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BROADBAND IN ITALY: TIMING IN INTERMODAL RIVALRY

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1. INTRODUCTION

The characteristics and evolution of broadband in Italy are the results of the systemic interactions between overlapping needs and niches of consumers, competing and yet complementary technologies, as well as between learning and heterogeneous actors involved in such technologies. More specifically, the structural and dynamic characteristics of broadband in Italy seem affected by three classes of factors: I) the overlapping of the characteristics of demand, II) the competition and complementarity between the incumbent's strategy (i.e., Telecom Italia), aiming at rejuvenating the old copper access infrastructure with ADSL combined with optical fiber in transmission, and III) the new entrants' strategies aimed at (partially) bypassing[1] Telecom Italia infrastructure by using their own proprietary infrastructure based on optical fiber to the curb (FTTC) and to the home (FTTH) in access and the Internet Protocol (IP).

In such a context, the diffusion of broadband in Italy can be viewed as the outcome of an interesting form of intermodal competition which can be analyzed by means of an extension of monopolistic competition between the incumbent Telecom Italia characterized by financial weakness and a quasi-irreversible huge stock of copper cables infrastructure, and a small number of new entrants, very often operating in local markets which represent geographical and product niches. Among these, the major new entrant is Fastweb, which introduced radical technological changes in broadband in Italy, investing exclusively in proprietary optical fiber network combined with IP, and providing advanced and integrated services for voice, video and data. Fastweb is eventually emerging as the major competitor to Telecom Italia at the national level.

The outcome of such interactions in terms of the diffusion of broadband in Italy characterizes the Italian society in an extremely uneven way. The diffusion of broadband is characterized by a strong heterogeneity, from both the technological and the geographical viewpoint with important consequences on the characteristics of the demand for broadband services. In this regard, the so-called Digital Divide is much strong in Italy and most evident first of all from the geographical viewpoint, not only reinforcing the social and economic distance between north and south, but also between metropolitan and rural areas. Moreover, it is most evident also from the demand viewpoint, with a minor portion of innovative firms and consumers that adopt complex broadband services and support the diffusion of broadband at large, and a larger portion of industrial and private users that are following or lagging behind.

Finally, it should be clear that within a systemic perspective where broadband is the result of the interplay between complementary and competing actors and

technologies, broadband diffusion cannot be regarded only as a matter of physical infrastructure and connectivity. The provision of services, contents and applications matter and in turn the characteristics of demand do also interact with the supply side factors in order to explain the evolution of broadband in Italy. The appreciation of the preferences and behaviors of users of broadband infrastructures and contents should be regarded as indispensable for the understanding of the rate and direction of broadband diffusion.

This chapter is structured as follows. Section 2 characterizes the overlapping characteristics of the demand for high-speed communication services. Section 3 combines the analyses of the characteristics of demand and supply to analyzing the diffusion of broadband services. Section 4 describes the structural elements of the broadband system in Italy with a special emphasis to the specific market characteristics and the technological infrastructures in use, their diffusion and their implications in terms of barriers to entry deterring competition to the incumbent from new potential entrants. It also shows that the interactions between different technologies and actors and the positive effect on the diffusion of advanced services and broadband at large are limited to specific geographical areas and technologies. This has important consequences in terms of the understanding of the Digital Divide in broadband in Italy. Section 5 qualitatively shows the way in which a great part of the radical changes in such an infrastructure and more general in the way of providing broadband services is due to the innovations introduced by Fastweb. Section 6, through the cases of COLT and TOP-IX, provides evidence for the way in which localized players can segment the market both geographically and technologically in order to identify specific niches

where they can be competitive providing customized and *ad hoc* solutions for their clients. Conclusions summarize the main results.

2. THE DEMAND FOR HIGH SPEED COMMUNICATION SERVICES

The demand for high-speed communication services is highly heterogeneous both with respect to the needs and characteristics of consumers and their geographical location. From the viewpoint of geographical distribution, the demand for high-speed communication services is highly uneven across the country. Demand is quite strong in a few metropolitan areas and in the northern part of the country, while the south and the countryside are lagging behind. The historical features of the nation in terms of low levels of metropolitan concentration play an important role: Italy has been for centuries and still is the hundred towns country: population density is spread through the country. Rome, the capital city accounts for less than 3% of total population. On the other hand Lombardy, Emilia and Veneto however exhibit high levels of homogeneous distribution of affluent population and advanced economic activities: a third of national population is concentrated in three regions. These characteristics have played a major role in shaping the strategies of actors involved.

From the viewpoint of the characteristics of consumers needs it can be defined as an instable bundle of interdependent and overlapping demand schedules for an array of specific services. Such a broad bundle includes: 1) the demand for high speed data communication such as access to Internet services in a fixed location; 2) the demand for high speed data communication services, such as internet services by mobile users; 3)

the demand for high quality telephony, or VOIP; 4) the demand for television services; 5) the demand for entertainment services.

These five specific demand schedules can merge into a broader aggregate demand, provided a number of qualified conditions, both on the supply and demand side, in terms of quality and prices, apply.

As a matter of fact however each of these specific demand schedules exists and exhibits quite specific characteristics. Consumers may be induced to use the services provided by the same basic technological platform or may find the supply of each service provided by quite well distinct technologies and firms operating in markets with their own idiosyncratic features. The merging of such demand schedules in other words is the result of a process where both consumers and suppliers play an active role.

Access to Internet services may be operated by means of Bluetooth technologies that work via cellular phones either in a fixed location or in mobile conditions. ADSL technology however makes it possible to supply medium-speed data communication via copper cables. Optical fiber technology indeed provides faster data communication services, but only in a fixed location. Access to television and entertainment can take place via analogue broadcasting, digital broadcasting, narrowcasting on cellular phones or delivered by means of coaxial copper cables or optical fibers. High quality interactive entertainment instead can only take place effectively by means of mobile narrowcasting or optical fibers, while the provision of IPTV over ADSL is still characterized by lower quality that can harm adoption and diffusion. Low quality telephony, like internet access can be provided via ADSL although the negative gradient in quality is larger. The same applies to television and entertainment narrowcasting.

Product enrichment based upon the implementation of the broadband platform generates important effects. Product enrichment makes it possible to climb the quality ladder and increase the spectrum of needs and uses that can be delivered by means of a universal platform. This can be the case of the broadband infrastructure, but also of an aggressive wireless platform able to deliver the full range of services. Progressively the demand for the services delivered by the universal platform moves upward and the room for alternative services provided by rival platforms can be squeezed. In the long term more than one rival universal platform can survive, especially if switching costs for consumers are relevant.

In the Italian case, as for instance in other countries such as North Sweden, it is clear that the combination of geographical dispersion and product heterogeneity has exerted a strong impact on the strategies of the firms involved in the process. The creation of a national broadband infrastructure stretched to the curb in fact has been substantially delayed by the long-term prospects necessary for an appropriate payback to take place. In turn geographical dispersion and heterogeneity has induced increasing product heterogeneity and enhanced the levels of intermodal competition.

3. THE ANALYTICS OF INTERMODAL COMPETITION IN HIGH SPEED DATA COMMUNICATION

Traditional models of monopolistic competition can be stretched in order to understand the logic of the strategic interaction upon which the diffusion of broadband in Italy is based.

The diffusion of broadband in Italy, in fact, depends upon the outcome of intermodal rivalry, where on the demand side different niches –geographically clustered- of customers with different needs exist and yet overlap systematically and exhibit high levels of cross price and revenue elasticity, and on the supply side different categories of firms, each characterized by different strategies and different resources compete.

The differences with respect to standard monopolistic competition must be stressed. A group of markets, as opposed to a single market, needs to be identified. Each market is characterized by porous borders with high levels of mobility both on the demand and on the supply side. A large number of firms can be active in each market on the supply side. Each of them however must face a strong competition that takes place both within each market and among markets, as it is both intra-product and inter-product. Finally, on the supply side, firms exhibit high levels of product diversification: each firm elaborate a strategy to try and operate across markets in order to take advantage of economies of scope stemming from joint production in production and fidelization of customers.

Many classes of technological and historical factors shape such a competition process; namely: 1) the total lack of coaxial cables in distribution due to the institutional imitations to TV broadcasting that impeded back in the 70s the use of cables as an alternative method of broadcasting; 2) the systematic use of optical fiber in core network transmission, i.e. communication between switches: Telecom Italia, actually SIP before privatization, had implemented a general strategy of modernization of all transmission and distribution networks; 3) the strong support to ADSL in distribution in

order to rejuvenate to copper last mile by the incumbent; 4) the diffusion of optical fiber to the curb and to the home combined with IP and the emergence of VOIP (Voice Over the Internet Protocol) as a new disruptive paradigm for voice communication by the new entrants; 5) the transition from satellite pay-tv to terrestrial digital TV based upon digital transmission capabilities.

In this context, broadband provides the opportunity to supply an array of high-speed communication services based upon the same technological platform. The bundling of such heterogeneous services on the same platform is extremely convenient both on the demand and the supply side. Specifically, on the supply side a universal broadband platform can be very effective because of the strong effects of economies of density. Optical fibers display almost unlimited capacity, no variable costs, and almost no wear and tear, at least related to usage intensity. Last mile broadband however requires strong upfront costs for installment. In such conditions it is clear that the larger is the number of users and the larger their usage intensity and the lower unit costs. In this case unit costs consist of long terms average fixed costs.

If each niche of customers remains separated and the bundling does not take place, the advantages of a broadband supply stretched to the curb may become less obvious. The advantages of broadband in fact become evident only if different niches of heterogeneous customers are brought together and induced to purchase the services based upon the same technological platform. This is a long-term process where historic time is relevant both for the delays in the diffusion of communication services stemming from the resilience of users at large and for the effects of intermodal rivalry.

In order for broadband to be successful, the bundling must take place since the beginning of the process.

Timing is relevant in assessing the outcome of the intermodal competition. A major window of opportunity emerged in the early 90s for the incumbent who could take advantage of the combination of the new technology cum the lack of all coaxial cables for TV in the country, due to prior legislation in favor of other broadcasting.

The project SOCRATES elaborated by SIP-STET in the years preceding privatization consisted exactly in an aggressive strategy of mass supply of optical fibers to the curb across the country. The aim was clear: the supply of fibers-to-the-curb would have prevented the entry of all kind of competitors in voice telephony as well as in all adjacent markets. At the same time the strong financial solidity of the company would have easily supported the investment, although increasing debt and reducing profitability in the medium term. The Project SOCRATES would have however created long term barriers to entry and to mobility and hence secured long terms profits. At the same time however SOCRATES would have provided the country with the unique opportunity to take advantage of an advanced digital infrastructure although partly unjustified from a short-term payback viewpoint. Privatization (Fransman, 2003) eventually took place in 1999 and a sort of management buy out brought the company under the control of Pirelli in 2001. The take-over conducted firstly by Olivetti and eventually by Pirelli was almost completely funded with the financial resources of the telecommunications company, in the while renamed Telecom Italia. The levels of debts increased dramatically reducing the room for long-term investments. Geographical dispersion of the country and the large number of small metropolitan areas scattered

through out the peninsula played a major role in imposing a dramatic stop to the broadband diffusion at least to reach consumers. The optical fiber network was completed just for the backbone network since the mid-nineties.

This paved the way to a variety of alternative strategies implemented by newcomers and the impoverished incumbent. Each newcomer has tried to take advantage of the financial weakness of the incumbent and to take the control of a well-identified niche of customers in the attempt to reduce the mobility of customers across products and hence secure a final demand. In this context the widespread diffusion of mobile communication by Italian consumers can become a factor of irreversibility in favor of the implementation of a mobile platform alternative to broadband. The active role of consumers and their taste for ad-hoc consumption technologies closer to the habits of advanced users may play a role (Lancaster, 1971; Bianchi, 1998).

Telecom Italia, which also controls TIM (Telecom Italia Mobile, the largest wireless company) has chosen to implement ADSL in order to rejuvenate the capillary copper network and at the same time to try and push the wireless scenario. Consistently the incumbent has systematically delayed the diffusion of the new low-quality telephony (VOIP over ADSL). The quality of the oral communication services provided by ADSL over copper networks remains indeed much lower than dedicated telecommunications services.

The duopolistic structure of the television industry e.g. MEDIASET and RAI has gradually agreed to try and defend broadcasting, taking advantage of the new digital transmission technology which has indeed increased widely spectrum capacity. The

chances to introduce interactive services however have suffered this outcome and there is potential for high-quality entertainment based upon fiber-to-the curb.

Finally mobile companies have systematically tried to push the so-called 'convergence scenario' by means of which mobile wireless access to internet services, based upon Bluetooth technologies implemented by means of the systematic use of WI-FI and recently WI-MAX technology becomes customary. In such a scenario the advent of UMTS technologies, the third generation of mobile telecommunications systems has been regarded by a few players as the opportunity to implement a multi-service mobile platform able to deliver voice, data and images including direct access to broadcast TV at the same time.

The strong segmentation of the broad bundle of advanced communication services into well defined niches, each defended by a group of firms with conflicting strategies has emerged as a result of the financial weakness and the irreversible endowment of Telecom Italia in the years between the end of the XX century and the first years of the XXI. Let us analyze such a process more in detail.

4. THE MARKET AND TECHNOLOGIES FOR BROADBAND IN ITALY

The diffusion and penetration of broadband access in Italy is to a great extent due to the integration between the traditional copper infrastructure and new compression technologies.

Table 1 and table 2 show in fact that in 2003 only 8.7 per cent of the diffusion of broadband access was due to the implementation and use of optical fiber, consisting in 0.24 per cent of the total population. On the contrary, 91.3 per cent of the total accesses

in broadband were due to access via xDSL technologies. This represents 2.48 per cent of the total population. In 2004, although the increase in the penetration of broadband, which has reached 5.73 per cent of the population, the gap between the use of xDSL technologies and optical fiber is even greater. Accesses via xDSL technologies are in fact more than doubled reaching around 3 millions of accesses, representing 93.9 per cent of the total accesses in broadband, 5.38 per cent of the total population and accounting for most of the growth in broadband access. The relative contribution of optical fiber is instead decreased from 8.7 per cent to 6.1 per cent of the total diffusion of broadband, reaching 0.35 per cent of the total population.

Table 1. The diffusion of broadband access in Italy (Users; Optical fibre and xDSL)

	2003* (x1000)	**2004** (x1000)**	**2003 (%)**	**2004 (%)**
xDSL	1,427	3,099	91.3	93.9
Fibre	136	201	8.7	6.1
TOTAL	1,563	3,300	100.0	100.0

* 1° H 2003
** 1° H 2004
Source: Assinform, 2004

Table 2. The penetration of broadband (Optical fibre and xDSL) in Italy (% of population)

	2003 %	2004 %
xDSL	2.48	5.38
Fibre	0.24	0.35
TOTAL	2.72	5.73

Source: calculations on data ISTAT and Assinform

Such a situation, in which the diffusion and penetration of broadband is mainly due to the use of ADSL able to rejuvenate the traditional copper network is affected and characterized by market, technological and institutional factors which are important to understand the structure and evolution of broadband in Italy. Let us analyze them in turn.

From the market viewpoint, table 3 shows the distribution of market shares in Italian broadband market between the incumbent Telecom Italia, the main alternative carrier Fastweb and the other local operators. Italian market can be clearly characterized as a quasi-monopolistic context where Telecom Italia with the business unit Telecom Italia Wireline is by far the major operator in terms of both revenues and access lines (in 2004, 87.73% and 80.90% of the total market shares in terms of revenues and access lines respectively). Fastweb and the other local operators share only a minor part of the whole Italian broadband market. In fact, in 2004 Fastweb share of the Italian broadband market is 3.59% in terms of revenues and 10% in terms of access lines, while in 2004 OLOs shares of the Italian broadband market amount to 8.68% and 9.09% in terms of

revenues and access lines respectively. Telecom Italia is clearly benefiting from its previous monopolistic position in traditional telecommunications and the diffused copper infrastructure implemented and updated through the country, by providing broadband services mainly over ADSL. On the contrary, it should be clear that alternative carriers can compete on the Italian broadband market only adopting segmentation strategies that allows them to satisfy specific users' needs, focusing on added value services mainly for business users and advanced consumers, and ultimately implementing niche strategies[2].

Table 3. Market shares in Italian broadband market (US dollars; PPP; 2003, 2004; values, %, 2004/2003 growth rates)

		Telecom Italia Wireline*	Fastweb	OLO**	TOTAL
Revenues (MLN $)	31.12.03	18,050.98	554.66	1,302.39	**19,908.03**
	31.12.04	23,787.62	974.74	2,352.42	**27,114.78**
Revenues (PPP)	31.12.03	14,511.84	445.91	1,047.04	**16,004.79**
	31.12.04	14,747.94	604.32	1,458.46	**16,810.72**
Access lines (.000)	31.12.03	2,040	331	209	**2,580**
	31.12.04	4,010	496	451	**4,957**
% Revenues	31.12.03	90.67	2.79	6.54	**100.00**
	31.12.04	87.73	3.59	8.68	**100.00**
% Access lines	31.12.03	79.08	12.83	8.09	**100.00**
	31.12.04	80.90	10.01	9.09	**100.00**
Revenues growth 2004/2003		31.78	75.74	80.62	**36.20**
Access lines growth 2004/2003		96.57	49.85	115.96	**92.14**

* Telecom Italia Wireline is the Telecom Italia Group's business unit for broadband marke
** Estimations

Source: Telecom Italia and Fastweb 2004 Financial Year Reports; US$/Euro Exchange rate: Federal Reserve; PPP: OECD

The telecommunication infrastructure already implemented and in use in the country plays also a major role in shaping the technological characteristics of broadband in Italy. The wide diffusion of the traditional copper network and the huge investments in traditional telecommunication access infrastructures based on copper network stimulated investments in new compression technologies especially by the incumbent Telecom Italia. Telecom Italia owns basically the total copper infrastructure in access (consisting in 104 millions km of copper cable) and this represents huge sunk costs. New ADSL also stimulated new investments by the new entrants, in order to use the traditional copper infrastructure for digital transmission at high speed without investing heavily in new infrastructures such as proprietary networks and optical fiber through local loop unbundling.

In particular, xDSL (ADSL, HDSL, VDSL, etc.) compression technologies have been developed in order to rejuvenate copper networks and the copper last mile as an access system to broadband. In Italy, strictly considering the technological viewpoint, compression technologies find in the traditional copper infrastructure a particularly favorable environment to be applied for broadband access. In fact, in Italy – compared to Germany, US and UK – a greater proportion of users are located closer to the local switch, which increases the efficiency of DSL. Moreover, it can guarantee a widespread potential diffusion through users given the diffusion of the copper network.

However, in Italy most important technological and institutional barriers that can harm market entries in general and in xDSL technologies in particular are at place,

limiting market and technological opportunities for the new entrants and eventually the development of broadband. These can be specified as follows.

First, limitations to the access to the incumbent's infrastructure may harm market entry and the diffusion of broadband. Second, new entrants must have access to the Telecom Italia proprietary copper network. Moreover, the use of ADSL implies the availability of broadband metropolitan infrastructure in distribution, in order to connect the new entrant's network to Telecom Italia sites. New entrants cannot implement their proprietary metropolitan network easily and without very important fixed and sunk costs. Without such a proprietary infrastructure, new entrants need to license connections from the incumbent, with a substantial increase in the operational costs.

Finally, it is clear that the institutional development of appropriate conditions of unbundling local loop (ULL) are most important to support market entry together with the diffusion of ADSL. Monopolistic rights delivered to the incumbent reinforced natural barriers to entry due to the technological characteristics of the integration between compression technologies and the existing copper network.

In sum, the diffusion of broadband in Italy is strongly biased by the presence of the incumbent Telecom Italia, characterizing the Italian broadband market as a quasi-monopolistic context. The integration between ADSL and the traditional copper network accounts for greatest part of the diffusion of broadband in access. Although broadband access based on xDSL technologies is easier and less costly than broadband based on optical fiber because it doesn't require new infrastructural investments, innovation in techniques and services is limited and constrained by the market, technological and institutional characteristics of the 'old' system. Limitations in market

entry and competition in turn are likely to harm the development and diffusion of broadband, both qualitatively and quantitatively. It is clear in fact that limitation in the technical variety due to limitation in competition and market entry affect not only the diffusion of single specific techniques (i.e., optical fiber, wireless, satellite, etc.) and related services in broadband, but also and consequently the quantitative overall diffusion of broadband. Next paragraph, in fact, will show that, although different types of technologies, services, operators and consumers coexist at the national level, advanced broadband services and consumers are concentrated in very few areas. The diffusion of broadband is uneven and the Digital Divide strong at different levels.

4.1. The Digital Divide in Italy

The analysis of the diffusion of broadband shows a picture that is characterized by strong heterogeneity from both the geographical, technological and market viewpoint (Figure 1).

Figure 1. The digital divide in Broadband in Italy (2003)

	N° municipalities	% population	% firms	% geography	WLL	Optical fibre	ULL	xDSL	ADSL	Sat	Competition
1st area	205	25	29	3	X	X	X	X	X	X	Technological variety Local competitors
2nd area	1869	50	50	36					X	X	Technological dualism Wholesale bitstream
3rd area	6027	25	21	62						X	Single technology Very limited competition

Source: Formez and Osservatorio sulla Banda Larga, 2003

The first area is represented mainly by the north-western regions (Lombardy, Liguria and Emilia-Romagna, and to a lesser extent Piedmont) and the Lazio and is characterized by the fact that broadband is here provided through a variety of technologies where the conditions for the unbundling local loop are most important to enable competition between the national incumbent and a variety of especially local players, active in specific market niches. Optical fiber is present and complementary to xDSL, but only to a minor extent and in practice limited to metropolitan areas. From both the technological and market viewpoint this area is the one in which broadband services are provided by a variety of competitors and through a variety of technologies. However this is the narrow area when considering either the number of municipalities covered (205), the percentage of population and firms reached (25% and 29%) and the extent of the territory covered (3%). Here, users and consumers are innovative a proactive and adopt complex broadband technologies and services.

The second area is represented by the northeastern regions or the so-called third Italy (with the exception of the Emilia-Romagna) (Veneto, Friuli Venezia Giulia, Toscana and Marche) and in part by the notable exception of the Campania and Calabria in the south of Italy. Here broadband is mainly provided through ADSL by the incumbent and by those local players operating in wholesale bitstream, which are reaching 50 per cent of both the population and the firms, but covering only 23 per cent of the Italian municipalities and 36 per cent of the territory.

Finally, the largest area in terms of the municipalities (74%) and the territory (62%) covered, but relatively minor in terms of firms (21%) and population (25%)

reached, is one in which competition is most limited and broadband services can be accessed only through satellite technologies. Here, it is the case of the regions in southern Italy, but also of those peripheral and mountain areas such as the Valle d'Aosta and the Trentino. The second and third areas represent the larger part of backward industrial and private users, generally adopting less advanced technologies and services, lagging behind the innovative users.

Such an uneven diffusion of broadband can be explained as the result of the intertwining effect of different factors. On the one hand, new investments in optical fiber require important expenditures characterized by long-term paybacks. On the opposite, such investments are now taking place in an increasingly competitive context, especially at the local level with a limited time-horizon. Actors are often seeking a short run payback for their investments and thus mainly investing in traditional technologies. The picture is therefore characterized by strong inertia due to the characteristics of the competitors and the stock of investments already in place. In a way, technological innovation and the introduction of competition seem to have reinforced the divide between regions. Investments in advanced infrastructures and technologies for broadband focus on those richer and more innovative regions and areas (such as northern regions and metropolitan areas), which can guarantee a shorter payback time for those investments, thus attracting new entrants. On the opposite, investments in those poorer and peripheral areas (such as, rural or mountain areas, southern regions) are slower and focused on incremental adjustments in technologies and services, in turn deterring market entry.

It is clear that in a context where resources are limited and infrastructures cannot be duplicated, two factors are most important. First, access to the incumbent's infrastructures and the development of the conditions of ULL is crucial to favor market entry and the opportunity of introducing innovations. Second, the development of appropriate services should parallel the evolution in technologies and infrastructure in order to provide a variety of contents able to stimulate the demand of broadband.

Next paragraph will show in which way technological complementarities, different from those between copper networks and ADSL, can generate innovation in both technologies and services, introducing important changes in the characteristics and evolution of broadband. In such a process where new technologies are used and new services are introduced, Fastweb is emerging as the key player and the main alternative carrier.

5. RADICAL INNOVATIONS IN BROADBAND: THE ROLE OF FASTWEB

Fastweb has been originally set up in Milan in 1999 as a joint venture between AEM, Milan's main power utility, and e.Biscom, the Italian leader in broadband telecommunications and media-related services established by Silvio Scaglia. In December 2004, e.Biscom and Fastweb merged, following the boards' approval in April. The merger represented the natural outcome of a streamlining process started in 2002 when the group began to focus on its core business: fixed broadband telecommunications in Italy. Following the merger, the new company is named Fastweb, whose shareholding structure is as follows: Silvio Scaglia (Chairman) 30.1%, Carlo Micheli (Vice Chairman) 10%, Fidelity investments 5.3%, Free float 54.6%[3].

Fastweb is now the main alternative carrier and competitor to Telecom Italia. It can be characterized as mainly a metropolitan carrier, with, at the end of 2004, about 500,000 phone lines activated distributed in the six main Italian big metropolitan areas (Milan, Rome, Turin, Genoa, Naples and Bologna), representing 10% of the Italian broadband market. Moreover, revenues at the end of 2004 amount to 974.74 US million dollars. Revenues and access lines growth rate between 2003 and 2004 are 76% and 50%, respectively (data showed in Table 3).

However, even though from a market and quantitative viewpoint Fastweb can be described as a niche operator, from the technological viewpoint the strategy behind such market segmentation and specialization led Fastweb to be the major innovator in broadband in Italy.

In facts, Fastweb's strategy is based on investments in radically new technologies in broadband, which make use of either proprietary fiber connections or unbundled copper lines from Telecom Italia and which in turn allow the provision of new and high value services to both residential and business users.

In particular, Fastweb completely invested in an infrastructure alternative to and thus unbounded from Telecom Italia's one. This infrastructure is based on the integration between the Internet Protocol (IP) and the implementation of a proprietary fiber network able to reach apartments (FTTH), in turn allowing the so-called triple play services, i.e., broadband Internet access, high quality voice over IP (VOIP), and broadband video services (both pay TV and pure video-on-demand).

While it is clear that for Telecom Italia new investments in fiber connections would have been highly expensive because of the important irreversibility due to the

previous endowment in copper lines, and because of the financial weakness following the privatization, different factors made the integration between IP and FTTH affordable and profitable for Fastweb.

First, the complete lack of coaxial cables and thus the total lack of cable TV in Italy, stimulated the diffusion of advanced broadcasting over alternative channels, such as satellite and the Internet.

Second, in Italy as well as in most of industrialized countries, residential users in cities together with business users such as SOHO and business service firms are mostly concentrated in condominiums.

Third, in Milan in particular the local utility AEM had already implemented a widespread ducts infrastructure for optical fiber as part of its infrastructure of underground ducts for gas and electricity. The same ducts were used to lay optical fiber cables, allowing Fastweb to build a metropolitan area network more easily and without starting investments from scratch. Moreover, similar infrastructures had been partially developed also in the main Italian metropolitan areas in the ‘90s by Telecom Italia as part of the project SOCRATES, aimed at developing optical fiber but which was never completed.

In turn, demand concentration and the availability of network infrastructures allowed Fastweb to reach scale economies high enough to implement Fibre To The Home (FTTH) and Fibre To The Office (FTTO) connections that allowed a bidirectional date rate of 10 Mb/s. Moreover, in those rural regions and small cities and towns where optical fiber is not yet available, Fastweb is providing broadband via

ADSL integrating unbundled last miles from Telecom Italia in access and Fastweb's technology in distribution, allowing a speed of 2 Mb/s.

In this regard, Fastweb is the only carrier that uses optical fiber in access to the home and the office, and this may be regarded as the first radical technological change introduced by Fastweb. However, Fastweb has been able to introduce innovations also in services, such as the triple play services, only through the integration between optical fiber in access and the use of the Internet Protocol in distribution. Here, the use of IP as a distribution technology can be regarded as the second and crucial radical innovation introduced by Fastweb.

The different actors providing broadband services based on the integration between ADSL and the traditional copper network, both the incumbent and the new local entrants, had to face the problem of changing from the traditional Public Switched Telephone Network (PSTN) to the packet switching (mainly ATM). In fact, PSTN is today almost entirely digital in technology except for the final link from the central (local) telephone office to the user. On the contrary, the development of a proprietary and independent fiber network represented twice a technological opportunity for Fastweb. On the one hand, it allowed Fastweb to bypass Telecom Italia infrastructure and to overcome the related barriers to entry. On the other hand, from the technological viewpoint Fastweb has not been bounded to the use of the traditional network for the development of broadband services, in turn being able to base broadband services on a single technology, namely the internet protocol, and to bypass also the shift from PSTN to the digital system.

The integration between IP technologies in distribution and optical fiber to the home and the office in access is now the key source of advantage for Fastweb (Guerci and Marcolongo, 2003). It makes possible the provision of new services, alternative to both narrowband telecommunications and ADSL, with much shorter time-to-market when compared to those of the incumbent and minor new entrants. The latter are constrained by the characteristics and limitations of the traditional network and longer time for testing, adjusting and finalizing the provision of new services. Fastweb can instead capitalize on the investments in new technology because of the important economies of scope between voice, data and video: in fact the same infrastructure is shared to provide different services at high quality, i.e. data, voice, and video over the Internet. The integration between IP and optical fiber can emerge as a standard in the provision of broadband services. Triple play services may be regarded as the third kind of radical innovation introduced by Fastweb.

Let us analyze more specifically the two most important services that may be regarded as key services for both the development of broadband and the understanding of competition between Fastweb and Telecom Italia: namely VOIP and digital TV.

First, in Italy VOIP can be a killer application for operators in the traditional copper infrastructure, including the incumbent Telecom Italia, to different extents. On one hand Italy still has a very low rate of PC penetration and Internet usage for data transmission. On the other hand, voice is still the main source of revenues for the great part of operators in telecommunications. Broadband services based on IP and data transmission alone would represent only a very small market. In this regard Fastweb's choice is to use the IP network to carry also primary voice and to provide the basic

Internet service integrated with data, voice as well as additional services such as video-on-demand and TV-based conferencing. VOIP reinforces the independence of new entrants, and Fastweb in particular, from Telecom Italia and from its traditional infrastructure. On the contrary, traditional operators such as Telecom Italia are bounded to change towards VOIP because of the coupled effect of the high costs of previous investments in the traditional infrastructure and the new investments necessary to change infrastructure. In this regard, Telecom Italia is not only facing the risk of increasing competition and decreases in the market share, especially in those innovative segments characterized by higher added value. Telecom Italia is also facing the risks for the high levels of indebtedness due to the investments in both the traditional and eventually the new infrastructure. Such risks are currently limiting the incumbent with regard to the introduction of VOIP, which is in fact provided by Telecom Italia through ADSL with significant lower quality in the service.

Second, digital TV is also most important to understand the direction towards which innovative service in broadband can evolve and the factors that affect such an evolution. The convergence between the traditional telecommunication copper infrastructure and television is in Italy especially at the base of strong institutional support to the transition from the traditional broadcasting system to the digital TV and pay-TV. Strong support to the transition to the digital TV has been in fact given both through fiscal incentives for consumers buying decoders, and through a law fixing the deadline for the complete transition to the digital TV and the switch-off of the analogical transmission as of 2006, 31st December.

Competition between different technologies through which digital TV can be provided is most important to understand the way in which digital TV could evolve. On the one hand digital terrestrial TV can take advantage from lower costs due to the use of technologies and infrastructures already in place and in use; that is, the copper telecommunication infrastructure and the traditional TV screens in Italy are in practice covering the total population. However, terrestrial digital TV using the copper cable for the uploading is providing lower quality interactive services. On the contrary, Internet digital TV based on broadband and optical fiber can be more costly but can also guarantee more reliable interactive services and triple play services in particular. In this regard Fastweb is again an important innovator. Relying upon the proprietary fiber network and taking advantage from the important indivisibilities in capital at place, Fastweb is providing triple play services with digital TV on demand over the Internet based on a 5,000 titles movie catalogue and around regular 300,000 subscribers to TV on demand. Moreover, Fastweb is also adding new services such as answering machine and fax services, and distant video recording.

Here it is clear that the provision of appropriate contents will be the key to support the diffusion of digital TV. Digital TV can provide a better quality transmission and the multiplication of TV channels over the current frequencies because of the information compression through digital technologies. However the risk is to have very scarce contents, imposing to the consumers the costs of a fast transition to the new system without providing them the appropriate contents.

6. MARKET SEGMENTATION AND LOCAL NICHES IN BROADBAND: THE CASES OF COLT AND TOP-IX

The cases of COLT Telecom Plc and the Consortium TOP-IX represent two different and yet complementary examples of market segmentation based on the identification of localized niches of broadband users and the provision of high-value and advanced broadband services.

Market strategies are here localized both geographically and technologically. First, from the geographical viewpoint, the strategies of COLT and TOP-IX find in metropolitan areas appropriate local markets because of the concentration of large firms and research centers, which are most important potential users of the broadband services provided by COLT and TOP-IX. Secondly, from the technological viewpoint the strategies of COLT and TOP-IX are localized because they are customized according to the users' needs. Large firms and research centers can be in fact the typical users of the advanced broadband services provided and able to pay for *ad hoc* and value-added services and technologies based on broadband. Let us analyze the characteristics of COLT and TOP-IX broadband strategies more specifically.

COLT Telecom Group plc is a European provider of broadband telecommunication business services with its Italian headquarter in Milan. Although COLT is an international player, its presence in Italy, and especially northern Italy, well represents the kind of strategies that players alternative to the incumbent can put in place in the Italian broadband market. Given the quasi-monopolistic power detained by the incumbent Telecom Italia is in fact clear the alternative players are induced to adopt

segmentation strategies aiming at identifying rich niches not covered by the incumbent services.

The location in Milan is in this perspective strategic for the development of COLT's Italian market and the selling of its services to business users, in turn configuring COLT mainly as a metropolitan operator[4]. COLT in fact found in Milan the appropriate environment in terms of both partners and preferential users, such as knowledge-intensive-business-service-firms and high-tech firms. Consultants and business services are much more concentrated in this area than in the rest of Italy. In terms of finance, management, and support to R&D, the province of Milan business services amount to 18.7 per cent of Italian business services. In terms of telecommunications and new technology business services, almost 30 per cent of Italian business services are concentrated in this area. Finally, from the qualitative viewpoint, in the Milan metropolitan area large firms in the high-tech sectors such as IBM, Alcatel, ST Microelectronic and Cisco can represent excellent partners and users for the services provided by COLT.

In this context, the broadband infrastructures and services provided by COLT can be the means for important organizational opportunities for its clients, especially when considering connections to other European metropolitan areas. In fact COLT is providing the first pan-European proprietary network on optical fiber and based on the Internet Protocol (COLT EuroLAN) connecting 32 metropolitan areas. Firms located in the Milan metropolitan area through this network can be connected Europe-widely, conveying voice, data, video and Internet over a single network. E-Business services are

also provided through the COLT network and the hosting service provided by the Internet Solution Centre (ISC) in Milan, connected to other 10 ISCs in Europe.

A different rationale is behind the experience of TOP-IX - Torino Piemonte Internet Exchange. TOP-IX is a consortium promoted by the CSI Piemonte (public centre for research, development and experimentation in advanced ICTs) and gathering the support of some of the main economic and research institutions at the regional and national level, such as Atlanet (Fiat Group), Sanpaolo IMI, Fastweb, Telecom Italia, Colt Telecom, Noicom. TOP-IX is born with a strong orientation towards future technologies, in particular multimedia applications in multicast and IPv6. The Consortium realized the only one NAP (Neutral Access Point - first level Internet access point) in Italy, in order to favor the local concentration of Internet traffic. The NAP provides virtually unlimited band, very high-speed capacity, distributed access, and multimedia applications.

TOP-IX adopted the WDM technology (Wave Division Multiplexing) as the suitable networking layer for the interconnection of the different nodes which represent the distribution backbone model. TOP-IX is constituted by different nodes distributed on the territory and linked by means of high speed backbones (> 2,5 Gbps) that, exploiting the WDM technology, allow to share over the same fiber different technological platforms. Each one of these nodes is equipped with 10/100/1000 Mbps switches (Ethernet). The nodes are connected through a high-speed connection constituted by Gigabit Ethernet links assembled in a single logical channel (GigaEtherChannel) so as to fully exploit the available band. This approach allows coexistence on a common physical infrastructure of the three TOP-IX platforms for

unicast Internet traffic, multicast Internet traffic (for the provision and transmission of multimedia contents[5]), and, on a totally experimental level, IPv6-based traffic, respectively.

In this context, public administrations, research institutions and large firms can be identified as the main potential users of the services provided by TOP-IX. In particular, two main applications of the services provided by the Consortium can be more relevant. First, applications in the so-called eGovernment such as the implementation of a unified desk for different administrative activities, on-line tax register and on-line tax-payment services, in turn reducing the complexity of administrative processes and increasing the capabilities to share information between public and private users. Second, applications oriented to create a common layer enforcing the cooperation between the Polytechnic School of Engineering, the University of Torino and private firms. In this regard, the start-up of the experimentation of the IPv6 platform benefited from the agreement between two main local research institutions such as the CSP and TILAB (Telecom Italia Lab). Particularly the agreement between Topix and TILAB will provide firms and research institutions the access to the 6BONE at a first stage, and subsequently to the EUROSIX (of which TILAB is a promoter company) and the USA IPv6 backbones (vBNS+, Abilene, 6TAP).

7. CONCLUSIONS

The financial weakness of Telecom Italia and the geographic dispersion of the country have caused a major delay in supplying the country with a broadband

infrastructure through the last years of the XX century. This in turn has paved the way to a strong intermodal competition where different groups of players have made systematic efforts to implement their own alternative technological platforms with conflicting innovation and economic strategies. Digital television seems more and more entrenched with little opportunity for broadband to become the basic distribution infrastructure. On the other hand the slow diffusion of UMTS has reduced the prospect for a wireless scenario. The progress in VOIP technology and the fast penetration of Internet services in households and business have increased the levels of the demand for broadband services stretched to the curb. The increasing financial solidity of Telecom Italia provides the final element. After a decade of delays, the prospect for a rapid and extensive coverage of the country of broadband is now gaining momentum. The implications are important both in terms of a reduction in the digital divide within the country and also in terms of the prospect for a shakeout and new consolidation of the communication industry into a general multiservice technological platform. The role of Antitrust may become decisive in the immediate future in order to preserve competition.

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[1] Some new entrants do not bypass (e.g. buy wholesale products from incumbent or LLU).
[2] See Section 5 for Fastweb's strategy and Section 6 for two examples of OLOs strategies.
[3] Shares at January 25th 2005.

[4] The Italian headquarter of COLT is located in Milan, which represents a COLT Metropolitan Area Network (MAN) and that hosts also an Internet Solution Centre. In Italy, COLT is also present in Turin, with the Turin MAN and Internet Solution Centre, while Rome is covered as MAN. It is clear from this solution that COLT' strategy in Italy is particularly aimed at covering main metropolitan areas. This is not the case, for instance, in Germany, neither in France, where, as nodes of wider networks, relatively smaller cities, such as Essen, Leipzig, Nuremberg, Mannheim, Karlsruhe, Toulouse, Bordeaux and Nantes are also part of the network.

[5] The embedded multicast technology provides optimal delivery of streaming events, video on demand and of multimedia applications in general, allowing to manage and prevent network overload.