quadro e la strategia nazionale per la diffusione dell'infrastruttura NGA. Segue un'appendice con un'analisi sullo spegnimento del rame.

Nel secondo capitolo, vi è un'analisi certissima dell'operatore italiano di vendita all'ingrosso Open Fiber Spa; analisi che va ad esaminare il suo modello di business ed i principali fattori di successo con cui sta trascinando l'Italia verso la Gigabit Society, creando giorno dopo giorno un'autostrada digitale che porta la fibra direttamente nelle case, nelle aziende e nelle Pubbliche Amministrazioni.

Il capitolo si conclude con due approfondimenti in appendice:

- il Risk Premium per gli investimenti nelle reti FTTH è paragonabile alla teoria dei prezzi delle opzioni?
- L'implementazione della tecnologia FTTH nell'area di Ancona.

La tesi termina con una panoramica finale delle parti interessate sui vantaggi e gli svantaggi di un'ipotetica ed esclusiva rete Tim-Open Fiber. In appendice al terzo capitolo, vi è una possibile previsione sul futuro delle Telcos e dei loro modelli di business, prendendo in considerazione una serie di nuovi driver che potrebbero influenzarle.

CHAPTER 1

THE BUILDOUT OF THE ULTRA-BROADBAND NETWORK IN ITALY & EUROPE

1.1 European objectives related to broadband and ultrawideband connections

In 2010, the European Commission adopted the Communication "A Digital Agenda for Europe" (EC, 2010), the challenge was to build an inclusive, fair and sustainable European information society. The agenda represents one of the seven "flagship initiatives" of the "Europe 2020" growth strategy; establishing around 100 follow-up actions, including 31 legislative ones, clustering them as a path to improve Europe's prosperity and well-being¹.

More specifically, the most relevant plans are as follows:

The goal is to improve the EU's competitiveness by maintaining its social market economy model and significantly improving the effectiveness of the use of its resources. The digital agenda presented by the European Commission proposes to make the most of the potential of information and communication technologies

¹ <https://www.efesme.org/europe-2020-a-strategy-for-smart-sustainable-and-inclusive-growth>

(ICT) to foster innovation, economic growth and progress. Among the seven actions to be taken to implement this initiative, the fourth is the promotion of fast and super-fast Internet access for everyone: Europe must have a fast and super-fast Internet, accessible to all and at competitive prices. The EU must create next-generation access networks (NGA) and strengthen its radio spectrum policy.

Quantitatively, the targets to be achieved are:

- Get to 2013 with basic broadband coverage of 2 Mbps for 100% of EU citizens;
- Get to 2020 with fast broadband coverage of 30 Mbps or more for 100% of EU citizens;
- Get to 2020 with ultra-broadband coverage of 100 Mbps or more for 50% of EU citizens.

The European Commission is boosting the spread of high-speed broadband by bringing forward new rules on cost reduction, a recommendation on next-generation access networks, revised state aid guidelines for broadband and a proposal to complete the telecoms single market and deliver a #ConnectedContinent.²

In 2016, with the Communication COM (2016) 587/2 “Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society” (EC, 2016) the European Commission announced the objectives for 2025:

² <http://ec.europa.eu/digital-agenda>

1. Connectivity of at least 1 Gbps for schools, libraries and public offices;
2. Connectivity of at least 100 Mbps, expandable to Gigabit, for all European families;
3. Uninterrupted 5G coverage in all urban areas and along the mainland transport routes.

The state of broadband connectivity in Europe and current modernization trends will not be able to satisfy the growing needs of a better and faster internet, obtainable through very high capacity networks. These networks are indispensable for citizens and businesses to develop, supply and use online products, applications and services across Europe. The success of e-commerce, the reliability of eHealth applications, the user experience with audio and video content in online games and streaming all depend on the quality of the networks.

Very high capacity networks are also needed to maximize the growth potential of our European digital economy. Instant transmission and great reliability will allow hundreds of machines to work together in real-time in industrial, professional or domestic contexts. Responsiveness and reliability are key factors to allow doctors to carry out remote surgery and cities to adjust their energy consumption or traffic lights in real-time according to actual needs.

The high upload and download speeds will allow companies to carry out high definition video conferences with multiple participants connected from different

places, or to work with common cloud software. Students will be able to take courses offered by universities based in the other Member States.

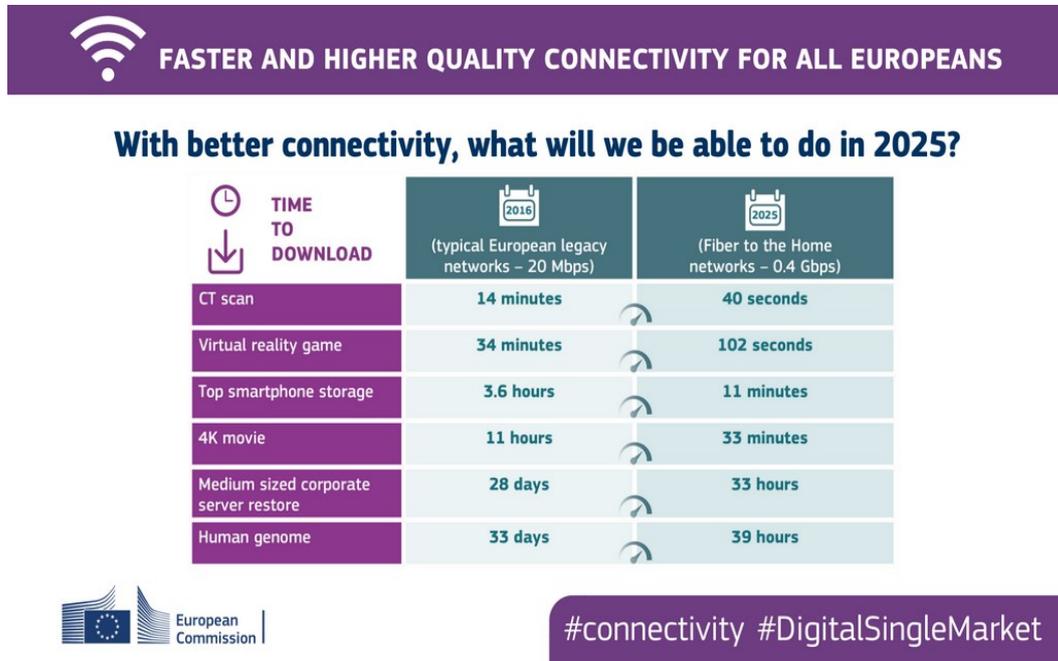
High-capacity networks are needed to ensure territorial cohesion so that every citizen in every community across Europe participates in and benefits from the digital single market. These networks becoming a necessity for Europe's growth, jobs, competitiveness and cohesion.

The Communication also clarifies that by very high capacity networks we mean: an electronic communications network made up entirely of fiber optic elements at least as far as the point of distribution in the place of destination or that is capable of providing similar network performance under normal conditions of peak in terms of bandwidth available for downlink/uplink, resilience, error parameters, latency and variation thereof.

Thereby, must be ensured that by 2025, 1 Gigabit per second internet connections reaches all schools, public transport facilities and the main administrative services, even in rural and extra-urban areas, is the objective of the European Commission's strategy "for a Gigabit Society" as illustrated below from Table 1.

To achieve this, the Commission has set up the European Broadband Competence Offices Network, which connects European authorities with national and regional authorities, supporting the development of broadband throughout the Union.

Table 1. European Commission's strategy "for a Gigabit Society"



Source: <https://ec.europa.eu/digital-single-market/en/policies/improving-connectivity-and-access>

According to the official text released by the European Commission "European Structural and Investment Funds" (EC, 2015), for the period 2014-2020, the EU has allocated 6 billion and 940 million euros for investments in broadband through the structural funds. And it is Italy that has won the most, with 1 billion and 161 million euros, followed by Poland, with one billion.

Most of the resources, 6.019 million, come from the European Regional Development Fund (ERDF), while 921 million come from the European Agricultural Fund for Rural Development (EAFRD). In addition to the structural funds, there are also another 3.2 billion available under the European Fund for Strategic Investments (April 2017 data), also known as the "Juncker Plan", assigned

to digital. The EU has made available around € 1 billion, which has led to an additional € 2.2 billion of public and private funds. The list of projects is available on the European Investment Bank website.

There are also other resources allocated through the Connecting Europe Facility (CEF), an instrument which has around € 1 billion to improve digital infrastructure and services in the EU (EC, 2018)

To stimulate the financing of small-scale projects, the EIB and the European Commission have also created a platform called "Fund to connect broadband in Europe", which aims to mobilize between 1 and 1,7 billion of public and private investments by 2020. However, money is not enough to promote the spread of broadband, an equally important aspect is to establish common rules in the sector. In recent years a complete set of new rules for the electronic communications sector has been published in the Official Journal of the EU and includes 5G and other new generation technologies across Europe.

Greater attention and importance are also given to consumer protection. States will have two years to comply with the directive by adopting the necessary national provisions.

In 2018, around 8.9 million persons worked as ICT (Information and Communications Technologies) specialists in the EU, 3.9% of total employment.³

³ https://ec.europa.eu/eurostat/statistics-explained/index.php/ICT_specialists_in_employment#Number_Open_Fiber_ICT_specialists

Digitization creates many jobs for skilled and well-paid specialists, the number of digital jobs will grow further in the coming years. According to data from the World Economic Forum, today 65% of children entering elementary school will do jobs that do not yet exist as adults.⁴

⁴ [http://reports.weforum.org/future-Open Fiber-jobs-2016/chapter-1-the-future-Open Fiber-jobs-and-skills/](http://reports.weforum.org/future-Open-Fiber-jobs-2016/chapter-1-the-future-Open-Fiber-jobs-and-skills/)

1.2 The Italian strategy for ultra-broadband

Speaking of innovation, many countries can come to mind, but Italy is certainly not one of them. Yet over the past five years, the Italian state has become the protagonist of a reform whose success has also been certified at European level by the European Court of Auditors (ECA, 2018)

On March 3, 2015, the Government approved the "Italian ultra-broadband strategy", an ambitious project born under the European Agenda 2020. The goal of the strategy is to give Italy a new speed, opening up people's access to the most advanced digital services and the opportunities offered by an increasingly interconnected world. It particularly aims to develop an ultra-broadband network across the country to create a future-proof telecommunications infrastructure.

The network is developed according to the principle of technological neutrality with an integrated approach (fixed and mobile, wired and wireless, satellite access) and is open, guaranteeing access to fair and non-discriminatory conditions. The plan provides for synergy between the public and private operators, which is essential in order to achieve the strategic objectives set: the main actor and the market, while public and subsidiary intervention for private investments in order to stimulate them and get where they do not arrive.

The strategy is conceived as a dynamic measure that will be periodically updated adapting it to the evolution of technology, services and demand, but which will, in any case, represent the compass in terms of actions, methods, organization and tools implemented.

The objective of the Action Plan outlined in the Strategy is to have by 2020 the subscription by at least 50% of the population of services to more than 100 Mbps, through a more precise goal of coverage for ultra-fast networks at over 100 Mbps up to 85% of the population including offices and public buildings (especially schools and hospitals), in the areas of greatest economic interest and demographic concentration, of the industrial areas, of the main tourist areas and of the logistics hubs, and to bring 100% of the population to at least 30 Mbps.⁵

The main interventions outlined can be traced back to three areas:

- 1) On the network infrastructure;
- 2) On the ways of supporting the development of the ultra-broadband on the supply side;
- 3) On the support for the development of ultra-broadband on the demand side.

With reference to the interventions related to the construction of the network infrastructure, they show recognition of the stock of existing infrastructure through the implementation of the under and above ground land registry:

⁵ <http://bandaultralarga.italia.it/piano-bul/obiettivi/>

According to the plan, the cadaster is designed as a web-based platform, enabling three different types of access - citizens (for aggregate information only), road managers, down and over ground operators - to manage a three-way communication level that make available, in an open formats, all the useful information about the various transmission types (wireline, wireless and satellite) and laying (cable ducts, mini-trenches, above ground, air and more). The Cadaster of the under and above ground must be fed obligatorily by telecommunications operators but also by all the other public and private subjects that possess or build, for whatever purpose, laying infrastructures usable for the development of new fiber optic networks, the administrations local (municipalities and provinces) and service management bodies (district heating, gas, electricity, water, electricity, etc.). This infrastructure register is coordinated by Infratel, a company with total public participation of the Ministry of Economic Development.

Regarding the methods of promoting broadband development, the options envisaged present a different degree of capacity. The most powerful of the instruments is creating an integrated network, "up to the dwelling", of optical fiber for broadband (so-called FTTH Fiber to the home).

The other options are creating a fiber optic network up to the "cabinets" of the distribution network, using the traditional telephone network for broadband signal transmission in the section from the "cabinets" to the home (this technology is

called Fiber to the Cabinet FTTC) and the two intermediate solutions Fiber to the Building (FTTB) and Fiber to the Distribution Point (FTTDP). In the Italian context, the most performing structure (considering that FTTH > FTTB > FTTDP > FTTC, that is the solution "up to the house" is intrinsically better than all the others in the order indicated above) must be carried out in time to guarantee the achievement of European objectives. Given the peculiarity of the Italian network, which does not present very large distances between the distribution cabinet and the dwellings, the development of the FTTC solution is, according to what is outlined in the plan, in the preferable state, considering the physiological evolution of the same towards the FTTH.

With reference to the interventions on the supply side, within the Plan, it was acknowledged that the European ultra-fast broadband target (speed greater than 100 Mbs) for at least 50% of home users by 2020 cannot be achieved without public intervention that stimulates and directs the programming of private individuals. In order to maximize the effectiveness of public intervention with respect to the limited economic resources available, clustering was carried out; it made it possible to identify differentiated hedging objectives, instruments and financial needs based on the characteristics of each area.

The investment planned to achieve the complete implementation of the strategic plan is € 12.4 billion.

The Italian territory was divided into 94,645 homogeneous sub-areas (based on the concentration of the population, the characteristics of the territory, the density of businesses and the offer of infrastructures for ultra-broadband already built and planned) that have been grouped into 4 clusters A, B, C, D:

1) Cluster A - profitable areas:

It is the cluster with the best cost-benefit ratio, the most favorable area to achieve the goal of creating 100 Mbs ultra-high-speed networks by 2020. It includes the main 15 black cities (i.e. those cities where more than 30 Mbps network operator is or will be present: Rome, Milan, Naples, Turin, Palermo, Genoa, Bologna, Florence, Bari, Catania, Venice, Verona, Messina, Padua and Trieste) and the main industrial areas of the country and make up 15% of the national population (around 9.4 million inhabitants). The instruments that are intended to be used to achieve the objective are financial instruments for accessing credit at preferential and low-risk conditions and/or measures for the tax exemption of investments. Therefore, in this cluster, the intervention will be carried out exclusively by the market;

2) Cluster B - areas for which an investment at 100 Mbs is not envisaged:

It consists of the areas where operators have built or will build networks with connections of at least 30 Mbps, but market conditions are not enough to guarantee acceptable returns on market-only conditions to invest in 100 Mbps networks. It includes 1,120 municipalities, in which 45% of the population resides (about 28.2

million), some in black areas and others in grey areas (i.e. those where there is only one network operator and there are no plans for a second).

It is divided into two sub-clusters, depending on whether a public intervention has been launched for the development of connectivity at least 30 Mbps:

- B1 in which network operators invest directly;
- B2 which includes the areas in which public plans have been created or are in progress for the construction of networks with at least 30 Mbps connectivity.

In addition to the financial instruments for accessing credit at reduced and low-risk conditions and/or tax exemption measures, the instruments that will be used to achieve the objective are also grants to upgrade networks from 30 to 100 Mbps limited to what is strictly necessary, with possible public participation in the construction of the works. Therefore, in this cluster, the intervention will be carried out mainly by the market with minimum use of public funds;

3) Cluster C - marginal areas:

These are marginal areas currently in market failure, including rural areas, for which it is estimated that operators can mature the interest in investing in networks with more than 100 Mbps only thanks to state support. It includes about 2,650 municipalities and some rural areas not covered by networks at more than 30 Mbps and about 15.7 million people (25% of the population) reside there.

The target set with respect to the cluster and coverage by 2020 of 30 Mbps guaranteed to the entire population included in the areas affected by the cluster, up to 100 Mbps in some of these (from an initial coverage of 2 Mbps).

The instruments that are intended to be used are financial instruments for accessing debt at reduced and low-risk conditions and/or measures of tax exemption and limited non-refundable contributions, but proportionally greater than that of cluster B with any public participation in the realization of the works. Therefore, in this cluster, the intervention will be carried out mainly by the market with proportionally greater use of public resources than in cluster B;

4) Cluster D - They are typically market failure areas (so-called white areas) due to their low population density and jagged location on the territory for which only direct public intervention can guarantee a resident connectivity service to more of 30 Mbps: It encompasses the remaining 4,300 municipalities, especially in the South, including some rural areas and resides there approximately 15% of the population (9.4 million people).

The tool that is intended to be used to achieve the goal is, above all in the South, the public incentive granted to a greater extent without a grant; having regard to the strategic ultra-broadband infrastructures for the purposes of cohesion policies for the development of particularly disadvantaged territories, with a per capita GDP of less than 75% of the EU-27 average (17 thousand euros). Therefore, in this cluster,

the intervention will be carried out entirely using public resources, as the State will intervene directly by creating an infrastructure of its own property and giving incentives to operators for the provision of the service.

Summing up, four different ways of stimulating the offer are hypothesized, with a different degree of public intervention depending on the greater or lesser suitability of the market to ensure the achievement of the objective for the different areas. They range from the direct intervention (applicable to cluster D), public-private partnerships, the incentive model, the demand aggregation model, which combines the three models indicated above, in order to make them sustainable, for the aggregate sub-areas, a 100 Mbps offer. For all models, the European Union requires the recovery (so-called claw back) of the incentives given in excess (detectable by a profit of the beneficiary) (BARCLAYS, 2018).

1.3 Resources and public role

The public financial needs hypothesized to achieve the objectives of the strategy are fully covered by integrating national and Community resources, including from different programs, but the use of public funds is linked and subordinated to the direction and amount of private financing.

- *Community funds*

To finance the National (PON) and Regional (POR) Operational Programs presented by the EU states as part of the Europe 2020 Strategy cohesion policies adopted by the European Commission, the Commission itself has adopted the Partnership Agreement, relating to the ESI Funds (Funds European Structural and Investment) for the period 2014-2020.

Among these funds, those used by the BUL strategy are the ERDF (European Regional Development Fund) and the EAFRD (European Agricultural Fund for Rural Development). In addition, then comes a portion of the fund of the Juncker plan, EFSI (European fund for strategic investments).

- *National and regional funds*

The FSC (Fund for Development and Cohesion) and, together with the European Structural Funds, the main financial instrument through which policies for the development of economic, social and territorial cohesion and the removal of economic and social imbalances are implemented.

The FSC is multiannual in coherence with the temporal articulation of the programming of the ESI Funds, guaranteeing the unity and complementarity of the procedures for activating the relative resources with those envisaged for the Community funds. In particular, the Fund's intervention is aimed at financing strategic projects, both infrastructural and intangible, of national, interregional and regional importance

The strategy is coordinated as a whole by the COBUL (Committee for the spread of ultra-broadband) and is composed of the President of the Council of Ministers, the MISE (Ministry of Economic Development), Infratel and AgID (Agency for Digital Italy), the latter has defined the national strategy and monitors its correct implementation in relation to the competences of the interested parties, possibly proposing corrective measures.

The MISE has the institutional competence in the field of telecommunication infrastructures, takes care of implementing the measures defined for the national strategy, also making use of its internal company Infratel Italia SpA and coordinates

the activities of all the public and private actors involved. Furthermore, the MISE manages the land and subsoil cadaster which also includes the functional data for monitoring the strategy itself (Infratel, 2015).

The Ministry of Agricultural, Food and Forestry Policies collaborates with COBUL for the implementation and monitoring of the strategy in the context of the Agricultural Fund for Rural Development which has dedicated part of its resources to the Plan in question.

AGCOM (Authority for Guarantees in Communications), within the scope of its prerogatives as independent guarantee authority, has the task of defining the regulatory context within which the development of the ultra-wideband moves, defining the access tariffs and managing the sector regulation, in relation to the calculation of any extra profits of the public funding winner.

AGCOM will also have the role of verifying the actual connection speed in the areas involved in the project and the trend of ultra-broadband subscriptions at least 100 Mbps, which it will communicate to AgID, thus making it possible to assess the impact of the measures at supporting demand. AgID ensures synergies with major public digital development projects by optimizing and rationalizing public investments.

Considering the nature of the funding of this strategy, the Cohesion Agency will exercise its spending coordination and control powers by evaluating and sometimes

directing regional plans, as well as monitoring the implementation of the measure both through COBUL and analyzing data published by MISE. The Agency will also be able to directly define the development initiatives and, by coordinating the Regions and the Autonomous Provinces, to implement all the measures that allow the optimization of the assigned resources and the containment of operating costs. Within this framework, the Regions and the Autonomous Provinces, which have direct competence in the matter, define the operational programs, establish the priorities for intervention and therefore the models to be applied in accordance with this strategy. With the support of MISE and Infratel, they also independently carry out their infrastructure plans and manage the resources used to finance the strategy. MISE after consultation with AGID, the National Association of Italian Municipalities (ANCI), AGCOM, the Minister for the Environment and the Protection of the Territory and the Sea, the Committee for Technical Rules on Spatial Data of Public Administrations and Unified Conference, defines the content of the "Federated National Information System of Under and Above Soil Infrastructures", as well as its methods of establishment and subsequent updating, for the training, documentation and mandatory exchange of spatial data held by the 38 individual administrations competent and other entities or infrastructure managers, as well as the rules for the use of the data between the central and local public administrations and the other holders or managers of infrastructures present in the subsoil.

The ANCI promotes the ultra-broadband strategy and ensures the coordination and uniformity of implementation of the federated national information system of the underground and above-ground infrastructures in Italian municipalities.

The Digital Champion in the Council Presidency will ensure the dissemination and communication of this strategy. In 2019, the Department for Digital Transformation was set up, it is the support structure for the President for the promotion and coordination of government actions aimed at defining a unified strategy for digital transformation and modernization of the country through digital technologies. It implements the President's directives on the matter and ensures the coordination and execution of digital transformation programs.⁶

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<http://presidenza.governo.it/AmministrazioneTrasparente/Organizzazione/ArticolazioneUffici/Dipartimenti/DTD.html>

1.4 The state of play concerning the ultra-broadband network

The achievement of European objectives for the development of ultra-broadband connections requires much investment interventions, both public and private. In 2015, as part of the ultra-broadband strategy, some critical issues concerning the development of the band were detected. More specifically, it was noted that Italy was below the European average of over 40 percentage points in accessing more than 30 Mbps and with a delay estimated to be around 3 years. As of July 2014, as indicated by Infratel, only 21% of the population had the availability to access the Internet at more than 30 Mbps, compared to the average of European countries that had already reached 64% of the population.

The initiatives of private operators would not have been able on their own to achieve European objectives; however, the most advanced countries, such as the United States and South Korea, were upgrading their network from 100 Mbps to 1 Gbps. In Italy, there was also a lack of demand for ultra-broadband connections, also linked to the contraction of the connection on the fixed network and to the limited offer of contents for which broadband is essential. Ultra-broadband projects refer to landline connections, however, the fiber infrastructure is also essential for improving the mobile connection; this is because the fiber binding of base stations is the solution that creates the best conditions to fully exploit the capabilities of LTE

networks. On 26 April 2019, AGCOM published the data of the Observatory on Communications (No. 1/2019), updated at the end of 2018, relating to electronic communications, the media (radio, TV, publishing, online advertising), and postal services and express couriers.

With regard to electronic communications, the data relate to the technologies used to provide access to broadband and ultra-wide electronic communications networks and show profound changes compared to previous years: while at the end of December 2014 almost 94% of accesses to the fixed network it was made of copper, at the end of 2018 these fell to 58%, equal to a decrease of 7.5 million lines. In the same period accesses increased through other better-quality technologies those in FTTC technology (+5.9 million units), FTTH (+540 thousand) and FWA (+ 700 thousand). In terms of connection speed, lines with speeds below 10 Mbit / s represent less than 25% of broadband and ultra-broadband lines in December 2018, compared to 75% in December 2014; conversely, lines with speeds equal to or greater than 30 Mbit / s have gone, with 2.7 million accesses, to 45.1% (from 3.7%). The accesses with speeds greater than 100 Mbit/s increase by 1.39 million units for a total, in December 2018, of 3.15 million accesses, with a considerable growth recorded in the fourth quarter 2018 (+360 thousand units).

The calls for creating ultra-wideband in market failure areas and construction sites opened on 2 March 2016, the Ultra-Broadband Committee (COBUL) decided to

focus public intervention in areas of market failure through the use of the "direct intervention" model and the CIPE, in the May 1 meeting 2016 has adopted this orientation, establishing that in the areas of market failure, only direct intervention is carried out. This national aid scheme was defined in accordance with European legislation on state aid.

On June 3, 2016, the first call for tenders for the fiber network was published "white areas", i.e. those in market failure, and grey areas grouped in Clusters C and D provided for by the National Ultra-Wideband Plan. The call was divided into five lots and covers six regions: Abruzzo, Molise, Emilia Romagna, Lombardy, Tuscany and Veneto, with which specific program agreements and relative operating agreements have been signed for the use, together with the National Development and Cohesion Fund, of the FESR and EAFRD structural funds. The public funds will be 1.4 billion, divided into more than one billion state funds (FSC) and 352 million structural funds at the regional level.

The tender was awarded to the economic operator Open Fiber Spa, for all five tender lots. The call covers the design, construction, maintenance and management of a passive and active wholesale access network, which allows telecommunications operators to provide services to end-users at 100 Mbps and in any case, not below 30 Mbps.

The network will be granted for 20 years and will remain in public ownership.

On 24 August 2016, the second call for tenders was published, divided into six functional lots, for the construction of the public broadband network in white areas, that is to market failure concerning the regions of Piedmont, Friuli-Venezia Giulia, Aosta Valley, Lazio, Basilicata, Campania, Umbria, Sicily, Marche, Liguria and the Province of Trento. Also, in this case, the procedure was awarded to the Open Fiber Spa operator, for all six lots placed for tender. Following numerous judicial appeals by various operators, the signing of the contract with the successful bidder was concluded in November. The third call for tenders, relating to the award of lots relating to the three remaining regions (Apulia, Calabria and Sardinia) was published on April 17, 2018, the tender ended on December 18, 2018. It was again awarded Open Fiber Spa which was awarded the contract for all lots.⁷

⁷ <http://www.gareinfratel.it/>

1.5 Digital divide 2.0 in the era of ultra-broadband

Defining what digital divide means in the era of ultra-broadband is an extremely complex fact, due to the countless technologies available on the access market (FTTH, FTTC, FWA of different types, and still 5G and 4G).

We could say that it is the gap between those who have (adequate) Internet access and those who do not (by choice or not), this entails exclusion from the advantages of the digital society, with socio-economic and cultural damage for people affected. What appears evident is that fixed access, in Italy an almost absolute monopoly of copper and now gradually replacing it with fiber, and mobile access tend to converge more and more and get closer in terms of performance making the regulatory issues that infrastructure competition.

According to the most accredited classification on the subject, it is possible to distinguish three types of the digital divide: global, social and democratic. The first refers to the differences existing between more or less developed countries; the second concerns the inequalities existing within a single country; the third focuses on the conditions of participation in political and social life based on the use or less effective and conscious use of new technologies.⁸

⁸ <https://www.agendadigitale.eu/cultura-digitale/il-digital-divide-culturale-e-una-nuova-discriminazione-sociale/>

When analyzing the phenomenon of the digital divide, it is necessary to highlight a cognitive dimension which presupposes the absence of minimal computer skills by an individual, who therefore is unable to perform the simplest virtual activities configurable in cyberspace; and an infrastructural dimension that focuses on the existence of shortcomings in the availability of infrastructure equipment and telematic tools necessary to allow effective navigation. In consideration of the relevant implications of the digital divide, a part of the most recent jurisprudence has recognized the existence of a real digital divide damage, caused by the violation of the right of access, which prevents the individual from exercising regularly of their online rights, configuring a peculiar type of prejudice, which can be classified as damage to the person in the form of loss of "inclusion" chances.

Speaking of Italian FTTH coverage (in terms of truly marketable real estate units) of the country in fact at the end of 2019 it can be estimated at around 28 per cent of the real estate units (as shown by the updated ultra-broadband map below) and the plans that are public of the main fiber infrastructure operators in fixed access (Open Fiber- TIM-Fastweb) lead us in 2023/24 to something of the order of 60%.

Table 2. Italian coverage NGA-VHCN in 2019



Source: <http://bandaultralarga.italia.it/mappa-bul/>

Probably the development of fiber in housing will take a decade to reach coverage close to 90% of the population, leaving open the problem, if you want to consider it, of how to manage the remaining 10%.

The reasons that influence this digital divide are obviously the same as the first-generation digital divide (broadband ADSL) and that is an extremely high connection cost in remote homes to which can be added the technical difficulty of construction in a country where the heritage artistic is important and rightly protected. However, the increase of about 30 percentage points of coverage, equal to about 10 million BU, is certainly not a simple step both from the point of view of the necessary financial resources and from an implementation point of view.

These problems are not limited to Italy but involve almost all of Europe.⁹

Web accessibility is one of the crucial factors to guarantee individuals the possibility of achieving economic equality first. In addition, a series of studies have highlighted the key role of the web and information technology in allowing higher social mobility by subjects: digital is, in fact, a strategic tool in the areas of continuous training, but also in finding opportunities to realize career advancements, and so on. Furthermore, the web always represents a key tool to guarantee social equality - and this always by guaranteeing universal access to information, communication tools and training opportunities. Lastly, the web has also opened up a series of immense opportunities from the point of view of the growth and economic development of a nation. In fact, information technologies help companies to optimize their productivity, minimizing waste; beyond that, the industry linked to the IT world is now one of the main sectors for the use of workforce; digital is still the keystone, the catalyst for creating the so-called Industry 4.0, in which physical and virtual reality can work synergistically with each other (OECD, 2008).

⁹ <https://www.agendadigitale.eu/infrastrutture/digital-divide-banda-ultralarga-ecco-tutti-i-problemi-da-superare/>

APPENDIX A.1

A copper switch-off analysis

In 2019 the FTTH Council Europe commissioned WIK - Consult to study copper switching off. Although many countries have extensive fiber coverage, there is limited progress towards copper switch-off in Europe.

Copper switch-off progress is very different across EU Member States, progress varies from one country to another, in some countries, the process is in its infancy, in others, FTTH is not yet widely deployed. A lack of understanding of the benefits of fiber and challenges in switching to a fiber operator may also be hampering consumer from migrating in other cases. (FTTH Council Europe, 2019)

The main factor delaying migration to FTTH in several countries is the continued reliance by the incumbent on copper rather than investing in or accessing FTTH networks. Among the ten Member States analyzed, Estonia, Spain and Sweden are leading the way. The greatest progress has been made in Estonia, with 70% of copper exchanges closed in 2018 and plans to remove copper access for 60% of broadband subscribers by 2020.

Copper switch-off significantly enhances the business case for fiber by increasing penetration on the FTTH network, thereby supporting a more widespread deployment. The transition to fiber is a win-win for consumers and operators.

The study found that both end-users and fiber network operators benefit from the transition to fiber in several key areas, including:

- Reliability: fiber is 70%-80% more reliable than copper resulting in lower fault rates;
- Energy efficiency: copper switch results in 40-60% energy savings due to the lower power consumption of fiber;
- Cost efficiency: 40-60% lower maintenance costs;
- A better deal for consumers: surveyed consumers were more satisfied with fiber (82% happy vs 50% on DSL), quoted higher bandwidth, a wider range of services and better value for money as key benefits;
- A better deal for investors: evidence suggests that clarity on copper switch-off can improve the business case for fiber. Member states and regulators should usefully act to enable PSTN (public switched telephone network) switch-off, which is a prerequisite and a facilitator to copper switch-off, remove regulatory barriers, and ensure that consumers are informed about which offers are based on full-fiber and its benefits.

The key steps to support switch-off:

- ✓ Findings suggest that member states and regulators could help enable copper and PSTN switch-off, and support consumer migration to FTTH;

- ✓ Incentivizing FTTH deployment and/or FTTH access use by incumbents;
- ✓ Avoid promoting continued reliance on copper and copper upgrades such as FTTC;
- ✓ Facilitating PSTN switch-off by encouraging operators to find solutions that support legacy equipment or informing consumers of alternatives;
- ✓ Reviewing conditions for copper exchange closure;
- ✓ Improving customer awareness by clearly distinguishing FTTH from FTTC in advertising;
- ✓ Improving processes for switching between the incumbent and alternative FTTH platforms.

The switch-off of the copper network is prefigured through three reference scenarios (AGCOM, 2019):

- The aggregation of the central areas: the closet areas attested to a local central office can be connected with optical fiber to another central office, allowing the divestment of the first. The plants/offices to be disposed of, in this case, are not normally plants open to unbundling services, and have small dimensions in terms of covered real estate units (a few thousand);
- The switch-off of the primary copper network: the development of an FTTCab architecture involves the fiber connection between the cabinets and the local exchanges, reducing the percentage of use of the primary copper network. This,

with a view to efficiency and having exceeded a certain technological migration threshold from copper to fiber, raises the theme of the switch-off of the primary copper access network section and therefore of the services provided on it;

- The switch-off of the primary and secondary copper network: the development of an FTTB / H architecture involves the fiber optic connection between the local exchange and the user site, reducing the percentage of use of the primary and secondary network in copper. With a view to efficiency and having exceeded a certain technological migration threshold from copper to fiber, this raises the issue of the switch-off of the section of the primary and secondary access network in copper and therefore of the services provided on it.

“Reasons for the limited switch-off plans are diverse. In some countries, FTTH has yet to be widely deployed. In others, strict controls on exchange closure may be delaying switch-off. What’s more, a lack of understanding of the benefits of fiber and challenges in switching to a fiber operator might also be making it difficult for consumers to migrate. However, regulatory approaches to access regulation and pricing, migration and advertising standards can all act as incentives for operators and consumers to switch. Product pricing in relation to perceived value influences migration to fiber. This perceived value, in turn, is affected by how broadband is marketed to customers and whether they understand the difference between copper, partial fiber, and full fiber. Customers must also be able to switch easily. Solutions

which provide 'plug and play' option and support legacy equipment could make switching easier. Pursuing PSTN switch-off could also be a helpful precursor to copper switch-off." Supported Ilsa Godlovitch & Director Brussels Office, WIK-Consult.

"We believe Europe needs a single market strategy for the migration process and the ultimate switch-off of copper. European-level debate on the fate of copper is required. Europe needs new fiber infrastructure and constructive dialogue amongst stakeholders. Our study aims to be a discussion starter and to bring together policymakers, copper network owners, new fiber investors and consumers to constructively approach this complex topic." Sustained Erzsébet Fitori, General Director of the FTTH Council Europe

"This study is of tremendous importance for the FTTH Council Europe. The telecom market is in a transitional phase, moving from an old copper-based infrastructure to new fiber-based networks. All eyes are on 5G, but we should not forget that fiber is the foundation of all technologies for connectivity. Policy is lagging behind the market developments, and it is important that it catches up." Explained Ronan Kelly, President of the FTTH Council Europe.

CHAPTER 2

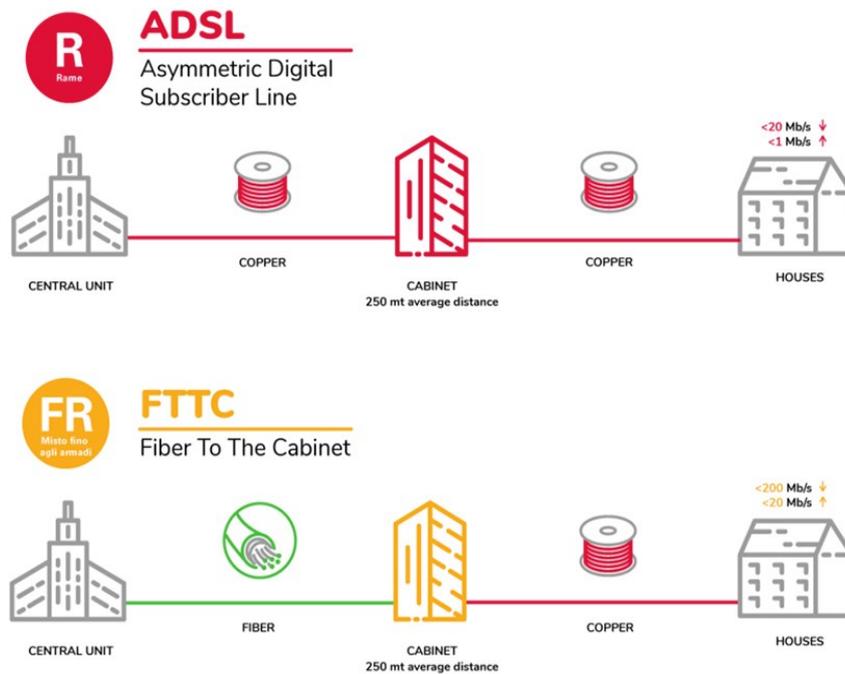
THE OPEN FIBER'S BUSINESS MODEL AND ITS COMPETITIVE ADVANTAGES

2.1 Open Fiber S.p.A. and how it works

Until recently, the spread and use of the Internet in Italian homes were still the prerogatives of a few, but, nowadays things have radically changed; almost all the inhabited areas of the “*Bel Paese*” have the opportunity to sign up for a subscription with this or that provider in order to surf the net to browse their favorite websites, listen to music, watch videos and so on. However, it must be taken into account that, although on paper the thing is feasible, in reality, it is not so. To be able to perform all these operations, and above all to be able to do it simultaneously - with other users, in the same house - and without any kind of problem, it is necessary to have a good connection to the Internet, stable and sufficiently fast just as only the optical fiber knows to be. Unfortunately, despite the great efforts made to "wire Italy", the fiber optic network is not yet available for the entire population. However, thanks to Open Fiber Spa a wholly-owned subsidiary of the Italian energy company Enel and CDP, things are changing (for the better) and are set to improve even more over the next years.

The Open Fiber network uses Fiber To The Home technology, the fastest in circulation because it is composed of fiber cables throughout the route, including the section that goes from the control unit to the customer's home. An infrastructure of this type allows to reach, both in terms of download and upload, a maximum speed of 1 Gigabit per second. In the case of ADSL, instead, the cables used to connect the customer's home to the control unit are entirely in copper, while in the case of FTTC technology, the two connections are one in copper and the other in fiber optics as showed in the next page from Fig. 1.

Fig. 1. Difference between ADSL, FTTC and FTTH networks.





Source: <https://openfiber.it/en/technologies/fth/fth-fiber/>

Its mission responds to the objectives set by the European Digital Agenda, by the Italian Ultra-Broadband Strategy and by the Gigabit Society with which we intend to establish the minimum levels of connectivity in all European countries for citizens, institutions and companies, urging the individual countries to act to encourage the construction of the latest generation networks.

The ability of Open Fiber to carry out its particular economic activity in a more efficient way than the competition is attributable to the exploitation of the Enel infrastructures in which electricity currently passes. Therefore, they are able to increase the fiber network without particularly expensive and structurally invasive operations; limiting the drawbacks dictated by the need to carry out ex-novo excavation and laying operations of the optical fiber, which, for obvious reasons, create more and more uneasiness and chaos in urban areas.

What Open Fiber do, in the first place, is to sign an agreement with the Municipality concerned for the construction, management and maintenance of a state-of-the-art

ultra-broadband fiber optic network infrastructure. In the agreement, the working methods and times, the compliance with the technical standards and those relating to safety are also defined for the contractors in order to cut the inconvenience to the citizen during the works to the bone.

The agreement also defines the excavation method for laying the optical fiber. Excavations can be carried out with one of the following techniques: that of the reduced mini-trench (also include the suction of waste material), that of the traditional mini-trench (it involves the creation of trenches 5 cm wide and has a very low environmental impact), that of the no-dig (without resorting to open excavations) or that of the laying of the aerial network (ITU-T, 2016). After carrying out all the work and after a first temporary filling of the excavation to allow the land to settle, the entire road surface is restored according to the timing dictated by the reference Municipality. Later, after obtaining all the permits and administrative authorizations, it is finally possible to proceed with the activities that will bring the optical fiber into the home. It is then up to the providers to request to use the infrastructure created.

On the after-sales service side the Service Operations Center (SOC) is the spearhead of Open Fiber, considered one of the most advanced on the national territory, SOC boasts over 100 available stations and is divided into two sections: Delivery and Assurance.

The Delivery system takes care of the activation of the network for the end customer based on the requests of Open Fiber partner operators who have purchased the services in the wholesale-only market.

The Assurance systems are designed to identify and intervene in the event of faults or anomalies in the FTTH network service, which is controlled by 24/7 monitoring on the status of the individual activated fibers and with the use of optical reflectors installed in the home of each individual customer.

Anomalies are identified in two ways:

- ✓ Reactive, partner operators manage end customers, report signal failure or anomaly. It is possible to carry out a very precise location of the problem since the Fiber To The Home (FTTH) network is perfectly mapped;
- ✓ Proactive, Open Fiber's technicians have provided some technologically advanced alarm management systems that are activated thanks to sensors and IoT elements inserted in POPs (Point of Presence) and throughout the entire path of the fiber-optic network.

Once the fault or anomaly present on the FTTH network has been identified, the Open Fiber suppliers restore the service to the end customer. It is therefore not difficult to deduce that the advantages deriving from using a network entirely in FTTH are not few, in terms of speed and reliability. Thanks to a network based on FTTH technology it becomes for example possible to watch a movie in streaming

and in HD on Netflix, listen to music on Spotify, upload photos to Dropbox as well as chat on the preferred messaging services and surf the net in search of interesting news, all simultaneously, smoothly for any connected users.

But it does not end there, fiber-optic connections also allow the implementation of systems related to home automation, allowing for a better quality of life. Clearly, apart from private customers, the advantages of the Open Fiber network can also be used by professionals, companies and public administrations.

Smart working, distance learning, efficient energy management and so on and so forth are all becoming "things" more easily usable.

All this is possible because the fiber optic connections are more stable and productive as they are less subject to interruptions and technical problems than copper wiring and are able to guarantee high performance. Fiber optic networks are also the future of telecommunications networks (Next Generation Network - NGN) and in the coming years, they will be able to reach even higher speeds than the current ones.

2.2 The services offered to the OAO

Open Fiber offers and guarantees to the OAO (its customer operators) not only the quality of the infrastructure but also great flexibility to offer the best solution to the market and the end customer:

- ❖ Housing at its POPs and Interconnection Points: allowing operators who want to infrastructure to install their equipment and connect them to the fiber network to provide service to end customers;
- ❖ MAN connections (Metropolitan Area Network): in order to create dedicated networks in cities between different infrastructures;
- ❖ PON connections - passive: for operators who have their own OF infrastructure, it grants FTTH access with the fiber off by connecting the POP to the end customer sites;
- ❖ Point-to-point connections - passive to connect end customers' customers, Public Administrations or to connect network infrastructures with fiber in point-point technology;
- ❖ Active FTTH services: for operators who do not have their own infrastructure, or prefer not to make direct investments on the access network, they provide a turnkey service by delivering traffic to end

customers in an aggregate manner both to its POPs and through its national backbone to Regional or National POPs;

Open fiber provides access to a scalable fiber-optic network that customers can activate according to their needs, to develop services saving time and money compared to the creation of its own network.

The quality of the connections is guaranteed by tested procedures and maintenance which always ensures maximum efficiency of the networks. Thanks to the extensive network of optical fibers, Open Fiber is able to offer its customers many advantages:

- Immediate availability of all the resources needed to allow professionals, companies and the Public Administration to develop services through networks an optical fiber;
- Big savings in the investments needed to activate and maintain a fiber network optics;
- Guarantee of an infrastructure constantly maintained in perfect condition, which it also includes excellent after-sales service to customers.¹⁰

¹⁰ <https://openfiber.it/servizi-operatori/diventa-partner/>

2.3 The Telco business model analysis

The Telco environment is becoming increasingly intricate, some operators have belatedly noticed that consumption trends are changing at the speed of light and that value is moving not only towards other phases of the value chain but above all towards completely different markets.

Telecommunications companies are constantly faced with the threat of over-the-top (e.g. Netflix) and until they put customers first and at the center of their strategies, they will have a hard time succeeding.

Digital consumer maturity is putting obsolete business models under increasing pressure and they are falling apart. Few - like Open Fiber - have understood this rapidly evolving scenario and have quickly taken steps to ensure that the business model is in tune with the changing times. An example is a fact that a Norwegian fiber operator Lyse convinces his customer to dig the connectivity of the last mile.

“Telcos should consider taking steps to incrementally change their business models while striving to adopt radical approaches in select areas, and challenge traditionally accepted norms of where a telco fits into the larger ecosystem” (CAPGEMINI, 2011).

Companies that want to succeed must basically check their business model regularly and, if necessary, challenge its components. However, in order to redefine its general orientation, it is fundamental to first understand the components of a business model.

"A business model describes the design or architecture of the value creation, delivery and capture mechanisms employed. The essence of a business model is that it crystallizes customer needs and ability to pay, defines the manner by which the business enterprise responds to and delivers value to customers, entices customers to pay for value, and converts those payments to profit through the proper design and operation of the various elements of the value chain. Put differently, a business model reflects management's hypothesis about what customers want, how they want it and what they will pay, and how an enterprise can organize to best meet customer needs and get paid well for doing so" (TEECE, 2010).

A business model is made up of three highly interconnected dimensions: Target, Interaction and Creation.

The goal is to define the revenue potential. This is derived as a sum of three key elements. First, the geographic or vertical markets within which the company aims to provide the service. Second, the customer segments that need to be addressed and their specific requirements. And finally, a range of products/services clearly defined according to the needs of previously identified customers. Together, these

elements form the basis for creating a unique value proposition for the company's product/service.

The interaction defines the way in which the company interacts with the customer to meet his needs with products and services; it includes three elements: the first is the relationship with the customer, with particular attention to the nature of the relationship, the intensity required, the duration, the content and the typical and ideal sequence of events during customer interaction.

The second is the distribution channels through which products and services must be marketed or which facilitate interaction with customers before and after the sale.

The third is the structure of payments with a clear definition of the method, time point and frequency of payments. Together, these elements define the company's income flow structure.

The creation is based on the first two dimensions of Target and Interaction, defines how a company can profitably satisfy its value proposition. The essential elements are the resources and special skills that the company introduced in creating value. These could be the company's production facilities, brand or technologies; another important element are the specific processes that the company must master in order to provide its services. Finally, it is necessary to address which components of the service must be provided internally - considering the background of the quality, costs and flexibility desired - and which should be ordered by a network of partners.

The organization of value creation essentially characterizes the company's cost base and determines the competitive capacity and sustainability of the business model.

Telcos have made efforts to innovate through the three main dimensions, through a combination of market, channel and network initiatives:

- ❖ Changes in the target: Telecommunications have started to change their core value proposition. Diversification is the keyword. In many cases, operators are entering completely new sectors or showing their willingness to modify their offerings to meet changing business and consumer realities;
- ❖ Changes in interaction: Telecommunications are making fundamental changes to traditional revenue models. As mentioned above, Lyse, once realized that the cost of digging a trench for the last mile between the house and the node was prohibitive, found an innovative model with which he offered a discount to customers who dug the trench by yourself; establishing that the activation of the services would take place only after at least 60% of the people in an area had opted for the do-it-yourself approach.

Lyse's idea was brilliant in terms of results and created an emotional bond with her clients;
- ❖ Changes in creation: Telecommunications are also making changes to areas that directly affect their cost base. In emerging markets, a key approach is to outsource significant parts of network operations to equipment suppliers;

an approach that is starting to gain ground in the developed ones too. Another possibility is to simplify complicated operations support systems/business support systems, to save costs. Many operators are trying to reduce the impact of their operations on the environment.

Nowadays, there is a pressing need to innovate business models for telecommunication operators. Telcos will have to innovate through all three elements of the business model in order to compete successfully in the Gigabit Society where it could play a significant role for the entire ecosystem.

By innovation, we mean a two-pronged approach, aimed both at modifying the business model incrementally and at constantly expanding the borders by offering new generation services.

Telcos should be flexible in incorporating the best practices of successful actors in other sectors and third parties. Online players have successfully demonstrated that employee input can have a significant impact on promoting innovation.

Telecommunications must create systems that encourage lower-level employees to contribute to ideas they can potentially consider.

Telcos should consider creating new value propositions by allowing access to content anywhere, anytime through the use of new technologies. Likewise, they should seek to create new monetization models in which they collaborate closely

with content owners and device vendors to create innovative packages that have the potential to generate synergies.

Telecommunications companies should increase collaborations with content owners in defining new models that can best serve each other's interests while offering maximum value for the consumer; in order for consumers to take advantage of data-intensive content services on the Internet; Telcos may consider experimenting with models in which they not only charge consumers for access to network resources but also potentially work with content providers to create tailored, diversified pricing models.

Telcos should work on the creation of models in which they agree with the content actors on provisioning dedicated to the quality of the service to guarantee the monetization of network resources (RAO – PRASAD, 2018).

Some telecommunications companies have already started to extend the traditional boundaries of telecommunications operations. With this in mind, it is vital that operators continue to engage with larger stakeholders, including other companies, regulators and consumers, on the need for an ecosystem in which everyone, including carriers, is compensated fairly for their respective contribution. Telecommunications companies must actively seek to open new horizons in all three elements of the business model. They should move from connectivity providers to third party offer aggregators and innovators.

Telecommunications will need to continue to extend the boundaries of what current revenue models allow. While traditionally followed B2B and B2C models, more and more innovative B2B2C models are more likely to be the norm in the future. From a cost perspective, the openness of both IT and processes will ensure that they adapt perfectly to the demands of new sectors. Going forward in all these initiatives, it remains imperative that telecommunications continue to use their main resources such as the ability to implement complex IT systems in order to provide an ecosystem to other sectors.

Telcos must undertake several changes to ensure that they can leverage their successes in providing telecommunication services. In the end, they will have to make sure they continually challenge established models and notions about their role if they really want to innovate their business model.

2.4 The Open Fiber's wholesale-only model

Open Fiber is the highest-profile wholesale distribution infrastructure operator in Europe, created to build an ultra-broadband network infrastructure entirely in FTTH (Fiber To The Home) optical fiber in all Italian regions¹¹.

In simple terms, wholesaler means that Open Fiber does not direct its offers to end-users directly, but offers its infrastructure only in bulk, to authorized providers. The operators are therefore able to make their offers available to a greater number of potential customers and, far from being unimportant, at an enviable speed being all based on FTTH technology, the fastest in circulation. Open Fiber relies on established third-party service providers (local broadband and mobile operators) to lead the business case.

Going into detail, the wholesale-only business model adopted by this NewCo consists in the construction and management of passive TLC infrastructures to be offered in common use to all the service providers concerned, in conditions of absolute equal treatment between them and avoiding competing with the same suppliers on the TLC retail services market. Since this is a company that is not vertically integrated and therefore active only on the B2B market (wholesale-only),

¹¹ <https://openfiber.it/en/corporate/about-us/mission/>

the possible conflict of interest and the temptation to resort to discriminatory and anti-competitive practices, which has hitherto characterized the activity of the incumbents, is eliminated at the root (BARCLAYS, 2018).

The wholesale-only model has recently obtained an important European recognition: the new European Code, in fact, provides that infrastructure companies that adopt the wholesale-only model can be granted preferential treatment by the national regulatory authorities, in the sense of more flexible regulatory obligations or in any case lighter. The new code also establishes a series of requirements to identify genuine wholesale-only operators: the simple legal separation of the incumbent's network, for example, will be irrelevant if the incumbent maintains control over the separate company.

The intention to give a signal to the investors is evident, encouraging investments towards wholesale-only infrastructure operators, who (unlike the incumbents) have no interest in prolonging the life of copper or in discriminating against service providers (since they do not compete with them on residential markets). They thus guarantee an absolute level playing field among the service providers (SÖRRIES, 2019).

In simple words, this innovative model removes the operator from the competition in the downstream market, and this fact technically reduces (but does not completely eliminate) the risk of cross-subsidies, and in general, of abuse of dominant position.

It is quite clear that if tomorrow, the operator who received public subsidies for choosing this model, should later change skin and enter the retail market, the same old problems would arise again. Such as, for example, those concerning TIM as a vertically integrated operator, present both as wholesale resale to operators and as direct sales to end-users. OF was born with a specific purpose and of primary public interest, that is to bring ultra-wideband optical fiber over the whole Italian national territory to give a new speed to Italy, to open to people access to digital services more evolved and the opportunities offered by an increasingly interconnected world.

The ultra-fast connections with FTTH technology take on even more importance because "the fiber game" is played simultaneously with that of 5G, the new communication standard that promises to be between 100 and 1000 times faster than the 4 LTE. In fact, 5G needs fiber to guarantee the right speed for innovative services, such as IoT, telemedicine and connected cars. If it is true that behind every antenna there must be an optical fiber, it is also true that in order to fully enjoy the benefits of 5G we had to wait for more complete development of the optical network in Italy.

The objectives of Open Fiber are to cover over 270 cities by 2022 with 1 Gb/s services, while in the so-called white areas (market failure) the goal is to reach 100 or 30 Mbps downstream, thanks to the funds made available by Infratel and Mise.

The Open Fiber Network, as stated on the official website, is already available in Ancona, Bari, Bologna, Cagliari, Catania, Genoa, Naples, Milan, Padua, Palermo, Perugia, Turin and Venice.

Today the operators who have chosen to use the 100% fiber optic network of Open Fiber are Vodafone, Fastweb, Wind Tre, Tiscali, FIBRA.CITY, HD Fibra, 1G Fibra, 4 ISP, ACHANTO, Kiara, Connesi, EasyConn, EOLO, WITHU, FASTNET, Go Internet, WC, XMATICA, InternetONE, eirintred, ISILINE, melita, QFiber, netoip, nexin, panservice, Planetel, sicilcom, sistemiHS, spadhausen, Eleusi, Tecnoadsl, TWT, umbrianet, Wavecom, WiCity, XStream, Retelit, Linkem.

According to many analysts, the new needs of the market are demonstrating the limits of the vertical integration model of networks and services: the one in which the owner of a network infrastructure also offers services to end consumers. A delicate knot that for years has been the nightmare of regulators and antitrust authorities.

The same analysts instead highlight the advantages of the wholesale-only model to be clear, which offers some obvious advantages:

- Providers can purchase the services and guarantee a more innovative offer to their users;

- The risks of unnecessary infrastructure duplication are overcome. As already mentioned, the infrastructure holder is one and he rents it to other operators who want to enter the market;
- Conflicts between network operators and service providers that are typical of those markets dominated by vertically integrated incumbents are reduced.

Wholesale-only is growing throughout Europe, in Sweden, Ireland, France, the UK and Austria, some municipalities are thinking of adopting it.

All the advantages described could collapse if this model were first adopted and later abandoned. In fact, there may be cases in which an operator, after receiving subsidies, positions himself on the market, capturing public and private financing to create the structure. And then later, decide to move to the direct resale to the infrastructure public.

We expect that the role of the Regulatory Authority, AGCOM is always high to be able to guarantee even the smallest competitors, but very present on the national territory, to be able to carry out valid and equally recognized infrastructural projects, with better access to the credit also for SMEs.

2.5 Open Fiber - A trustworthy business model and its key success factors

The goal is to cover 18.8 million households with optical fiber (or about 66% of total Italian families) with FTTH (speed of 1 Gbps, latency <1.5 ms) distributed over 7000 municipalities, distributing 150,000 km of fiber by 2023. Open Fiber was born in the last quarter of 2015 from the combination of two assets Enel and CDP which are co-owners 50/50. Enel is the historic Italian utility for electricity and gas. The project involved the implementation of a Fiber To The Home network using Enel's infrastructure, in particular, its ducts. Open Fiber was therefore combined with Metroweb, a telecommunications network operator who had already implemented FTTH in some Italian cities (in particular Milan) and which belonged to the *Cassa Depositi e Prestiti (CDP)* Group, which is a large state-owned financial institution with the mission to support the Italian economy as a lender and investor. Open Fiber is implementing its network in two areas:

- Areas A and B with 271 cities located in dense areas representing around 10 million families and 60% of the Italian population;

- Areas C and D, approximately 6,700 cities in non-dense areas representing around 9.6 million building units. In these areas, Open Fiber will benefit from around € 3 billion in public subsidies and has a concession granted by Infratel until 2037.

The key factors of Open Fiber's success are:

- ✚ The presence of Telecom Italia as a historical incumbent and the complete absence of any cable infrastructure was essential to assess the size of the market opportunity and the level of wholesale competition for Open Fiber. The less competitive infrastructure pushes to invest in a wholesale-only supplier;
- ✚ The key to facilitating the penetration and construction of the new Fiber network is to have the right partners, managing political/regulatory relationships and reducing unit delivery costs. In the case of Italy, Enel and the local municipalities are the keys to success. Enel has:
 - 1) The infrastructure of the pipeline with which to facilitate the creation of FTTH;
 - 2) Clear political know-how;
 - 3) Potentially a retail customer base with which to be a potential end customer;
- ✚ Another element not to be underestimated is that of having a fertile competitive retail environment with retailers very eager to support an

alternative infrastructure. This is essential to encourage high network penetration: the greater the number of potential retail partners, the greater the market opportunities. In the Italian case, Vodafone and WIND TRE are all available dealers. Both companies were clearly supporters of the Open Fiber construction and have the potential to add a significant number of customers.

Speaking of capital expenditure, Open Fiber has set itself as a target € 250 as a cost per house passed while currently, it is around € 300 speaking about the horizontal part.

In a European context, this low cost is possible because Open Fiber exploits the existing electricity distribution network of Enel, which covers around 85% of the Italian population. Enel has 1 million of street lockers against 150 thousand of Telecom Italia. This is particularly relevant in areas C and D.

In large cities, Open Fiber uses the public lighting infrastructures of the municipalities which are obliged to give access (charging or free access), trying in any way to facilitate the implementation of the FTTH; Telecom Italia also provides access to regulated pipelines and swimming pools. In Rome, Open Fiber has signed an agreement with a Roman electricity company (ACEA) to access its pipelines in exchange for supplying fiber to the company.

In areas such as Milan, where there are numerous multi-storey buildings (more than 12), Open Fiber builds vertically, otherwise, it waits for the customer's first order before construction.

Open Fiber points out that Metroweb offers valuable know-how developed over the years by developing fibers in Milan and other cities. In 2019, Open Fiber has 10,000 active workers and expects it to increase to 15,000 in the next years.

Open Fiber expects that the total Capex will be € 6.5 billion, of which € 1.4 billion from Infratel, therefore the net Capex for Open Fiber is € 5.1 billion, of which € 4.4 billion by 2022. There are € 3.0 billion of public funding (€ 0.35 billion from the regions), which could already be included in Infratel's Capex issue.

2.6 Open Fiber's Swot Analysis

The SWOT analysis (in this case of Open Fiber), consists in investigating, examining and deepening the context conditions in which the business takes place, through an accurate internal analysis of the strengths and weaknesses organization and an external analysis of the opportunities and threats presented by the external environment, in order to identify, control and find appropriate strategies for managing the areas of planning, risk and value creation.

Carrying out a SWOT analysis allows you to acquire detailed and structured information to guide the decision-making process concerning a project in all phases of the life cycle.

STRENGTHS:

- ✿ High quality and efficient infrastructure: the FTTH network, entirely in optical fiber, guarantees extremely high-performance thanks to a transmission capacity that can reach up to 40 Gbps ("future-proof"), the only one capable of supporting the evolution of the offer of services. Furthermore, among other advantages, compared to other fiber technologies, it does not involve conflicts of interest between a legacy

copper network and the new network, as it is made entirely of fiber, without copper passages and bottlenecks;

- ✿ Protection of competition: as an infrastructure supplier in FTTH, active exclusively in the wholesale market (wholesale-only), they offer access to the entire fiber-optic network on fair and non-discriminatory conditions to all interested operators. The main national ones have entered into agreements with Open Fiber, snubbing the ex-incumbent. The words of the CEO of Vodafone Italia, Aldo Bisio, explained why of the collaboration with Open Fiber: "We have seen a radical change of model. In Italy, there has never been competition on the fixed network. It seemed an unrepeatable opportunity to use a passive network and offer services to customers. Third parties are a revolution for us compared to the TIM model with which we still face today";
- ✿ The separation between network and services: starting from the cardinal principle of the protection of competition and from the right attention to the liberalization process of the TLC sector, desired by all Italian and European authorities, they maintain a clear separation between the use of the network and that of the services to it related.
- ✿ Development of innovation and the creation of shared value: thanks to innovative and inclusive technological solutions in favor of global economic

growth, they establish a policy of constant dialogue with local institutions and communities.

- ✿ Sustainability and environmental attention: always oriented towards environmental sustainability, they favor the development of an optical fiber network, where possible, on an already existing structure. The design of their infrastructures, which combines sustainability and advanced technology, manages to protect the integrity of the places, with particular attention to areas of landscape and cultural interest.
- ✿ The exploitation of internal know-how: Open Fiber can take advantage of the know-how acquired by the organization (ENEL) in managing such complex projects, albeit operating in a different business;
- ✿ Reuse of existing infrastructure: Enel's electricity network is extensive and widespread (much more than the telephone network) and can be partially reused for this initiative, allowing significant cost savings;
- ✿ Definition of a well detailed, but adaptable program;

WEAKNESSES

- ✿ The implementation of new technology: If on the one hand, the creation of a telecommunication network entirely in FTTH mode is certainly a strong

point at the base of a competitive advantage, on the other the implementation of this technology presents important uncertainties, as being a new technology, the terms of comparisons are reduced and the prevention and management of risks and problems requires skill, creativity and excellent problem-solving skills;

- ✿ Open Fiber is a newly established company that enters a new business: it was created specifically to enter the ultra-broadband business, a new sector for the group that traditionally operates in the energy and gas sector; this involves the need to set up the organization of the company, to acquire new skills (first of all engineers who know how to build fiber optic networks) and to learn the rules that govern the game in this sector;
- ✿ Amount of costs in white areas: some argue that Open Fiber's offers for competitions in white areas are impossible, but the CEO claims that they are valid, and that convenience is given by the greater ability of Open Fiber engineers;
- ✿ Recovery of investments in acceptable times: certainly the number of investments to carry out the program is significant and that of the FTTH telecommunications network is a great challenge, but it is expected that it will also be the future, which cannot be done without, for which the company is confident.

OPPORTUNITIES:

- ✿ Superfast connections are the future: they are an important element in determining the future of our country. If we think about the vast repercussions that the presence or lack of a superfast connection will have on the functionality, development and competitiveness of our country and the multiple realities involved, from the companies that create and manage the infrastructures to the operators that sell the services, to the companies that generate software that needs these technologies, to end customers, domestic, businesses and public administration;
- ✿ The program could also be extended internationally: obviously adapting it to needs but being able to take advantage of the know-how and skills acquired;
- ✿ No imminent infrastructure progress is expected: technology is constantly evolving, but infrastructure changes much more slowly. Currently, an FTTH infrastructure is the most performing that can be had and no significant further developments are planned;
- ✿ Italy's delay compared to other European countries.

THREATS:

- ✿ Poor sharing of infrastructure projects between telecommunications operators;
- ✿ Competitors' claims: risk of unfair competition and cross interests;
- ✿ The slowness of bureaucracy;
- ✿ Heterogeneity in local regulations for the construction of infrastructure works: there is a prevalence of territorial autonomies that can create difficulties in coordination, heterogeneity in interventions and possible diseconomies;
- ✿ The slow evolution of the digital culture of the population and limited propensity to purchase ultra-broadband connectivity services.

APPENDIX A 2.1

Is the Risk Premium for investments in FTTH networks comparable to the Option Pricing Theory?

The answer is yes; investments in real assets, in this case, FTTH networks, are characterized by "irreversibility", "uncertainty" and "delayability" in a way that is completely analogous to what happens for financial investments (AGCOM, 2019).

The irreversibility is due to the fact that the expenses necessary to make an investment, once incurred, are no longer recoverable (sunk costs) or, at the very least, they are only minimally. The irreversibility makes the investment sensitive not only to the uncertainty on the future values of the decision variables (market prices of the goods produced, interest rates, operating costs and investment times) but also to the macroeconomic conditions of the country in which it invests.

The uncertainty concerns the future returns of the investment and the probabilities that greater or lesser profits (or even losses) can be generated.

The delay of the investment, however, understood as the possibility of postponing an investment decision - even if it is not always feasible - basically represents an opportunity cost, as delaying a decision could allow acquiring new information on some key random variables.

In this sense, irreversibility, uncertainty and delayability make an investment opportunity very similar to a financial call option that guarantees the right to postpone the purchase decision pending market evolution.

Taking the definition from financial theory, options are financial contracts which give the buyer the right, but not the duty to buy in the case of call options or to sell in the case of put options, a specific quantity of a financial or real asset. underlying at a specified price (called the strike price), on a specific date (European type options) or by a specific date (American type options)¹².

The risk remunerated by the premium in question does not represent the systematic risk (market risk or non-diversifiable risk) already considered in the determination of the beta coefficient for calculating the WACC.

In particular, the characteristics of the FTTH investment give rise to two different types of "premium options": one inherent to the "wait and see" option and another to the "flexibility" option.

The "wait and see" option stems from the fact that, since investments in FTTH are largely irreversible, the investor, instead of investing today in conditions of uncertainty, may decide to wait in order to acquire new information. In this way, the decision to make the investment or not, depending on the favorable conditions

¹² <https://www.borsaitaliana.it/notizie/sotto-la-lente/opzioni.htm>

that will be observed in the future, can be postponed to a later period. In this case, the premium recognized to those who invest today is aimed at remunerating the investor for the fact that, by investing today rather than postponing the decision to invest in a subsequent period, the latter renounces the possibility of waiting and acquiring new information (DIXIT - PINDYCK, 1994).

The "flexibility" option, on the other hand, derives from the regulatory nature of the obligations of access to the new FTTH infrastructures imposed on the operator who decides to invest. In particular, an alternative operator will request FTTH wholesale access services only when it verifies the existence of a retail demand for fiber services to be satisfied, while, in the event that this demand is insufficient, it will not enter the market, leaving the burden of investments in FTTH networks (which by nature are sunk costs) to the initial investor.

In this way, an asymmetry is generated between the incumbent and the alternative operators for the allocation of both risk and return. In this case, the premium recognized for exercising the flexibility option is aimed at remunerating the incumbent for the flexibility that allows alternative operators to access the network - by virtue of the regulatory obligation - only in the presence of economic convenience. The value of this option will also be conditioned by the agreements that can be entered into between the incumbent operator and alternative operators (risk-sharing agreements, long-term contracts, volume discounts, advance payment

of access fees, etc.) which they tend to spread the risk of the investment, in whole or in part, and consequently entail a decrease in the value of the option itself.

The premiums calculated for the two types of options described above are not additive, i.e. the premium overall is less than the sum of the two. This is manifested in that an investor decides to make the investment only when the profitability prospects of the investment are sufficiently favorable. However, as the profitability prospects increase, the value of the "flexibility" option decreases because it becomes more and more likely that a new entrant will buy wholesale access services (AGCOM, 2019).

APPENDIX A.2.2

The implementation of the FTTH technology in the Ancona area

Speaking of Ancona, the Open Fiber plan was signed on 21 September 2017, a plan that provided for the coverage of about 37,000 real estate units with a duration of about 24 months since the works ended a few months ago. About 13 million euros investment for the city where more or less 420 kilometers of fiber have been laid as foreseen by the project.

The agreement signed with the Municipality also attributes the management and maintenance of the infrastructure to Open Fiber, in addition, it established the excavation and restoration methods for laying the optical fiber, as required by the ministerial decree of 2013.

Open Fiber has complied with the technical and safety standards by using existing underground cable channels and infrastructures where possible to limit the impact of excavations on the territory and limit the inconvenience for the community.

The excavations were carried out favoring innovative methods with low environmental impact, minimizing the difficulties and inconveniences for users; in other words, the traditional excavation was carried out only where none of the other solutions could be used.

Open Fiber's goal was to make Ancona ultra-fast, bringing fiber optic infrastructure throughout the city (houses, condominiums, schools, offices, companies and public administration structures) with a connection speed of up to 1 Gbps (1000 Megabits per second) accelerating the digitization process, simplifying and improving relations between citizens and public administrations and increasing the productivity and competitiveness of businesses.¹³

The optical fiber is transported in Fiber to the Home (FTTH - Fiber to Home) mode and thus allows maximum performance, which cannot be reached with copper (ADSL) or fiber/copper (FTTC) networks.

"The agreement signed with Open Fiber - underlined the engineer Paolo Manarini, Councilor for Public Works of the Municipality of Ancona - was the result of a shared decision with which the municipal administration took note of the great opportunity to offer citizens, at no cost, an ultra-fast and widespread network, which allows you to receive and send data much faster, in line with the most advanced countries. A service that arrives directly inside the houses, as in the past, by water, electricity and gas, which will allow access to more advanced services of the same public administration, which will benefit from optical fiber in different areas ".

¹³ <https://openfiber.it/mondo-open-fiber/comunicati-stampa/tlc-comune-di-ancona-e-open-fiber-insieme-per-una-citta-ultraveloce/>

"To bring the fiber directly into the homes of citizens - explains Enrico Pietralunga, Head of the Network & Operations Area Center of Open Fiber - the collaboration of condominium administrators is necessary. The installation technicians are professionals and need access to the entrance of the building. The operation takes little time and is totally at our expense ".

Ancona was the first city in the Marche region where Open Fiber built its ultrafast fiber network infrastructure.

CHAPTER 3

THE POINT OF VIEW OF THE STAKEHOLDERS ON THE POSSIBLE MERGER BETWEEN TIM AND OPEN FIBER

3.1 Advantages and disadvantages of a hypothetical and exclusive Tim-Open Fiber network

In these years of digital revolution, more precisely of Industry 4.0, the truth that we expected emerges, namely that the mixed fiber copper (FTTC) networks are no longer enough; thus imposing a revolution also with regard to telecommunication infrastructures, which, moreover, increasingly constitute the decisive infrastructure for the competitiveness, employment, social cohesion of each country, therefore for lasting, inclusive, balanced growth and sustainable.

Only the FTTH, i.e. infrastructure networks entirely in optical fiber with decentralized architecture (therefore equipped with local data processing devices) will have the technical requirements required for the use of the services, products and applications of the Gigabit Society (LITTLE, 2018).

The impetuous difference in performance between fully fiber networks (FTTH) and mixed copper fiber networks (FTTCab, FTTdp, FTTp) is now known and above all confirmed by both the European Commission¹⁴ and AGCOM. It is a difference measured not only in terms of downloads (gigabits per second rather than megabits) but above all in terms of upload speed, security, latency, resilience, reliability and energy consumption.

Therefore, the minimum quality level of the universal connectivity service that should be ensured to citizens and businesses has changed, overcoming old minimum limits built based on obsolete economic and technological logics. And at the same time, the business model also changes radically. It is no longer a question of managing existing infrastructure networks, providing for their maintenance and completion and encouraging competition within the infrastructure type of the incumbent; it is a question of building large new infrastructure networks.

Modernizing means building a new fiber infrastructure that replaces the obsolete copper one. Through huge investments and the need for long-term greenfield investments.

Value creation and profitability move along the value chain to the advantage of vertical companies and to the disadvantage of companies that provide connectivity.

¹⁴ <https://ec.europa.eu/digital-single-market/en/news/proposed-directive-establishing-european-electronic-communications-code>

However, this is a disincentive for incumbents, but also for other TLC operators, to invest in new ultra-broadband networks.

This raises the question of whether infrastructure competition is the best solution for reaching a state-of-the-art infrastructure or whether considering the level of investments necessary to dispose of new networks within limited time, it is no longer appropriate to create a single state-of-the-art infrastructure FTTH and make it available to all service providers free from the conflicts of interest typical of a vertically integrated operator. The latter, above all in order to guarantee the universal right of everyone to have high-quality network connections, and to avoid alterations to the fair competition between companies and between territories deriving from the different quality of the available TLC connection.

In favor of the first solution (infrastructure competition), there is the obvious and consolidated observation that competition normally generates virtuous competition that rewards innovation, investment and management efficiency. However, the peculiarity of the Italian context also offers solid arguments to the second solution (single infrastructure) (BASSANINI, 2017).

The revolution that the world of telecommunications is undergoing, requires massive greenfield investments in the latest generation infrastructures that the old privatized incumbents have (almost all over Europe) difficulties to face agile.

There are four legacies of the past that often weigh on the incumbent (BASSANINI, 2019):

- ❖ The need and convenience to delay the divestment of the copper network over time, which has higher operating costs and offers lower performance than that of the new fiber network, but which nevertheless constitutes one of the main activities of the former monopolist and is almost entirely amortized;
- ❖ Significant indebtedness, sometimes deriving from leveraged purchase operations on the company's capital;
- ❖ The maintenance costs of the obsolete copper network and the excess personnel costs inherited from the moment the company enjoyed an undisputed market monopoly;
- ❖ The prevalence of short-term investors in the ex-monopoly shareholder, reluctant to finance - with adequate capital increases - long-term investment plans such as those necessary for the construction of the new FTTH and 5G infrastructures (OFCOM, 2018).

In purely business logic, the incumbents have so far preferred, with a few exceptions, to delay the replacement of the old copper networks with the new generation ones.

The justification often used to motivate this choice was and is, the lack of sufficient demand on the market for FTTH fiber connections by families and SMEs; According to them, therefore, much less expensive hybrid fiber copper solutions (FTTCab) in terms of Capex. But this argument is no longer valid today, given both the rapid progress of the digital revolution and the need to converge with general interests.

In Italy, we have the case of the historic incumbent Telecom Italia (now TIM) who thirty years ago was at the forefront of the world in terms of technology and management efficiency; he had been among the first to start replacing copper with a fiber network in buildings, however, in subsequent years, he had slowed down investments in fiber, claiming that in the Italian market there was not enough demand for ultra-fast connections by families and companies.

In fact, the four legacies of the past mentioned above were also valid for TIM: the alleged lack of demand that would negatively characterize Italian families and SMEs was a pretext for not having to explicitly admit that it was not convenient for TIM and its shareholders to invest heavily in FTTH, accelerating the transfer of copper. On the other hand, the substantial indebtedness of the company due, more than to the investments made in previous decades to the purchase of leverage operations which have been a particularly heavy obstacle since TIM lost its investment-grade rating.

Until 2018, the TIM network remained the only fixed TLC network with national coverage, over 90% of retail users are still connected to it (48% are served by TIM, the rest by the OAO). On the other hand, the incumbent operator's reluctance to invest in the new generation fiber network is one of the causes of the delay accumulated by our country, which still ranks in the last places in Europe on the basis of numerous indicators available (DESI,2019).

In the absence of cable television networks, the only competitive challenge capable of forcing TIM to modernize/renew its copper network could be represented by the new operators of the incoming infrastructure.

This is the case of Open Fiber, born thanks to the approval by the government of the BUL plan and the entry into the field of two industrial and financial giants such as Enel and CDP.

The NewCo has, as it was in the intentions, forced TIM to accelerate investments in the Italian infrastructure of TLC. However, TIM has chosen to focus, for now, mostly on the hybrid FTTCab architecture (fiber up to the wardrobe), both for lower investment costs and to extend the life of the copper capillary network that connects his closets to homes. At the same time, it has adopted a series of measures, aimed at discouraging the migration of end-users from the copper (or mixed copper-fiber) network to the entirely fiber FTTH network.

TIM's initiatives have not significantly slowed down the Open Fiber investment plan in the main Italian cities, which instead happened in the so-called white areas (clusters C and D). Above all, they have contributed to hindering the implementation and effective use of the new network infrastructure, that is the migration of families and businesses from the old infrastructure mainly in copper to the new infrastructure entirely in fiber.

The penetration of the fiber is in fact slowed down by TIM's market preemption actions, but also by the objective barrier to entry represented by the cost of migration from copper to fiber, which is estimated on average around 300/400 euros per family. The intervention of the Authorities can sanction the former, little can be done about the latter (voucher). Moreover, the sanctions appear to be scarcely effective, both because they intervene with years of delay, and because they are not paid to the damaged competitor (Open Fiber), but to the tax authorities.

The current competition between Tim and Open Fiber can be classified as an asymmetric infrastructure competition model. Since where Open Fiber infrastructure has arrived, infrastructural competition exists, but it presents some evident critical problems, which do not allow, at least for now, to be considered symmetrical.

In other words, it cannot be compared to the infrastructure competition that emerged in the mobile telecommunications sector, as symmetric competition between

vertically integrated operators, albeit with the sharing of a part of the infrastructure between them. The main problems are three:

1) Competition remains highly asymmetric, as TIM now directly serves almost 50% of the demand to end-users and indirectly 80% of the residual demand made up of subscribers to Fastweb, Vodafone, Wind, Tiscali and other minor service providers. This situation is still expected for several years, given the dominant position of TIM, given its dual role on the wholesale and retail markets, given the wide possibility that TIM continues to have and implement discriminatory practices towards Open Fiber and given the exposure of the OAO to the "seductions and threats" of the dominant operator;

2) The risk of inefficient duplication of investments, and therefore the risk of paying the higher costs of the construction of two parallel passive infrastructures to end-users, when one would be enough, being, in most of the territory, a sort of natural monopoly. In other sectors (rail transport, electricity network, roads and highways), the risk of duplication was avoided by reserving to the State the construction and management of the only infrastructure used by all the suppliers of competing services; or assign to private individuals, through competitive procedures and for a specific period of time, the concession for the construction and management of the individual infrastructure, with defined investment or coverage obligations;

3) The risk of a new digital divide, i.e. the risk that alongside areas in the country where two highly performing network infrastructures can compete with each other, there will be others in the which instead will be available only the old obsolete copper infrastructure, or, at most, a hybrid infrastructure (FTTCab).

The "universal right to the Internet" would not be guaranteed in these areas, or at least it would not be in the best conditions of reliability, resilience, latency, connection speed. For clusters C and D, the BUL plan solved the problem by providing for the construction of public infrastructure, partially financed by European structural funds and partially by concessionaire resources. Instead, the so-called grey areas (a good part of cluster B) remain completely uncovered, for them, the BUL plan assumes the granting of incentives, in order to induce private operators (TIM or Open Fiber in the first place) to invest; but the measure is waiting to be fully defined and to be subjected to the European evaluation (to verify the compatibility with the prohibition of state aid), and in any case, there is no certainty as to its effectiveness.

In summary, the market and competition are not a value in themselves, but a means of guaranteeing through competition the best mix between service quality and cost for users. Being a strategic infrastructure that today requires a new cycle of long-term investments, it is necessary to ask whether the market and competition represent enough tools to achieve the expected results: results for the public good,

well beyond the logic of the market and business convenience. Total coverage of the territory with latest generation network infrastructures, also combining the essential needs of national security, the social cohesion of the country, the quality of life, the competitiveness of the national economic system.

A single TLC infrastructure model, mostly owned by long-term investors, Stakeholders interested in investing in a new future proof FTTH network, could be what Italy needs. The ideal would be an infrastructure controlled by parastatal investors or by territorial institutions, as well as by the *Cassa Depositi e Prestiti*. It is a model that would strengthen the guarantee of adequate protection from possible threats to national security (IT security) transmitted through telecommunication infrastructures. At least on paper, the single infrastructure seems to be the only solution capable of overcoming the three critical issues mentioned above; and also seems to be the most capable of combining three orders of general interest reasons or needs:

- a) the reasons for growth, competitiveness, work and social cohesion;
- b) the need to contain subscription costs for TLC services for families and businesses;
- c) the guarantee of effective equality of competition between all operators of the TLC services, which would make use, in conditions of real equality, of a truly neutral infrastructure;

The single infrastructure is also the only solution that would allow imposing universal coverage obligations, properly compensated, and to enforce them. And therefore, to move towards the recognition of a universal right to the internet, understood as the right to have an ultra-fast connection of the latest generation.

For these objective reasons, the solution of the only neutral infrastructure, not vertically integrated, was considered, in a well-known joint document of the two Communications and Competition Regulatory Authorities (AGCCOM and AGCM), as the abstract solution preferable to any other.

Nowadays, the ownership separation of TIM's network infrastructure and its subsequent merger with the infrastructures of other operators (first, Open Fiber), can only be achieved in two ways (DECINA, 2019):

1) Separation of the TIM network and merger with Open Fiber assets; the option is certainly the best from the point of view of economic efficiency but involves several problems:

- Slow technical implementation for the merger of information systems and the distribution of personnel
- Allocation of a significant amount of network debt (at least 15 billion of TIM's 25 billion net debt)

➤ Critical sustainability for TIM's service company (on which another 20 billion gross debt would remain).

2) TIM's purchase of Open Fiber assets in non-market failure areas; it is a realistic option with immediate benefits for both companies. Open Fiber would sell its assets to TIM covering the costs incurred and collecting a capital gain (in the case of valuations above 2 billion) and would remain active in the market failure areas to which all three Infratel tenders were awarded (approximately 4 billion). The main problems of this option are:

➤ Possible European regulatory constraints;

➤ Absence of a wholesale-only model and loss of economic efficiency.

There is no shortage of supporters among the international investors of the projects for the separation of the incumbent's network infrastructures. Faced with the need for important new long-term greenfield investments necessary to finance the new generation networks (FTTH and 5G), there are in fact those who believe that it is convenient to completely separate the two different businesses, that of the service provider TLC (possibly vertically integrated with that of content and platform producer) and that of developer and manager of network infrastructures. The best process to achieve the merger of the networks would immediately involve the incorporation of Open Fiber assets (non-bankruptcy areas) into TIM.

Subsequently, a network separation should be planned to achieve a state-controlled wholesale-only model.

The non-vertically integrated single infrastructure company, likely to attract long-term investors interested in the fiber asset class, would be in a position to give a strong acceleration to investments in the construction of the network of the latest generation (FTTH and passive infrastructure of the 5G network), which represents a decisive factor for the growth and competitiveness of the country in the Gigabit Society in the coming years. Families and businesses would have all over the country those ultra-fast connections, which will also be the fundamental tool for new forms of entertainment, remote work, professional training and updating, crime prevention and people and things, prevention and home health care, interactive dialogue between citizens and institutions and between citizens and public administrations.

The benefits for Shareholders arising from a merger are certainly lower than those of general interest. One thing is sure, the merger between the two infrastructures would produce fewer synergies than those abstractly conceivable, in fact, the architecture of the two infrastructure networks is different.

TIM is divided into exchanges from which the copper twisted-pair cables start which, passing through the closets in the street, reach the customers; twisted-pairs only partially replaced by fiber, and mostly only up to the wardrobes.

Open Fiber is based on fiber optic connections that from POPs (i.e. the technical rooms in which OF, as Wholesale Only operator, hosts the various Service Provider devices functional to the activation of the G-PON service) reach through flexibility points primary/secondary, end customers.

In fact, therefore, both networks reach the same customers but starting from physically distinct points (the central ones and the POPs) and according to different paths. Also, being fiber performance higher than that of copper, G-PON connections reach greater distances and therefore the number of POPs is lower than the number of exchanges with the same area served, thus reducing the operating costs of the network. In addition, POPs, and not central or closets, appear to many analysts to be more correctly positioned to host data proximity center for edge cloud computing. The major synergies therefore essentially concern passive infrastructures (cable ducts, piled overhead lines, vertical ducts in buildings), where the paths of the two networks coincide, and therefore where these infrastructures are located so that they can be effectively and usefully used in the construction of the new FTTH / FWA infrastructure.

The decisive points to the advantage of the merger between the two infrastructures are however other:

- a) The first derives from the fact that, still today, about 90% of Italian families and SMEs are connected on TIM infrastructure, directly or through other OAOs. The same business plan as Open Fiber expects to be able to

break even in five years by counting on the migration of just under 50% of the retail market to its fiber infrastructure; therefore, expects that in 5 years still at least 50% end customers (households and businesses) will navigate Telecom Italia's infrastructure, largely still hybrid;

b) The second derives from the fact that, at present, in grey areas, the convenience to invest is modest/insufficient, and those areas are likely to remain served for many years by TIM's hybrid infrastructure alone, of which

- with bowls still, and therefore net of any incentives or public contributions
- all TLC service providers will be forced to use themselves to connect families and businesses resident in those areas. So almost 10 million business units would be condemned for years, in the absence of the unification of the two infrastructures of TIM and Open Fiber, to a new digital divide.

If, on the other hand, as a result of the combination/merger between the two infrastructures, the Newco of the single infrastructure could migrate 100% of the real estate units connected by copper / hybrid infrastructure to FTTH, it could easily ensure, at its own expense, the fiber coverage also of the grey areas, and therefore connect all the families and businesses in the country. Serving all the country's business units with FTTH infrastructure (except FWA for scattered houses) obviously implies greater investments (putting more fibers in cable ducts or on airlines to connect not 50% of users but tendentially 100%), but yes it would be a

fractional increase in Capex, against doubled revenues.

In this perspective, the value of TIM's traditional infrastructure is therefore not only made up of the value of its assets (cable ducts, overhead lines, power plants, cabinets, and fiber optic lines where they can be integrated into the single infrastructure network), but above all, value of the market share (households and SMEs) which still makes use of the same traditional infrastructure, even if less performing; or, more precisely, the value of the cash flow generated by this market share, in the fixed still very significant. Stakeholders who oppose the single infrastructure project stress that TIM would be deprived of the ownership of a fundamental asset for the company's income statement, but also of an important underlying of its debt, as well as the possibility of continuing to use the ownership and management of the infrastructure to erect barriers in defense of its dominant position on the market for TLC services.

In the opposite direction, those who are inclined to change, also on the basis of the experience of other countries, believe that the separation of ownership of the network would generate value, both on the supply side of the TLC services and as regards management and enhancement infrastructure.

In summary, the single infrastructure (FTTH and potentially 5G) and therefore the merger between Tim and Open Fiber would have the following advantages and benefits both among the companies and at the economic level of the country:

- It would avoid the inefficient duplication of investments and consequently, sharing the cost of investments on a number of users more than doubled, would allow service providers to maintain the prices already applied in the most profitable black areas and also in the least profitable grey areas, migrating its customers from the copper infrastructure to the optical fiber without increasing the cost of the subscription, despite the better quality of the connection and the services, a cost that today represents a sort of barrier to universal access to the fiber; where not possible, vector solutions (enhanced copper) would be maintained;
- A single industrial plan for ultra-broadband on the wholesale model only would favor a strong acceleration in the construction of state-of-the-art network infrastructures with national coverage (FTTH, 5G, edge cloud computing) and therefore would make it easier to compensate for the delay of our country compared to more advanced countries;
- It would make it easier to apply the "universal coverage" obligation, avoiding the emergence of a new digital technological divide and guaranteeing everyone the "right to faster, safer and more reliable Internet connection";
- It would be possible to plan the reabsorption of excess TIM resources (about 15,000 redundancies) towards developing markets, also through a moderate and intelligent form of "digital protectionism", in defence of

workers' interests, which at the same time limits also the abuses of digital multinationals (tax avoidance, violation of privacy, data sensitivity);

- The development of teleservices would be encouraged, in particular, those with significant macroeconomic impacts (telemedicine, teleassistance, teledidactics, environmental telemonitoring, video surveillance); and teleworking in large ICT companies in order to improve the environmental impact and reduce energy costs.

APPENDIX A3

What will Telcos' business models look like in the future?

“The pace of change in the European telecommunications industry is accelerating: the boom years are either over or coming to an end very fast. The technology sector has seen huge disruptive changes affecting social life, politics and business”.¹⁵ Throughout history, both corporate and industry insiders have colossally misunderstood or totally underestimated markets that we could not live without today.

Nowadays consumers demand very high-quality telecommunication services and at the same time, data consumption is growing exponentially. To compete and win new customers, Telco operators have made huge investments in networks, customer support and new offers. Despite these efforts, they are facing a general drop in revenue, while Over-the-top competition is growing. To survive, Telco operators have started creating additional revenue streams, such as new digital services (IoT, mobile payments, TV on demand, e-health, cloud services, etc.).

The drivers that could shape the future of the telecommunications sector have been analyzed and grouped into five categories: social, technological, economic, environmental and political.

¹⁵ <https://www2.deloitte.com/de/de/pages/technology-media-and-telecommunications/articles/future-Open-Fiber-telco-business-model.html>

They were then assessed for their degree of uncertainty and their impact on the telecommunications sector as shown in Figure 2.

Fig. 2. Driver evaluation according to the degree of impact and the degree of uncertainty



Source: <https://www2.deloitte.com/za/en/pages/technology-media-and-telecommunications/articles/the-future-of-the-telco-business-model.html>

Examples are the property of network innovation, which is an important success factor in the telco ecosystem. Network innovation could be driven by telecom themselves or outsourced to other players in the value chain, such as hardware vendors, while telecom people simply use the network. Another example of high impact and high uncertainty drivers is the role of Over-the-top players, who could become a significant threat to telecommunications companies as their power in the market increases.

Over the next five years, Telcos are likely to move towards a "digital service provider" model, whereby telecommunications services will no longer be the core business but a means of providing a new digital offering.

The evolution of Telco's business model means that IT is being asked for more in terms of applications, data and infrastructure.

Telcos' current IT architectures are the result of multiple mergers and acquisitions, technological waves and systems integration initiatives undertaken under strong temporal pressure, to the detriment of architectural coherence. As a result, they are already insufficient to support today's business needs, not to mention tomorrow's needs, in terms of flexibility, speed and economy.

CONCLUSIONS

In conclusion, it is possible to formulate a series of critical considerations on the current situation of the diffusion of the NGA infrastructure in Italy and it is also possible to question the advantages and disadvantages of a possible merger between Open Fiber and Tim.

Furthermore, it is possible to fully answer the initial question that motivated the entire research, i.e. what impact of Open Fiber has had and will have on our optical fiber market and in achieving European objectives towards the Gigabit Society.

First of all, it is observed that although our country is paying the price of years of immobility and short-term policies in the ultra-broadband sphere, Italy seems to have entered a new phase of dynamism, which could bring it in a reasonably short time to bridge the infrastructure gap that currently penalizes it.

It can undoubtedly be considered that Italy is one of the countries that have experienced (and partly even today is experiencing) the digitization process in a more extrinsic and less incisive way: as underlined during the discussion, in fact, what is found in our country, alongside an undoubted digital infrastructure gap, there is a deeply rooted digital divide of a mainly cultural, social and behavioral type.

Open Fiber, with its innovative business model, has successfully entered the arena with great ambitions and all the means to support them, and it is clear that there will be several obstacles to overcome, but the objectives of the European Union for 2025 are not they seem so far away.

Enel and CDP have undoubtedly played a key role, through the decision to enter the fiber sector with Open Fiber, which thanks to their resources and know-how, represents the first real competitor, but above all the first real alternative to the old "monopolistic" service offered by TIM.

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