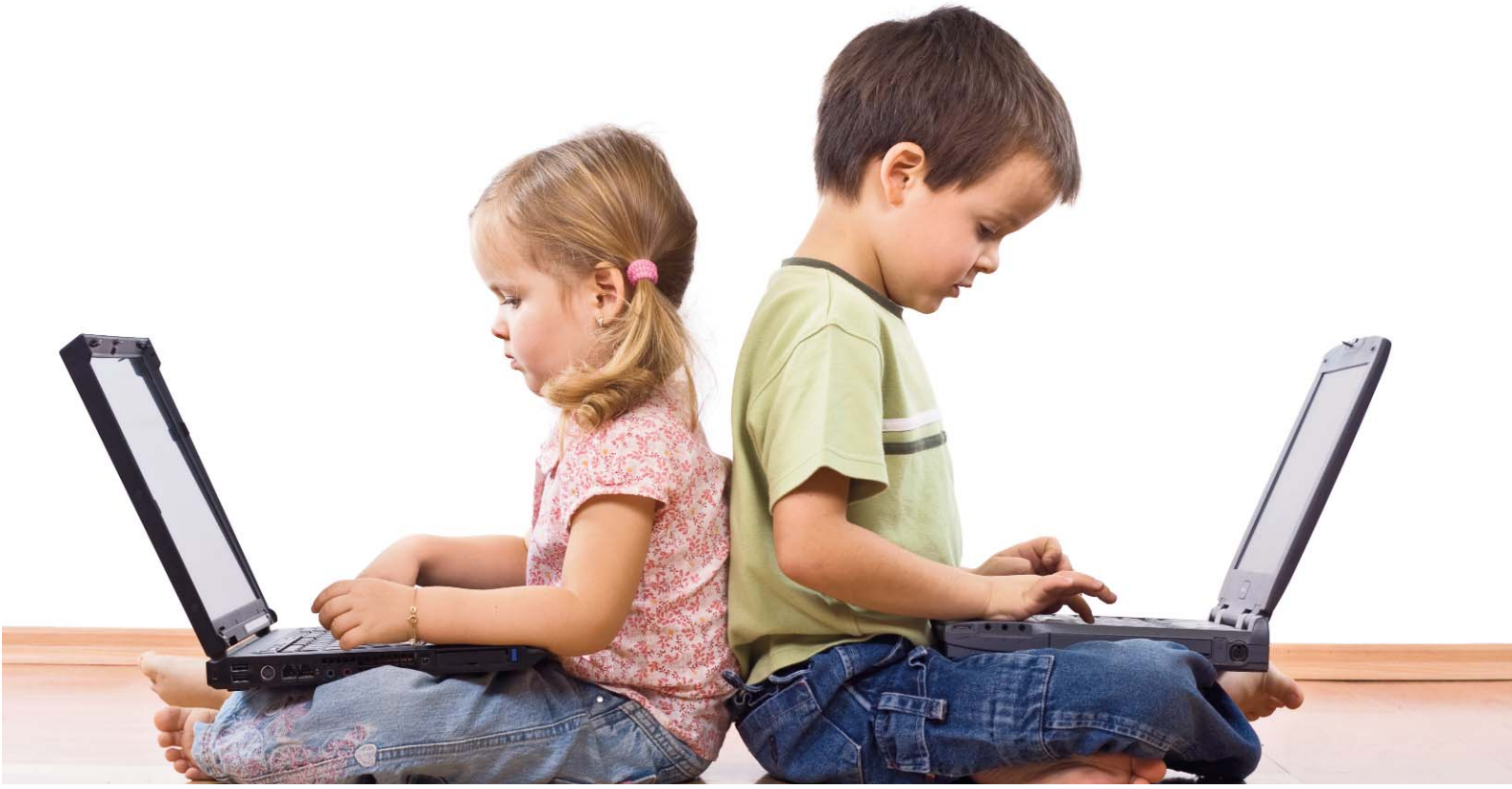

Next Generation Competition

Driving Innovation in Telecommunications

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i. Key messages

- Europe has one of the most competitive telecom markets globally. Especially at the infrastructure level, competition has intensified in the past decade. We are seeing an accelerated pace of innovation and convergence leading the market to the Next Generation Competition.
- The €250 billion Western European telecommunications market is of vital importance to Europe's economic growth and competitiveness. The broadband sector which represented 14 per cent of the market in 2008 is rapidly expanding with revenues growing at 28 per cent per year since 2004 compared with overall growth of 3 per cent for the overall market.
- Broadband access is increasingly at the epicenter of competition between telecom providers. Many applications are carried on broadband. Voice is already used, video is following, competing with traditional providers such as satellite, cable and digital terrestrial television (DTT), with more applications potentially to follow.
- Broadband innovations have led to a series of significant speed upgrades. According to Akamai, for example, the average download speed for 19 European countries is close to 4 Mbit/s. With further upgrades to existing infrastructure, significantly higher speeds can be expected.
- Projecting the known applications that are most frequently used by the largest majority of consumers today—and accounting for the growing appetite for high-bandwidth applications by more and more consumers over the next few years—it is reasonable to believe that bandwidth of 30 Mbit/s to 40 Mbit/s will represent a very significant enhancement of the services currently available to the majority of consumers as they gradually increase their demand for bandwidth.
- In the absence of any disruptive "new to the world" high-bandwidth applications, it is reasonable to believe that the most economically efficient objective for infrastructure providers over the next three to five years is to gradually increase speeds available to the mass market and move up the "consumer sweet spot," which in the context of this report means the majority of consumer demand for applications supported by broadband. Whilst gradually enabling higher speeds for the mass market, providers will likely continue to roll out and market ultra-high (>>100 Mbit/s) bandwidths.
- Industry estimates of where this mass-market sweet spot will be across Europe by 2014 vary widely, depending on a number of factors, including variations in supply and demand for high-speed broadband in different markets.

- Next Generation Access (NGA) won't be accomplished by a "single leap forward". Most fixed infrastructures today can, in fact, be upgraded to NGA with the right investment incentives. It remains uncertain how much consumers are willing to pay for higher-bandwidth. As a result, broadband providers so far appear to be more inclined to follow a natural pace of experimentation and adaptation to consumer demand, rather than invest in major system-wide network upgrades.
- High-speed broadband has so far followed a pattern of continuous, counter-cyclical waves of innovation and investments. That is especially true where there is competition among access infrastructure providers, as one player's progress in network upgrades to higher speeds usually triggers competitive responses from other players.
- Next Generation Competition is likely to evolve along similar lines, as a number of different infrastructure providers seek to balance investments in technology advances and product innovations against emerging consumer needs—with the objective of ensuring investors can recoup a return on their investments.
- A major challenge confronting the companies engaged in Next Generation Competition is how to earn sustainable returns in markets with multiple wireline access infrastructures, except in some of the most densely populated markets. The analysis so far indicates that two fixed infrastructures with wireless challenger infrastructure competition (satellite-TV, DTT, 3G–4G voice and data) create a dynamic competitive market with economically sustainable competition.
- Consolidation among subscale or regional players and service resellers is expected. This scenario is more likely in countries with fragmented cable and fragmented broadband provider landscapes. Consolidation, in turn, will shape the competitive dynamics, with improved economies of scale from procurement, marketing and overheads for the merged entities being the foundation of more competitive intensity at a national level.
- Markets with one single fixed access infrastructure lack the competitive dynamic between access infrastructure owners with the incentives of "first mover investment advantage" and operate with heavier regulations. These factors may have the effect of slowing investments in innovation and network upgrades in some markets. Creative break-out solutions may stimulate innovation more rapidly.
- Despite delivering lower speeds, wireless infrastructure providers are emerging as competitors to wireline companies in broadband markets throughout Europe in a significant part of the market. Next generation wireless technologies such as long-term evolution (LTE) will further intensify this wireless-wireline competition.

ii. Background and approach

Europe has built one of the most competitive telecommunications markets in the world. It is balancing the objective of stimulating effective competition in the market with social economic policies relating to an inclusive Information Society. Particularly, Europe's leading broadband nations rank amongst the most competitive digital economies along with the US, Japan and Korea.

In order to maintain its broadband leadership and accelerate growth in the European digital economy, the European Union has reinforced its commitment to a number of policies under its "Digital Europe" strategy in support of the EU's new social economic objective of a "radical transformation towards a Knowledge-Based Society"[i]. The EU's objectives are that all Europeans have access to broadband Internet by 2010, and to high-speed broadband Internet by 2013[ii], although specific speeds have not been defined.

The deployment of Next Generation Access (NGA) networks has become a priority and a key approach for the European Commission (EC) to meet these Digital Europe objectives. In this report, networks are considered to be NGA if they offer broadband speeds of more than 50 Mbit/s. Such speeds would, for example, enable consumers to view multiple high-definition video streams, allow for video communication and a multitude of further services such as telemedicine. The challenge facing both broadband providers and policy-makers is to use this next wave of telecom innovation to provide significant upgrades from today's broadband products for the largest possible group of EU citizens.

Following EC priority setting, we are witnessing an accelerating push for upgrades and build-out of these infrastructures across Europe over the next five years. Regulators and governments are still in the process of formulating their approach on how to stimulate the transition and some market participants are eagerly awaiting those decisions before making major investments.

The magnitude of macroeconomic value of a next generation infrastructure expansion is still much debated in the academic and governmental communities. Some reports indicate high short-term gross domestic product (GDP) and employment gains levelling off over time. A recent EU report estimates NGA roll-out in Europe could create up to one million new jobs and result in €850 billion in economic activity.

Given what may be at stake and the rapidly changing market, regulators, governments and market participants will need to set a vision for the shape of the market over the next five years. This will require making informed choices on key questions such as:

- How fast will demand for high-bandwidth applications develop and what is driving this development?

[i] Barroso, Jose Manuel, President of the European Commission, Letter to European Heads of State and Government of Member States, 17 June 2009 [http://ec.europa.eu/commission_barroso/president/pdf/statement_20090618_en.pdf].

[ii] Reding, Viviane, "Digital Europe—Europe's Fast Track to Economic Recovery", The Ludwig Erhard Lecture 2009, Lisbon Council, Brussels 9 July 2009.

- How fast will—and should—broadband networks migrate to higher-bandwidth and what are the drivers of this transition?
- How much access infrastructure competition is desirable and sustainable?
- How to avoid a digital divide once NGA becomes a prevalent standard?
- How to balance the investment risk between investors and market participants?

The answer will vary from country to country—and within nations (for example, rural versus urban areas). A key driver of answering these questions in each market is the starting position of the country or region. What is the current country or regional infrastructure coverage? With are the technical capabilities? How many players exist? What are the key consumer trends? What is the current regulatory environment?

This report takes stock of the current state of play of the European telecommunications market. It focuses mainly on the consumer segment and describes the past evolution and its drivers. It also provides a perspective on possible future market structures and potential pathways going forward.

In order to understand the challenges and opportunities for Next Generation Competition across Europe, we use the following approach:

1. We analyse the major factors that influenced the evolution of telecommunications in the past—including market forces, competitor dynamics and business strategies—and then assess the potential impact of these factors on the future development of telecommunications in Europe.
2. To account for differences in market conditions across the various European countries, we analyse countries with similar conditions.
3. We describe the potential paths the future evolution of telecommunications might take in specific countries.
4. We present likely scenarios of future market structures, taking into account the possible evolution of telecom infrastructure and consumer demand.

iii. Executive summary

Introduction

In the last two decades, the telecommunications sector in most European countries has evolved from a national, state-owned monopoly to a vibrant, competitive marketplace where multiple providers—telecom operators, cable operators and service providers—are vying to provide customers a wide array of telecommunication services: from traditional fixed-voice telephony to cutting-edge, over-the-top video streaming. This competitive marketplace and regulatory environment has resulted in significant consumer benefits—for example, telecom service prices have declined by 28 per cent since 1996 in Europe according to Eurostat[iii].

The broadband market segment has become the fastest growing segment, increasing on average by 28 per cent between 2004 and 2007, driven by the improved availability of broadband networks and the increasing consumer demand for higher-speed access. With the potential to create more than one million jobs in the next few years, the telecom sector is crucial to Europe's future competitiveness and can help to better navigate through the current economic downturn—but, at the same time, it represents a challenge for market players and regulators, as they grapple to define the shape and pace of Next Generation Competition.

While everyone shares a common vision for the future—to ensure that European consumers have access to the latest, world-class telecommunications services at prices that are fair and equitable, that there is no compromise in quality and that consumers have plenty of choice in terms of providers—there are many paths to achieving that goal. Our research shows that each has its advantages and pitfalls. Add to that the unpredictable nature of two key forces influencing the future of European telecom—technological developments and consumers preferences—and forecasting the future of European telecom becomes even more complex.

European regulators and market players understand they have to make choices—and the goal of this report is to help them understand market dynamics and develop a practical framework for decision making. We have focused our analyses on the "natural" market dynamics of competition to identify those areas where competition will spur the transition to higher-bandwidth networks, and those areas where the competitive stimulus might not be sufficient to achieve the desired migration, with the risk of a digital divide.

Intensified competition in the European telecom market

Liberalisation in the European telecommunications market has led to increased competition over the past 15 years. Today, competition exists not just at the telecommunications service level but also at the infrastructure level where the key bottlenecks existed—a substantial

[iii] Eurostat July 2009; Countries in the study include BE, DE, IE, GR, ES, FR, IT, LU, NL, AT, PT, FI

change from the time when each country had just one national telecom operator. Now, Europe's telecom market has reached another important crossroads: "Next Generation Competition" offers an opportunity to review past approaches and frameworks and consider options over the crucial next few years, as the global economy resets.

In doing so, it is important to consider the changing contours of competition:

- Competition for the same customers and same services has intensified between fixed and mobile network operators. In voice services in 2009, the total mobile voice traffic in Western Europe[iv] exceeded the total number of fixed voice calls; and increasingly, in data services too, consumers in specific segments like single households are switching from fixed to mobile. That trend will intensify with the further roll-out of third-generation mobile networks and investments in LTE networks, which will provide consumers with much higher bandwidth speeds on mobile devices.

- In European markets where a second wireline access infrastructure is widely available (most frequently cable in residential households), telecom and cable operators are increasingly competing in one another's traditional markets. This competition is also spurring momentum for the upgrade of wireline networks, pushing them to provide higher broadband speeds. In countries such as the Netherlands, Belgium and Switzerland which have two competing fixed infrastructures covering more than 80 per cent of the population, consumers already experience higher average broadband speeds of 5.3 Mbit/s compared with 4.0 Mbit/s in other Western European markets. In addition, in these three countries broadband penetration is at 32 per cent of the population compared with 25 per cent in other Western European countries.

A sustainable degree of infrastructure access competition is more likely to make available required bandwidth more efficiently and in line with demand than "top-down target setting".

Like all digital consumers worldwide, European consumers also have an increasing appetite for bandwidth and it is hard to predict what European consumers will be willing to pay for improved broadband services. Therefore, "bandwidth speed target setting" can result in high-bandwidth speeds that appeal only to consumer niches, lacking a broad consumer base willing to pay for the increase in capacity. One alternative, which appears to have greater economic rationale, is to focus on bringing the whole market to higher average access speeds, to a "consumer sweet spot" in line with what will likely be needed, appreciated and paid for by mass audiences. By "sweet spot," we mean the majority of consumer demand for applications.

- Extending the offering significantly beyond current usage patterns can be done with speeds up to 40 Mbit/s. For example, these speeds would allow for a household to simultaneously use several currently known applications and services (for example, the simultaneous use of voice, data, P2P sharing and up to three HD channels).

[iv] Countries included are: AT, BE, DK, FI, FR, DE, GR, IE, IT, NL, NO, PT, ES, SE, CH, UK

- Due to uncertainty of consumer interest in high-bandwidth applications and their willingness to pay, it is unclear whether consumer pull will provide sufficient investment incentives to migrate to NGA networks within the next five years.
- Separate from consumer pull, technology push by infrastructure owners may allow earlier consumer penetration of higher-bandwidth offerings at affordable prices. Continuous fixed and mobile infrastructure upgrades in broadband performance levels will move (and are moving now) the "consumer sweet spot" of the market upward—but not in one quantum leap.

Given the high levels of capital investment required, analysis so far indicates that it is difficult for most markets to support multiple fixed access infrastructures—and two seems to be a more viable environment to promote technology innovation than the alternatives: either a myriad of failures of financially unsustainable players or a monopoly without infrastructure competition to stimulate innovation.

Two access infrastructures are the most sustainable level of achievable wireline infrastructure competition. Under reasonable economic assumptions, including return on investment, it is difficult to economically justify more than two nationwide NGA networks in the residential market. This economic "law of gravity" is an important factor in driving additional sector consolidation, which generates mixed reactions but in practice often results in more vibrant competition compared with a multitude of regional or service/reseller-based smaller players.

- The nature of investment in dedicated wireline access to each household is highly capital intensive and has high barriers to entry.
- As a consequence most typical consumer areas in a given country can support a maximum of two wireline access infrastructures—assuming that they leverage "brownfield" networks rather than greenfield build-outs. This applies to most consumer areas, with some exceptions in high-density regions.
- Historically, attempts to establish a multitude of fixed infrastructures beyond selected dense geographies have failed due to unsustainable financials. In the UK market, for example, 80 per cent of challengers either merged or went bankrupt within eight years of entering the market.
- One likely result: Small players will increasingly team up to consolidate to create viable fixed national competitors, thus improving the competitive dynamics.
- Whilst challenging each other, dual fixed infrastructures typically compete as well with alternative infrastructures such as satellite, DTT and mobile, which provide both substitution in certain segments and complement the offering in parts of the market in which they have unique advantages.

In countries with a sustainable number of access infrastructures, high-speed broadband has so far followed a pattern of continuous, counter-cyclical waves of innovation and investments.

Countries where more than one fixed access infrastructure is available to the majority of the households appear to provide the most vibrant evolution to faster migration to higher-speed broadband. We observe this dynamic in a number of countries (representing approximately 45 per cent of European households in terms of homes passed, although close to 30 per cent in terms of homes actually connected). In these countries, generally, former PTT networks, cable and challenger fibre networks compete directly in access infrastructure. In particular in the Netherlands, Belgium and Switzerland, most consumers have a real choice between competing infrastructures.

- Infrastructure competition provides strong incentives for infrastructure owners to continuously upgrade their networks and to invest in the next technology. Where dual fixed infrastructures exist each infrastructure owner has an incentive to invest (either selectively or nationwide) in the next generation of technology to provide consumers with superior bandwidth performance in order to acquire or retain customers. This typically stimulates the competing network towards a counter-wave of investment which, in turn, generates a further response from the other access provider.

- The recent consumer bandwidth race in many countries in this category has, for example, seen European cable operators upgrading to DOCSIS 3.0 to achieve NGA bandwidth performance levels, benefiting from the lower and more gradual network upgrade costs. The likely result, already playing out in some markets including Germany and the UK, is an acceleration of telecommunication companies' investment to respond with their own technological solution.

- In countries where fixed access infrastructure operators are a collection of regional or smaller players, consolidation into a national competitor can have the effect of further stimulating competition as a result of scale efficiencies in multiple areas (branding, content, procurement), providing additional room for network investment.

Next Generation Competition: matching consumer needs, technology innovation and investor returns.

Sustainable infrastructure competition seems to be the most effective stimulant for continuous innovation and network expansion.

- Most fixed infrastructures today are, in fact, NGA-capable with the right investment incentives, given that the existing telecommunication and cable networks are in essence brownfield plant capable to evolve into NGA infrastructure. NGA network build-out should therefore not be seen as a "quantum change" from today's telecommunication networks but rather a natural (and in most cases gradual) evolution build-out of all NGA-capable networks in a given market.

- Next Generation Competition can be defined as infrastructure-based competition that enables a healthy pace of technological development and NGA network roll-out allowing for investors to recoup their returns while meeting evolving consumer uptake of high-speed connections.
- There is likely to be no end state of infrastructure and competition in the telecommunications market; after the upcoming NGA era there will probably be a new generation of network technology satisfying the ever-increasing consumer demand for bandwidth. Having some degree of infrastructure competition will provide the foundation for the next round of NGA.

Markets with underdeveloped challenger access infrastructure will be looking for creative alternatives and "out of the box" solutions.

In countries where a widespread nationwide access infrastructure alternative is missing or unavailable to a majority, new solutions are being contemplated. There are very significant economic challenges to additional national build-up of alternative greenfield NGA networks, due to the very high up-front investments versus the risk-adjusted returns. The situation in these markets may also result in a slower speed of upgrade of the existing infrastructure, given that single access infrastructure owners today are heavily regulated and investors in these companies are understandably concerned about the risks of investing more. In those markets, alternative solutions are likely to be experimented with to accelerate the migration of existing infrastructures to NGA.

- A few international examples of solutions attempted include some form of regulated local-loop structural carve-out of the single access infrastructure (for example, in the UK). This approach has been correlated to a stimulus in DSL roll-out, a proliferation of DSL resellers, moving into unbundlers once they achieved a certain scale and then by a round of consolidation of these providers, although this approach does not resolve per se the issue of driving a fundamental network upgrade.
- Some countries have experimented with public vehicles or publicly funded incentive mechanisms (state aid, grants, tax holidays, regulatory exemptions, reverse auctions for local licences and so on) aimed at upgrading the existing single access infrastructure. However these solutions have natural limitations given that they do not provide sustainable long-term competitive tension to stimulate the next phase of innovation.
- There are few examples of approaches geared towards public stimuli aimed at supporting a single—either greenfield or brownfield—alternative access infrastructure. This approach may appear counter-intuitive (why use public funds to create redundant infrastructure?), but it may produce, as a long-term outcome, impetus to innovation and future migration to the next technological wave.
- Wireless broadband can provide a powerful additional level of competition, albeit less so in the ultra-high-bandwidth segment where wireless performance reaches natural limitations.
- Wireless broadband can also provide a solution to covering white spots in those markets where unfavourable economics make fixed access infrastructure build-out unfeasible.

There is no one-size-fits-all approach

The future of Digital Europe is a mosaic. Each country's telecommunications market will evolve based on its past investments, the number of players, the extent of the infrastructure coverage and, of course, the willingness of its consumers to pay for the next generation of telecommunications services. As regulators and governments find the balance between stimulating consumer demand and encouraging market players to invest in the future, there will be corrections and mid-course adjustments. Technological change, after all, is often disruptive and the migration to the Next Generation Access networks might well be a bumpy ride for some European countries.

1. The European telecom market today

The European telecommunications market is of vital importance to Europe's economic growth and competitiveness. The market is made up of four sub-segments—fixed voice, mobile voice, Internet and television (TV)—each with unique competitive dynamics and economics. Furthermore, for each of these sub-segments, the competitive and consumer dynamics of the market varies for each European country. In this chapter, we will provide a brief overview of the market and the competitive landscape across Europe to set the stage for our discussion of Next Generation Competition in the sector. For the purpose of this report, we define Europe as the 27 member states of the European Union (EU) as well as Switzerland unless otherwise stated.

a) Importance of the telecommunications sector

The European economy is in the midst of a world-wide economic crisis, experiencing some of the most severe decline witnessed over the last 50 years. Across Europe, gross domestic product (GDP) has declined 4.7 per cent since its peak in the first quarter of 2008, and the European Stock Index, the Euro Stoxx 50[1], has dropped by 49 per cent since July 2007[2]. While the telecom sector represents 2.2 per cent of European GDP in revenues[3], its impact on the economy is much larger. According to a report published by the World Bank, the information and communications technologies (ICT) sector has a significant impact on the growth of an economy[4,5].

Europe will need to continue investing in the sector to remain competitive during the current recession and prepare for the eventual recovery. In her July 9, 2009, speech at the Lisbon Council, EU Commissioner for Telecoms and Media Viviane Reding expressed the European Commission's belief that high-speed Internet deployment (fixed or wireless) "could create around one million jobs in Europe, and spur broadband-related growth in economic activity to the tune of €850 billion"[6].

With this in mind, the European Commission and other national regulators are reviewing their policies to ensure competition in the market and stimulate investments in next generation access (NGA) networks. Another important objective is to bridge the digital divide by providing close to 100 per cent broadband coverage to Europe's underserved rural areas by 2010.

[1] The Dow Jones EURO STOXX 50 Index covers 50 Blue-chip stocks from 12 Eurozone countries.

[2] As of 10 July, 2009; Bloomberg

[3] EITO; Eurostat, European GDP defined as GDP of EU27 at €12.5 trillion in 2008; revenues of €250 billion in 2008 for fixed voice, mobile voice, broadband and TV (includes some double counting in inter-operator revenues and termination rates)

[4] The report assessed the impact of a 10-point increase in penetration of telecommunications services such as fixed voice and broadband on economic growth (measured by percentage point increase in GDP). The analysis was conducted for multiple countries, which were split between high- and low-income economies.

[5] "ICAD 2009: Extending Reach and Increasing Impact", The World Bank Group, 2009

[6] "Digital Europe—Europe's Fast Track to Economic Recovery", Reding, Viviane, The Ludwig Erhard Lecture 2009, Lisbon Council, Brussels, July 9, 2009

b) Overview of the telecommunications market

Definition

This report defines the telecommunications market as the services offered to consumers: fixed voice, mobile voice, broadband and TV. We have focused more on the consumer market, as it is less developed than the business market, where telecommunications competition first emerged.

The blurring of telecom service boundaries and the increased ability of market participants to offer more than one product or service to consumers are changing the competitive landscape. For example, cable operators such as Virgin Media that traditionally derived a majority of their revenues from TV subscriptions now see two-thirds of their revenues come from either fixed-line telephony or broadband Internet. The emergence of Internet protocol TV (IPTV), delivered by telecom operators over fibre or very high bit-rate digital subscriber line (VDSL) allows telecom operators to compete with cable and satellite providers in the TV market.

Similarly, mobile infrastructure is increasingly competing with wireline infrastructure, with mobile prices dropping closer to fixed-line prices. For example, in countries with low mobile price levels like Austria, already 70 per cent of the voice traffic minutes are carried over mobile networks compared with 45 per cent for the rest of Europe[7].

The boundaries between the traditional product segments are blurring, too. Increasingly, consumers can access user-friendly and high-quality voice, video and live-TV applications over the Internet. These changes are steering the market towards a more bundled future where the traditional fixed products become applications over a broadband connection.

Market size, growth and profitability

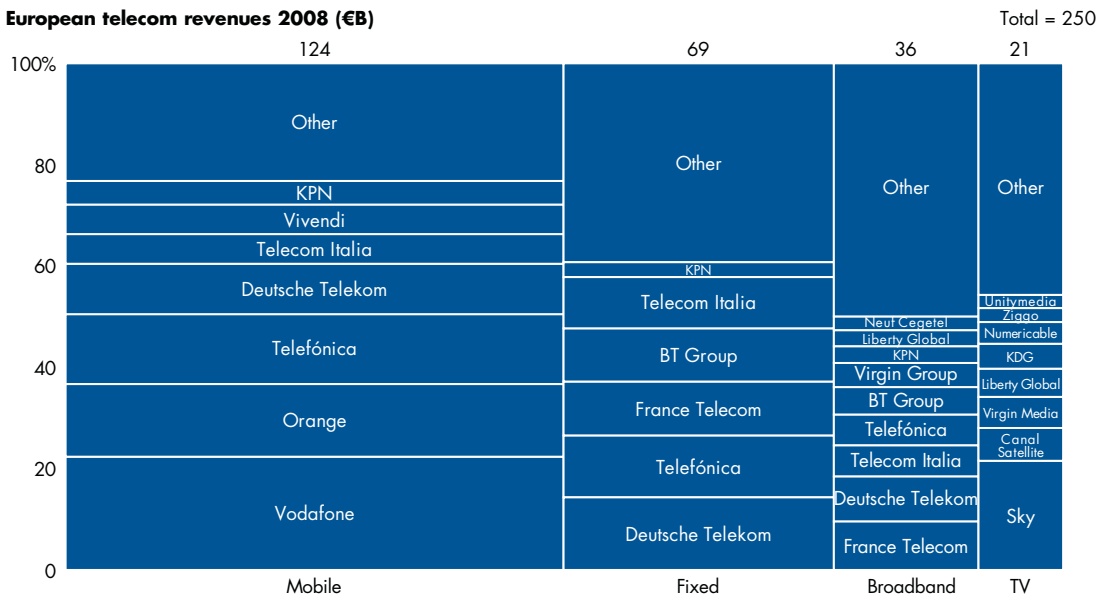
In 2008, European telecommunications providers earned approximately €250 billion[8] (see Figure 1) in revenue. Of this, approximately €124 billion came from mobile revenues and €69 billion from fixed voice revenues. The Internet market contributed another €36 billion while the TV market comprised of cable, satellite, digital terrestrial TV (DTT) and IPTV amounted to approximately another €20 billion.

Since 2004, the market grew on average by 3.4 per cent annually in revenue terms, however, this growth varied by segment. Fixed voice experienced annual declines of 6 per cent (see Figure 2), while mobile revenue grew by an average 5 per cent a year, slowing down to 3 per cent per annum in the last year due to a saturation of the market and price erosion. The broadband market grew rapidly at 28 per cent annually, as more and more consumers adopted broadband services. The TV market experienced annual growth rates of 8 per cent as a result of increased penetration and the introduction of paid services such as digital TV packages and video on demand (VoD).

[7] "The Power of Mobile Broadband", (J.P. Morgan, July 2008).

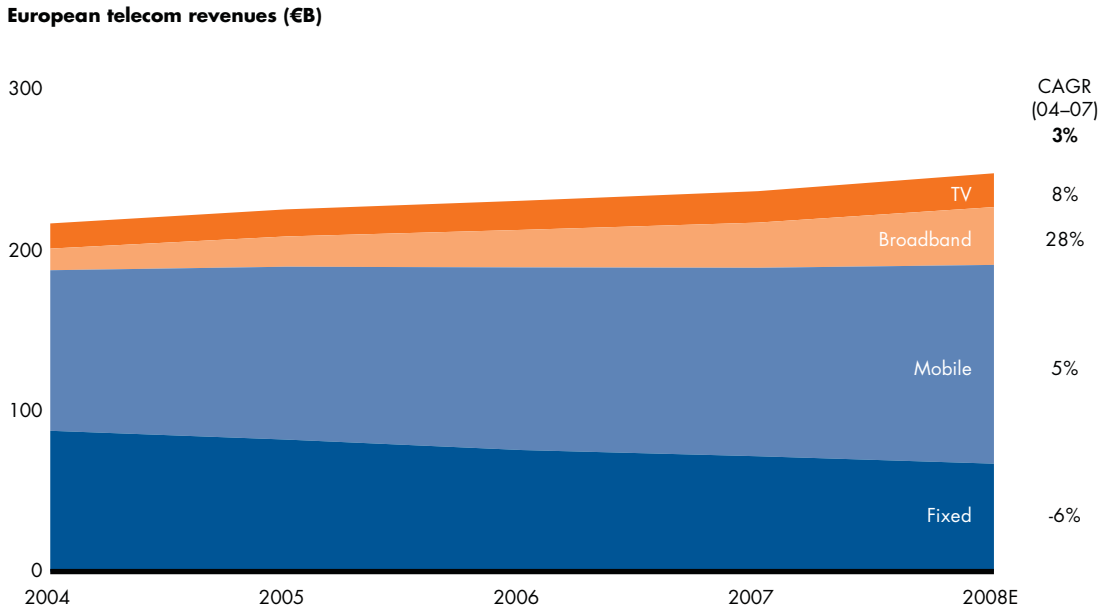
[8] Represents consumer and business-related revenues, includes some double counting in inter-operator revenues and termination rates

Figure 1: European telecom market



Note: TV includes cable TV, satellite TV, terrestrial TV and IPTV; 2008 data extrapolated based on 2007 numbers; countries included: AT (Austria), BE (Belgium), DK (Denmark), FI (Finland), FR (France), DE (Germany), GR (Greece), IE (Ireland), IT (Italy), NL (Netherlands), NO (Norway), PT (Portugal), ES (Spain), SE (Sweden), CH (Switzerland), UK (United Kingdom) (mobile, fixed and bb); AT (Austria), BE (Belgium), DK (Denmark), FR (France), DE (Germany), IT (Italy), NL (Netherlands), RO (Romania), SE (Sweden), UK (United Kingdom), CH (Switzerland) (TV) (mobile, fixed and broadband); AT (Austria), BE (Belgium), DK (Denmark), FR (France), DE (Germany), IT (Italy), NL (Netherlands), RO (Romania), SE (Sweden), UK (United Kingdom), CH (Switzerland) (TV)
Source: Analysys Mason; Screen Digest

Figure 2: Growth of European telecom market



Note: TV includes cable TV, satellite TV, terrestrial TV and IPTV; 2008 data extrapolated based on 2007 numbers; countries included AT, BE, DK, FI, FR, DE, GR, IE, IT, NL, NO, PT, ES, SE, CH, UK (mobile, fixed and broadband); AT, BE, DK, FR, DE, IT, NL, RO, SE, UK, CH (TV)
Source: Analysys Mason; Screen Digest

In terms of industry profitability, as measured by earnings before interest, taxes, depreciation and amortisation (EBITDA), market segments show differences, too. Overall, the telecommunications industry's EBITDA was €84 billion in 2007, or approximately 34 per cent of revenue, decreasing slightly compared with 2004, when it was 37 per cent (€81 billion) of revenue.

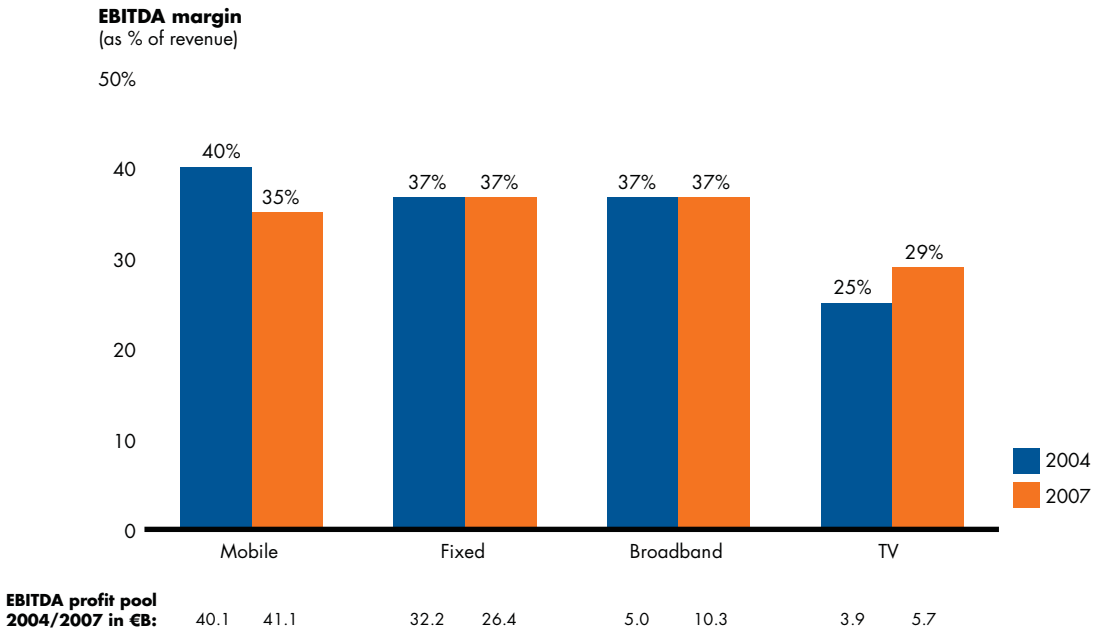
Within this, in the mobile segment, average industry EBITDA margins declined from 40 per cent in 2004 to 35 per cent in 2007 (see Figure 3) due to a decline in prices and increased regulations on termination rates (the cost per call for completing a call on the mobile network). Meanwhile, the TV segment's EBITDA increased by 4 percentage points in part due to an increase in demand for more premium packages as digital TV penetration increased across Europe and in part due to efficiency gains in the consolidating cable sector. During this period, the EBITDA margins of fixed voice and broadband remained stable.

c) Competitive landscape

Types of competition

The competitive landscape in Europe varies across countries and telecom market segments both in terms of the number and type of competitors. Within each country or region, we distinguish between infrastructure and service competitors. Infrastructure competitors own and operate a mobile, copper, cable, fibre or satellite infrastructure.

Figure 3: The telecommunications profit pool in Europe



Note: TV market size including cable, satellite, terrestrial and IPTV for following countries: AT, BE, DK, FR, DE, IT, NL, RO, SE, UK, CH; TV EBITDA margin based on following companies: Sky, KDG, Unitymedia, Numericable, Telenet, UPC Broadband; fixed voice and broadband margins based on aggregated wireline margins as reported by operators
Source: Wireless Intelligence; Credit Suisse; Analysys Mason; Screen Digest

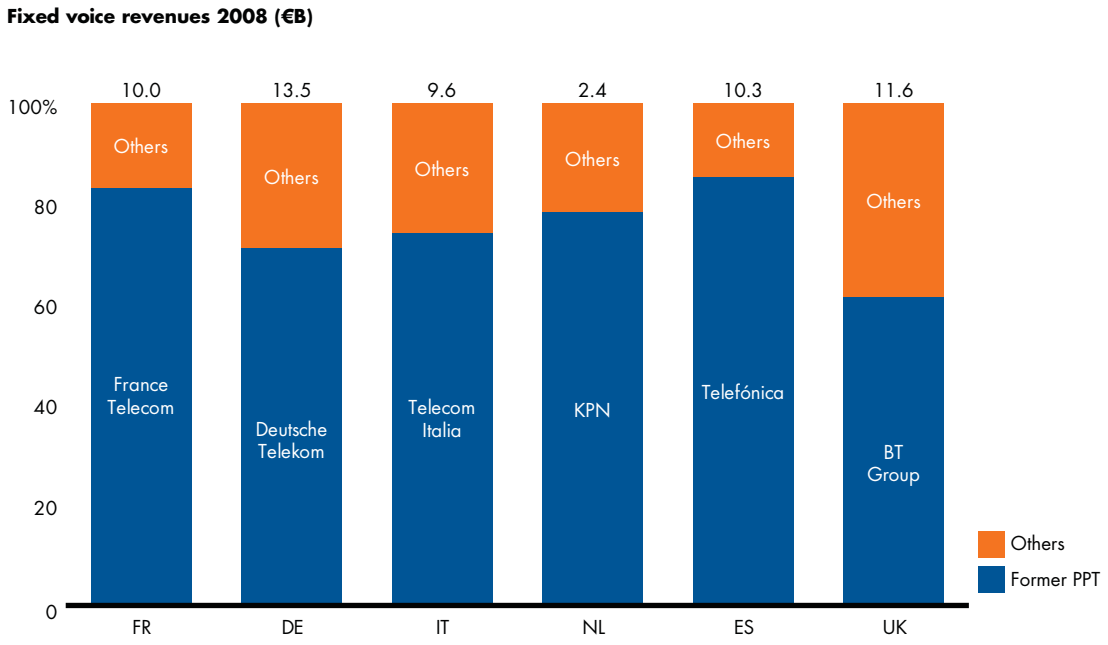
For copper, cable and fibre, they own the "last mile" to the customer, which is also known as the local-loop infrastructure. Service providers include a broad range of companies with different degrees of their own facilities and can include some owned infrastructure, for example: Backbone capacity; leased access to the local loop of an infrastructure owner; or long haul lines and switches.

Fixed voice market

The fixed telephony market was the first to open to competition in the late 1980s to early 1990s, leading to both service and infrastructure-based competition in the market. After deregulation following decades of monopoly, former public telephone and telegraph (PTT) companies now hold between 60 to 85 per cent of market share in the fixed voice market across most European countries (see Figure 4). Service providers as well as cable operators make up the remainder of the market.

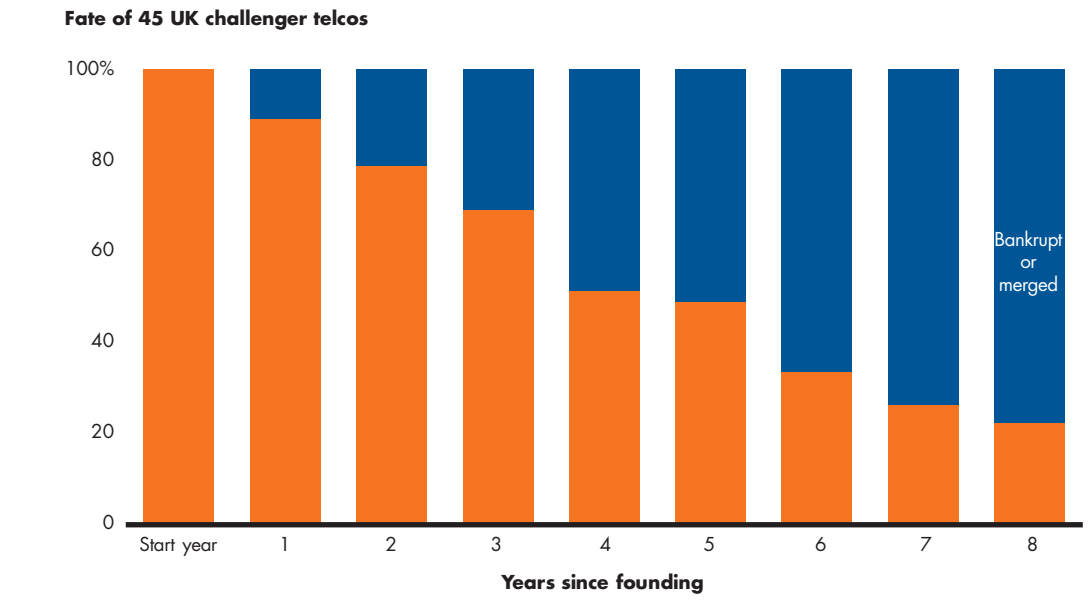
After liberalisation, the telecommunications market experienced intensive competition. Over the years, due to the economics of a fixed-line network, the competitive landscape re-consolidated with many mergers and several bankruptcies. In the UK, for example, nearly 80 per cent of challenger telcos either went bankrupt or were subsumed by other players within eight years of entering the fixed-line voice market (see Figure 5).

Figure 4: European fixed voice market



Note: 2008 data extrapolated from Q2 07–Q1 08 data
Source: Analysys Mason; Annual reports

Figure 5: Short lifecycle for challenger fixed-line telcos in the UK



% standalone, solvent:	100	89	79	69	51	49	33	26	22

Source: BvD FAME UK database; Company financial reports

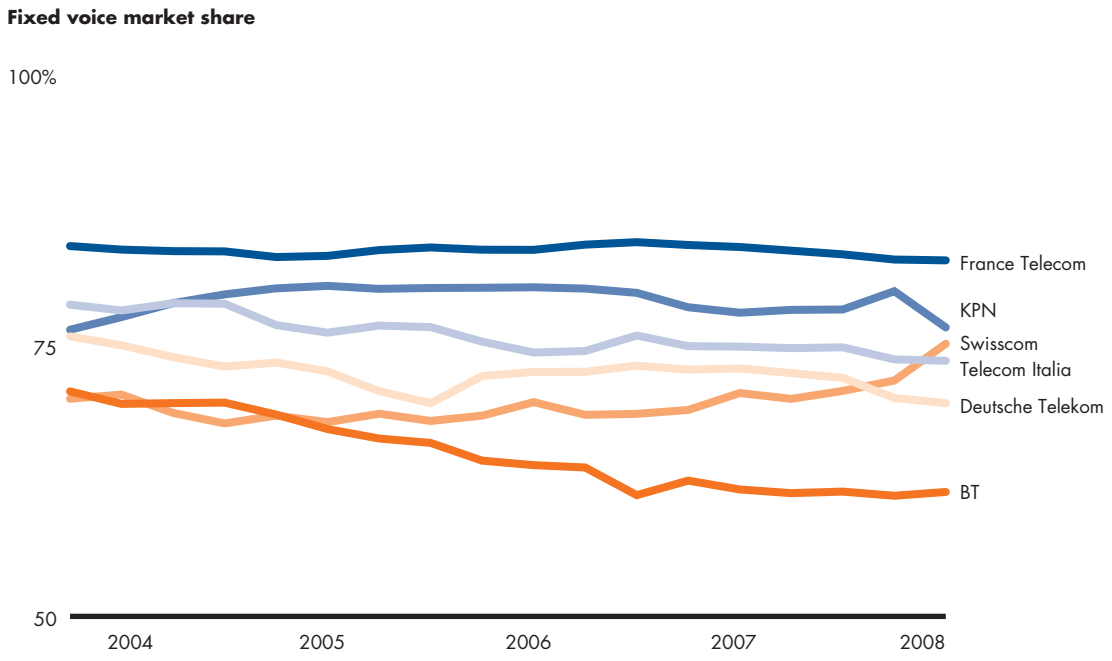
With the market maturing, the competitive dynamics have become more stable in recent years and the market shares of the former PTTs and the challengers have stabilised over time (see Figure 6). Throughout Europe, the fixed voice segment is expected to further stabilise and consolidate in the next few years.

Mobile market

Competition in the mobile market at the infrastructure level is dependent on the number of mobile licenses auctioned to operators by local governments. In most European countries the mobile market usually has three to five operators. At a European aggregate level, due mainly to consolidation in mobile across countries over the last few years, the top 10 mobile operators today represent almost 90 per cent of the European market. Most of these mobile companies are fully or partially owned by a former PTT telecom operator with the exception of Vodafone, which is the largest major independent mobile operator in Europe (see Figure 7). The second-, third- and fourth-largest pan-European mobile players are T-Mobile, Orange and O2 and are owned by Deutsche Telekom, France Telecom and Telefónica, respectively. All these leading companies have mobile licenses in multiple European markets and aim to benefit from some scale advantages in areas like procurement, product development and marketing.

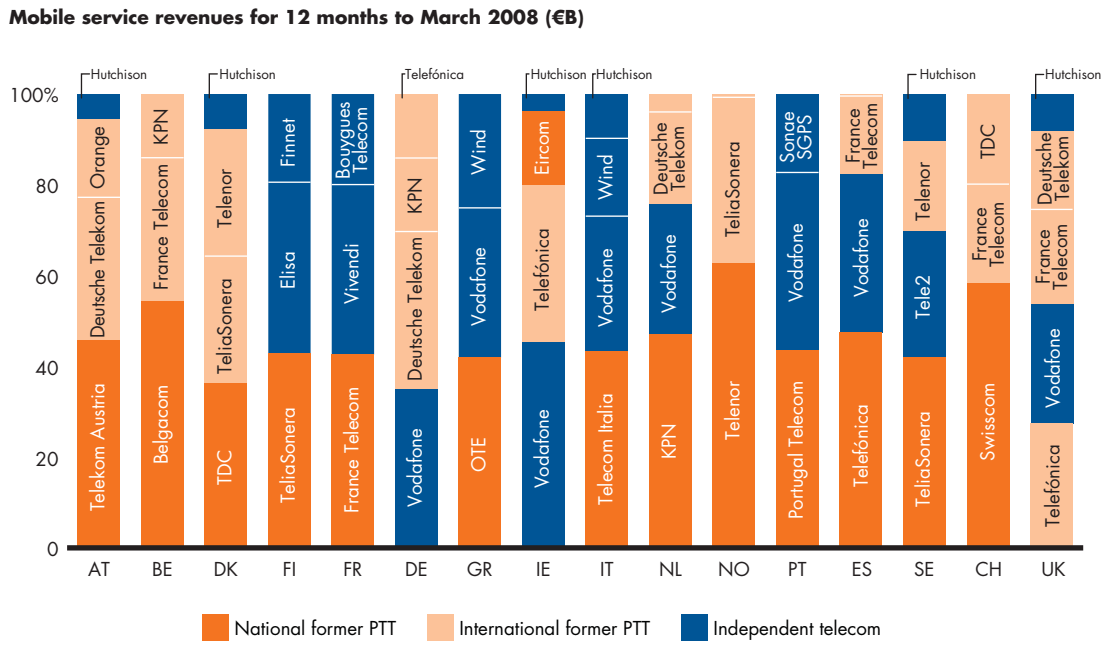
In addition, mobile virtual network operators (MVNOs)—companies that provide mobile services under their own brand but do not own a license—compete in the market by reselling mobile minutes from licensed infrastructure operators. MVNOs not owned by

Figure 6: Former PTTs with stable market share in the fixed voice segment



Source: Analysys Mason; Company financials

Figure 7: European mobile market



Source: Analysys Mason; Company financials

infrastructure-based mobile operators serve less than 10 per cent of subscribers in the European market with 10 to 20 per cent market presence in the UK, Netherlands and Scandinavia; they are virtually nonexistent in other markets such as Italy and Spain[9].

Broadband market

The level and type of competition in the European broadband market varies significantly by country. Inter-platform competition is defined as that which occurs among infrastructures (cable companies, former PTTs, mobile operators), and intra-platform is defined as competition occurring among service providers (some of which are facilities based) that use the network of the infrastructure owners.

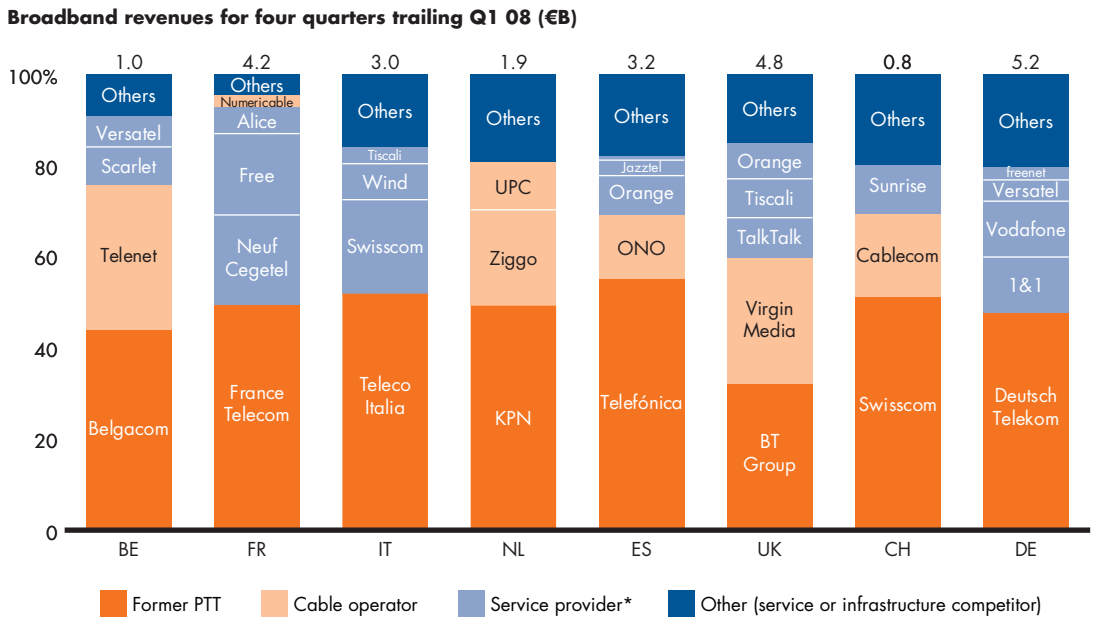
Service competitors can participate in the market by accessing the local loop of an infrastructure provider, typically the former PTT of a country. This is possible due to the unbundling of the local loop (the connection from the telephone exchange's main office to the customer premises) of the former PTT. The service provider co-locates its equipment at the former PTT's exchange, thus gaining access to the last mile to the customer. The service provider typically pays the former PTT a regulated cost plus fee for co-location. To ensure that the former PTT provides fair access of its facilities to service providers, a number of regulatory rules have been put in place. These include requirements for the former PTT to provide easy access, apply equipment and safety rules that do not exceed its internal requirements and allow for the equipment of the challenger to be co-located even if it includes switching or enhanced services equipment.

The degree of access infrastructure competition versus factilities-based and service competition among unbundlers in broadband depends on the availability of multiple infrastructures in a given market. In markets such as Belgium and the Netherlands, more than 70 per cent of the broadband is provided by the former PTT (Belgacom and KPN, respectively), and cable companies (Telenet in Belgium and UPC and Ziggo in the Netherlands), with the remaining broadband access coming from service providers. In markets such as France where alternative infrastructures are less built-out, cable represents less than 10 per cent of the market, but service competition is strong with companies such as Neuf Cegetel and Free providing about 38 per cent of broadband access by leveraging the unbundled local loop (see Figure 8).

Mobile broadband is also making inroads in the European market. Due to generally lower access speeds and higher relative prices, the adoption of mobile broadband was slow in the past but currently, it is accelerating. Austria provides an illustrative example of the potential future impact of mobile broadband on the market: The country witnessed steady fixed-line losses while mobile broadband saw a rise in net addition of subscribers (see Figure 9). The change is partially due to a decline in mobile broadband prices: As mobile broadband became cheaper than fixed-line broadband, it resulted in increased substitution. Telekom Austria responded to this substitution trend by also offering mobile broadband to its fixed broadband customers for a small surcharge. This has helped decrease fixed-line customer losses for Telekom Austria during 2008 and also moderated the growth of mobile broadband customer additions during the same time period.

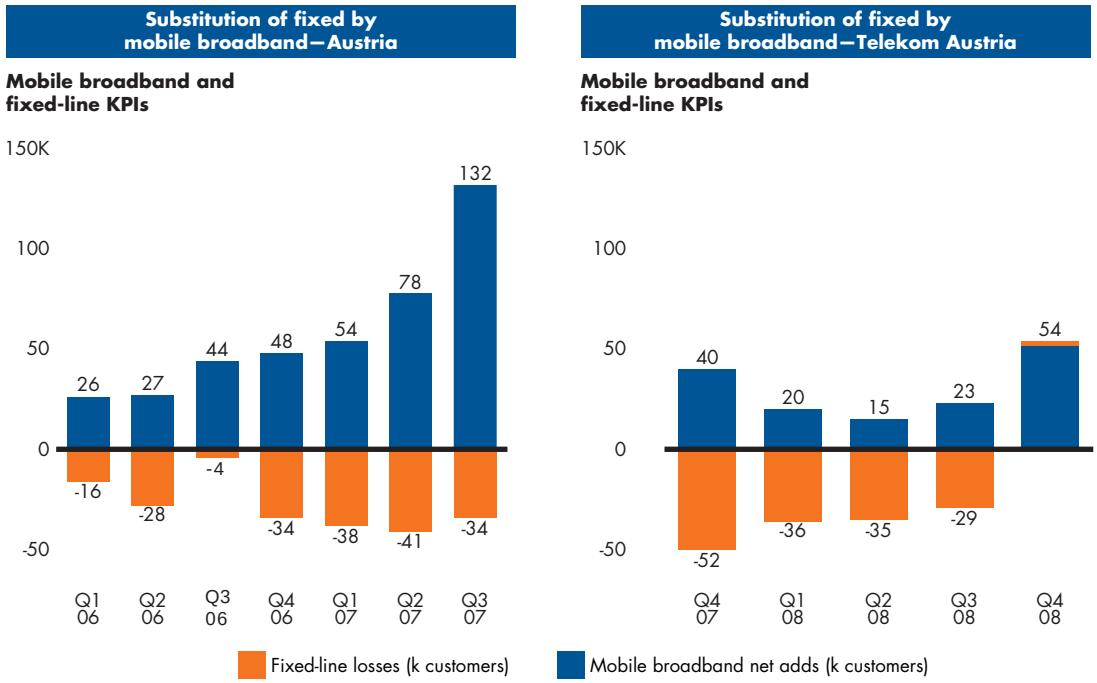
[9] Telecom Market Commission, Spain, literature searches

Figure 8: European broadband market



*Service provider category comprises a broad variety of players, from resellers without any facilities to service providers with investments into some infrastructure (e.g., for ULL)
Note: 2008 data extrapolated from Q2 07–Q1 08 data
Source: Analysys Mason; Company financials

Figure 9: Fixed-mobile substitution in Austria



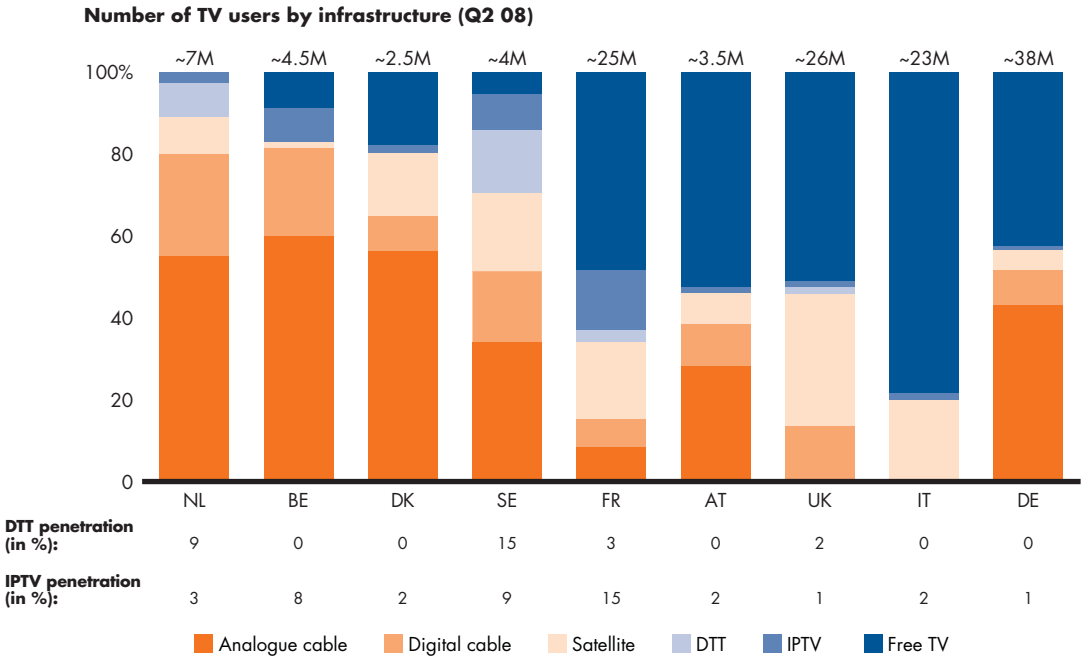
Source: J.P. Morgan

TV market

Today, competition in Europe's TV market is among four technologies—cable, satellite, digital terrestrial TV (DTT) and IPTV (delivered through multiple broadband platforms), although in some countries only one or two of the TV access technologies may be available. For example, based on data available on nine West European countries for 2008, 31 per cent of households in Western Europe[10] accessed TV by subscribing to cable; satellite had a 16 per cent share; DTT 2 per cent; and IPTV 4 per cent. Free TV, which includes free satellite and terrestrial, covered the remaining 47 per cent of households[11]. Each technology has different shares within different European countries due to different terrestrial regulations, penetration of cable and the historic evolution of competition. For example, in the UK, satellite TV is strong with Sky as a leading player and Virgin Media as a challenger. In the Netherlands, cable is the market leader while competing infrastructures such as satellite, DTT and IPTV have a much smaller share of the market (see Figure 10).

The state of development of IPTV varies across markets, as former PTTs have deployed very different investment and marketing approaches. For example, in France, IPTV penetration was about 15 per cent in 2008, which is significantly higher than most other European markets.

Figure 10: European TV market in 2008



Note: Per cent of free-TV households calculated as residual; Free TV includes both terrestrial and satellite; NL excludes Fibre
Source: Screen Digest; Telecompaper; Dataxis; OneSource

[10] Percentage based on nine Western European countries (NL, BE, DK, SE, FR, AT, UK, IT, DE)

[11] Data based on nine markets in Figure 10

Some credit for the significant penetration of IPTV in the French market goes to Free, a good example of a challenger that has contributed to the popularity of IPTV in the French market. Free was established as an Internet service provider (ISP) in 1999 and began offering IPTV service in December 2003. It offers a triple bundle of services—phone, Internet and IPTV with more than 200 television channels and VoD. Subscribers need a set-top box (Freebox modem) to receive the service and only pay for voice and Internet. Free's customers get the basic IPTV service free of charge and only pay for premium TV channels. Today, Free is one of the largest IPTV providers in the world to more than "2.5 million IPTV-enabled homes in France with an estimated 1.4 million cumulative IPTV connections in 2008"[12]. Following Free's success, France Telecom has also started bundling its Internet and telephone services with IPTV.

The four markets we reviewed are increasingly converging, blurring the boundaries between voice, data and video in the future. This is leading to more complex competitive dynamics where market participants compete across traditional market and geographical boundaries and for a more diverse set of customers.

[12] http://www.variety.com/article/VR1117988460.html?categoryid=19&cs=1&nid=2570

2. The evolution of telecommunications competition in Europe

Over the last 15 years, the European telecommunications sector has witnessed radical changes. Often, regulation has played a crucial role in enabling and shaping competition in the telecommunications sector. In fact, regulators pursued liberalisation of the telecommunications market with the belief that a competitive market would result in lower prices for consumers and increase innovation.

Until the late 1980s, the telecommunications sector in most European countries was a monopoly. The sheer costs and high economies of scale associated with owning and operating the telecommunications infrastructure encouraged such structures. This was especially true at the local-loop level connecting households to the local switch, since duplicating these "last mile" copper wires was prohibitively expensive. In almost all countries, state-owned PTTs provided all local and long-distance voice telecommunications services to consumers and businesses.

Liberalisation and privatisation of the telecommunications sector in Europe started in the late 1980s and carried through the 1990s with the approval of two directives from the EU in 1990 (in parallel with national liberalisation initiatives pursued by individual governments, starting from the UK). The Telecom Services Directive established the deadlines for full liberalisation on the continent and the Open Network Provision Directive established the framework for access to and use of public telecommunications networks and services[13]. Multiple other directives followed that specified the steps that needed to be taken to liberalise the market further. By 1996, four European countries opened the market to competition—the UK, Sweden, Finland and Denmark. These were followed by the Netherlands in 1997 and Austria, Belgium, France, Germany, Italy and Spain in 1998. Since then, Ireland, Portugal and Greece have also followed suit.

Each country followed a slightly different path towards liberalisation, but in each an independent telecom regulatory body was established—a national regulatory authority (NRA)—which then developed regulations for competition within the sector. For example, in Germany, the 1996 German Telecom Act committed the country to fundamental telecom reform with the goal to "promote competition, to guarantee appropriate and adequate services throughout the country and to provide for frequency regulation." The Act led to the privatisation of Deutsche Telekom through the sale of 26 per cent of its shares. The German government then created an independent regulatory body in 1998 that set benchmarks for interconnection rates. Most deregulation was accompanied by at least partial privatisation of former monopoly PTTs.

Historically, European regulators encouraged both service- and infrastructure-level competition in the sector. **Service-level competition** allowed new service providers to use the former PTT network, especially the local loop, at regulated prices. The entry of service

[13] "Privatization and Liberalization in the European Union", Business America, July 1997, Denny-Brown, Myles, http://findarticles.com/p/articles/mi_m1052/is_n7_v118/ai_19605321/?tag=content;col1

competitors resulted in greater competition and better options for consumers such as lower retail prices and more choice. However, the service provider business model (by its very nature of relying on a common underlying platform and infrastructure and because of the low barriers to entry) is an "arbitrage" business, leveraging the price difference between retail and interconnection prices. Over time service providers' margins got slimmer, making it more difficult to attract new customers and survive as a competitor purely on the basis of price. Therefore, while service providers succeeded in taking away market share from former PTTs, they have been generally less profitable and prone to consolidation over time.

Consider the German mobile market. When it first opened up to service providers, several players entered the market, providing network operators with the much needed salesforce required to penetrate the evolving market. After a long process of consolidation, today only one major player—the recently merged Mobilcom-Debitel—is left. Controlling 10 per cent of the market, it is much larger than its next largest rival—Drillisch—which has around 1 per cent market share[14]. With the network operators increasingly focusing on optimising their sales effectiveness—for example, by introducing sub-brands aimed at ethnic groups and discount brands—and the overall market saturating, the future outlook for service providers in Germany is challenging.

In addition to allowing service competitors to enter the market, the European Commission encouraged from the start **infrastructure competition**. As a result, in both the local loop and in long distance, a number of investors in telecom infrastructure started providing services to the same consumer creating competition:

- In **fixed voice** between former PTTs, cable operators and in selected areas other access providers;
- In **mobile voice** between three to five overlapping mobile operators;
- In **TV** between cable, satellite and digital terrestrial TV;
- In **broadband** between former PTTs and cable operators and increasingly even mobile providers for the low end of bandwidth requirements.

Infrastructure competition in wireless was based on the auctioning of spectrum licenses and resulted generally in three to five national providers with full coverage and competing infrastructures. In wireline, the situation was mixed—in some areas (either in central business districts or residential areas) a number of competing infrastructures were developed. Equally, in backbone and long distance a number of concurrent infrastructures have been deployed. However, in the majority of residential areas, the economies of deploying a greenfield infrastructure in addition to the former PTT's copper lines has proved very challenging with the exception of the situation where existing cable infrastructure (originally only able to deliver analog TV) was repurposed for broadband, voice and Internet services. The root

[14] http://www.welt.de/webwelt/article2163486/Debitel_darf_iPhone_im_Media_Markt_verkaufen.html

cause lies in the economics and the civil works associated in building a dedicated wireline to a home versus the more modular build-out of wireless network where multiple users in a catchment area effectively "share" a radio loop among themselves.

Regulation in many countries therefore moved to use other levers to stimulate further competition, creating a framework for unbundling what they considered the most important bottleneck to competition: wireline access. This resulted in unbundling of the local loop, effectively a form of "cost plus" reselling of the former PTT last mile, moving over time some of the competition at the "facilities" level (such as the co-location of the new entrant's facilities at the former PTT's exchange).

Especially where cable and former PTTs compete, the telecommunications market has continued to evolve into a phase of convergence, which we define as the blurring of definitions of vertical market segments. For example, a voice call can now be transmitted through the public switched telecom network (PSTN) of a former PTT or the cable network of a cable operator. Moreover, these multiple networks—cable, copper, third-party fibre—can deliver a multitude of services. As convergence occurs, companies are no longer confined to their original markets such as telecom operators to voice or cable companies to TV. Fixed and mobile operators increasingly offer content in addition to a bundled (voice, Internet, TV) telecommunications product. Content providers, in turn, expand their distribution channels using all available access networks to reach the consumer.

In a number of academic studies the benefits and outcomes of infrastructure competition have consistently shown that infrastructure-based competition leads to higher innovation and penetration rates [15, 16, 17]. Studies also show that infrastructure-based competition has a positive downward effect on prices, which remain stable afterwards.

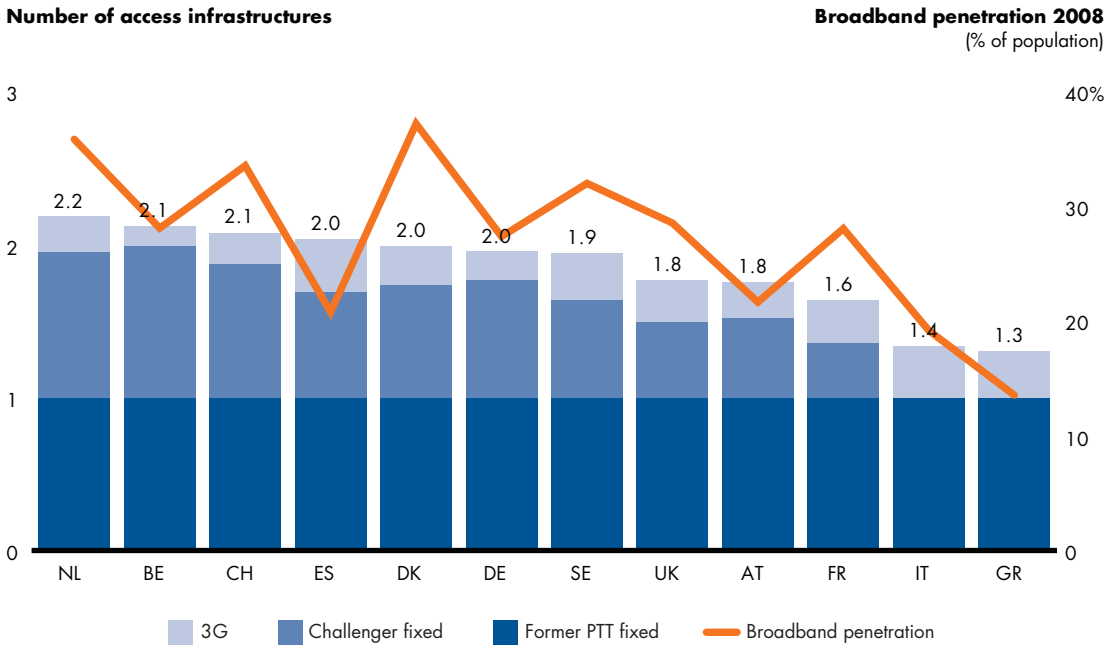
Current data on the European broadband market seem to confirm that some nationwide competiton in access infrastructure is associated with greater broadband penetration. We analysed the number of available infrastructures in each country measured by penetration of each infrastructure in the market. Every country had close to 100 per cent copper penetration, which we counted as 1.0, variable cable penetration varying from none to almost 100 per cent in markets such as Belgium and the Netherlands, and variable 3G mobile coverage, which is to a large extent a complement to the two fixed-line infrastructures. Looking at broadband penetration for each market we can see that while the correlation is not perfect, markets with more available infrastructures tended to have higher broadband penetration (see Figure 11).

[15] Kittl, J, Lundborg, M, Ruhle E, 2006, "Infrastructure-Based Versus Service-Based: Competition in Telecommunications", Communications and Strategies

[16] Denni, M and Gruber H, 2005, "The Diffusion of Broadband Telecommunications: The Role of Competition", working paper

[17] Bouckaert, J, vanDijk, T, Verboven, F, 2008, "Regulation and Broadband Penetration—What Is Required to Regain Speed in Belgium?", working paper

Figure 11: Countries with two national wireline access infrastructures, plus robust mobile broadband, experience greater broadband penetration



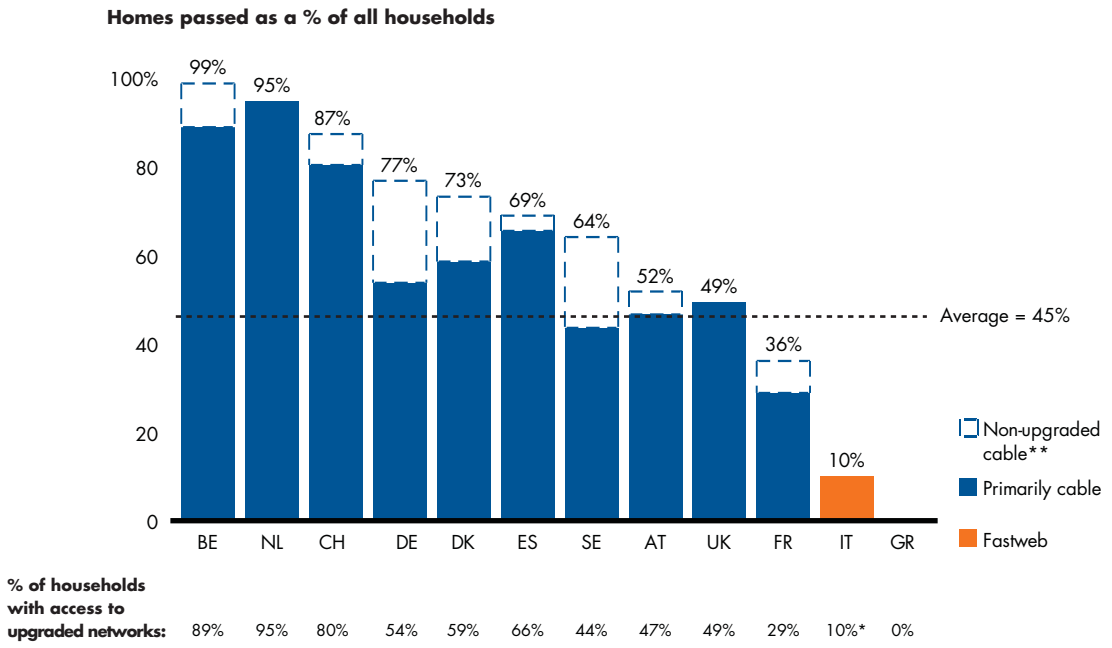
Note: Cable penetration data as of 2007, Broadband and 3G data 2008
Source: OECD; Wireless Intelligence; Screen Digest

3. The state of availability of competing fixed access infrastructures in Europe

The degree of penetration of competing fixed access infrastructures, as well as consumer demand and technology adoption, varies significantly across Europe. Some countries and sub-markets (regions within a country) boast of two or more competing fixed access (local-loop) infrastructures, which provide broadband access to consumers. Typically, these consist of a former PTT operator and the cable company or other fibre providers. There are, however, still a number of countries and regions that rely predominantly on the former PTT's local-loop infrastructure for broadband access to consumers.

The starting points in terms of available second fixed access infrastructure differ by country (see Figure 12). Very few countries have a full national coverage of two fixed access infrastructures—only the Netherlands and Belgium reach more than 90 per cent of the population with two fixed access infrastructures. Greece is the only country in Europe with one single fixed access infrastructure in the entire country. All other countries, which represent the majority of the European market, fall between these extremes with levels of coverage of the second fixed access infrastructure between 10 per cent and 87 per cent. On average in Western Europe, approximately 45 per cent of the population (in terms of homes passed) has access to two fixed access infrastructures.

Figure 12: Market types differing by infrastructure availability



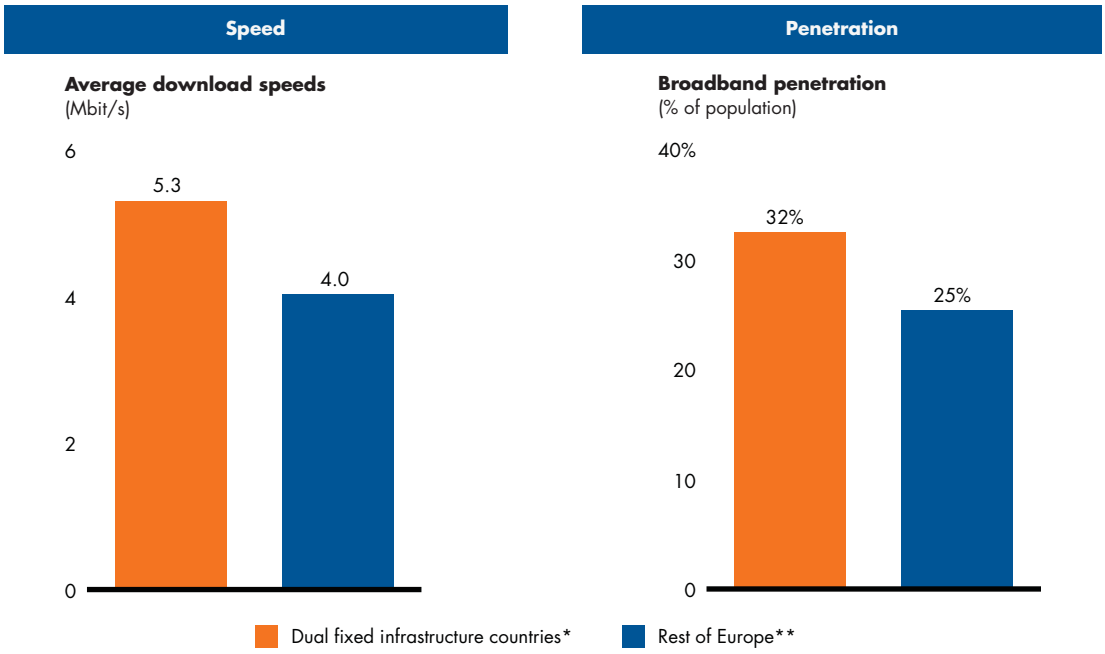
**Not 2-way upgraded
Note: In Italy 2M FTTH subscribers; remaining 8M homes passed by FastWeb utilise Telecom Italia's local loop
Source: Screen Digest; Company report

At one end of the spectrum, countries (for example, Greece) and some sub-regions in most European markets have seen limited roll-out of cable and other alternative infrastructures for historical and economic reasons. Such countries or sub-regions rely on a former PTT's copper access infrastructure for broadband and fixed voice services. Typically, in these instances, the copper infrastructure market is regulated to enable service competition.

At the other end, countries such as the Netherlands, Belgium and Switzerland have two fully rolled out competing fixed infrastructures covering more than 80 per cent of the market. In addition, some areas are currently experiencing the emergence of local fibre competitors offering a third infrastructure option in certain towns and municipalities. In Switzerland, for example, local utilities are stepping up to participate in the roll-out of the fibre infrastructure and in the Netherlands various fibre network operators exist in the market.

Given the high fixed costs associated with deploying a network, infrastructure owners have a strong interest in getting additional customers on their network to cover the costs. Therefore, competition tends to be fierce among infrastructure players in dual or multiple infrastructure markets. When we compare the two dual infrastructure countries (the Netherlands, Belgium and Switzerland) with other countries in Europe, we find that the head-to-head race between multiple infrastructures in these three countries has resulted in high access speeds as well as virtually full broadband coverage, resulting in the highest broadband penetration in Europe (see Figure 13).

Figure 13: Broadband in Europe: KPI comparison



*BE, CH, NL
**AT, DE, DK, ES, FR, GR, IT, UK, SE
Source: European Union; Akamai; OECD

In these dual infrastructure countries, NGA network roll-out has begun early and has reached the highest roll-out levels compared with other European countries. In the Netherlands, for example, cable operators began upgrading their networks to EuroDOCSIS 3.0 in September 2008 and aim to achieve full upgrade coverage by the end of 2010.

In the Netherlands, KPN has entered into a partnership with independent fibre player Reggefiber in an effort to accelerate fibre to the home (FTTH) coverage. Together with other fibre players they have achieved a 4 per cent[18] household penetration and are expected to reach more than 13 per cent penetration by 2013. Also, Tele2 is rolling out VDSL offering speeds of up to 60 Mbit/s.

In Switzerland, Swisscom is following a multiple fibre strategy, in cooperation with local utilities, to deploy several optical fibres in one duct and thus improve the economics of deployment. This approach is expected to result in FTTH household penetration of more than 12 per cent by the end of 2013[19].

In the majority of the remaining countries in Europe there is a certain amount of second fixed access infrastructure in many regions of the country in addition to the former PTT infrastructure. Frequently, this second infrastructure is cable, but is fragmented and primarily covers metropolitan areas.

Those networks have typically relatively limited scale and reach versus former PTTs and often have not yet been broadband and voice-enabled. For example, in Germany, while cable runs past 74 per cent of all households, so far only about 50 per cent of total households are connected to a two-way upgraded network and are able to receive broadband access[20] from their cable operator. In Germany's cable industry, different players operate at different levels of the infrastructure. Many smaller players are unable to invest in upgrading their networks. Other fixed infrastructure challengers in Germany are local providers such as NetCologne, which has a limited footprint in the Cologne-Aachen region and M-Net, which operates in Munich. These players were often created as start-ups by local utilities when the market was liberalised.

In the UK, there have been a variety of infrastructure-based fixed line operators. In addition to the former PTT BT, the UK has experienced proliferation and eventually consolidation of several alternative network operators. The principal alternative residential access infrastructure in the UK, however, has been cable networks, covering approximately 50 per cent of all households. Having originated on a very fragmented local/regional basis, UK cable consolidated over a period of decades, eventually under the brand name Virgin Media. Though cable is only available to half the UK households, competition for households in those areas is fierce between Virgin Media and the many service providers using BT Openreach's infrastructure (including the retail arm of BT).

[18] Cullen International research

[19] http://www.ftthcouncil.eu/documents/studies/Market_Forecast.pdf

[20] "European Broadband Cable 2008", Screen Digest

Despite these challenges, countries in which a second fixed infrastructure partially exists see the benefits of increased competition in terms of greater broadband penetration. While DSL in Germany is still the primary broadband technology today with more than 90 per cent of households subscribing, cable operators are increasingly gaining share with more than 20 per cent of new customers choosing cable over DSL[21].

[21] WestLB 2008

4. Forces of change

To see how the market will develop in the future we need to take a look at the underlying forces driving the evolution going forward—and estimate how they will change. We have identified four key forces of change that have driven—and will continue to drive—the evolution of the sector:

- Technological developments;
- Consumer demand and preferences;
- Evolving business models;
- Governmental intervention/regulation.

It is important to note that while these forces shape the competitive environment, they are also interdependent. Technological developments, such as the emergence of a new wireless technology, for example, will prompt new regulatory action. Regulatory intervention (for example, pushing for lower retail prices by setting lower interconnection charges) may lead to increased consumer demand.

Given the uncertainty of technology and consumer demand we will focus most on these two key drivers of future competition in the market.

a) Technology development

Technological developments are a key enabler for continued innovation in the telecommunications market and have resulted in the proliferation of telecommunication services. In turn, technological developments are supported by competition amongst providers employing different technologies.

In the early days of market liberalisation, most basic voice and data telecommunications services were provided through copper-based technologies such as the public switched telephone network (PSTN) and simple copper-based data networks. Since then, technological developments have significantly shaped the competitive landscape. The most important developments include:

- The Internet protocol (IP) has allowed data networks to provide multiple services, such as video, voice and information over the same infrastructure, creating infrastructure competition for traditional PSTN-based networks.
- Wireless technology has moved from a complementary infrastructure for use "on the move", to an increasingly important substitute for wireline infrastructure. This substitution has been very significant for low-bandwidth services like voice. There is increasing substitution of wireless for wireline voice in markets such as Austria with low relative prices for wireless voice or where fixed-line penetration was traditionally low (for example, in developing countries, where wireless may "leapfrog" wireline).

- The introduction of fibre at different levels of the network, including at the access level, is providing users with access speeds of more than 50 Mbit/s. This enables the viewing of multiple high-definition video streams and makes video communication possible. Technologically, these NGA networks will be based on: Former PTTs' copper-based networks upgraded with fibre; coaxial cable-based networks; and newly deployed fibre-only networks (such as those from alternative network operators).

Telecommunication networks

In most European countries, the network of the former PTT has undergone a steady evolution from a copper-based PSTN providing early connectivity services, to an increasingly fibre-based, all-IP network providing high-speed broadband access and other services. Other than a few exceptions, the transition from copper to optical fibre has been an ongoing process that started in the late 1980s, beginning with "backbone" core networks and moving gradually towards the edge of the network, to the homes of the customers. Fibre has been a means to deliver much higher-capacity links, and as it has moved to the edge of the network, the bandwidth available to consumers has increased significantly.

With current ADSL (asymmetric digital subscriber line) technology, fibre is built out to the local exchange and the connection between the exchange and the household is delivered via a copper network, up to a distance of 7 km between the exchange and the household. ADSL allows consumers to receive bandwidths of up to 25 Mbit/s[22].

Faster bandwidth speeds can be achieved by using fibre closer to the customer's premises. This can be done either in the form of *fibre to the node/curb* (FTTN) or *fibre to the home* (FTTH) (see Figure 14). The former relies on traditional copper lines from the node to connect to the customer via VDSL technology. While this requires less investment in fibre deployment, the speeds provided are limited to 50 to 60 Mbit/s depending on the distance between the customer and the DSLAM at the exchange. FTTH requires a more costly direct optical connection to the user's home.

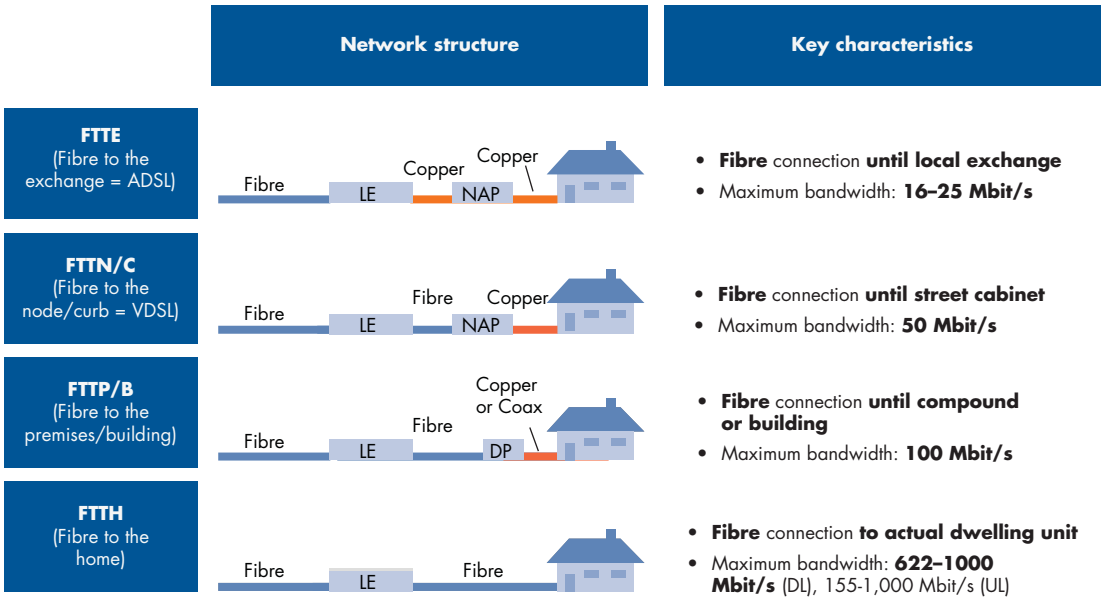
Cable TV networks

Television cable networks have followed a similar path, with increasing deployment of fibre. Cable networks have evolved from all coax networks to hybrid fibre coaxial networks where the coax part of the network is restricted to the last few hundred metres. Upgrading coax networks to HFC (hybrid fibre coax) has required cable operators to put a significant amount of fibre in the ground, to aggregate small segments of homes that are connected via coax to the fibre backbone and to install new hardware at the network head-ends (see Figure 15).

Across Europe, cable operators are currently making further investments to upgrade their networks to EuroDOCSIS 3.0. EuroDOCSIS 3.0 represents an important technological development for the cable industry's role as a key high-speed infrastructure provider in Europe.

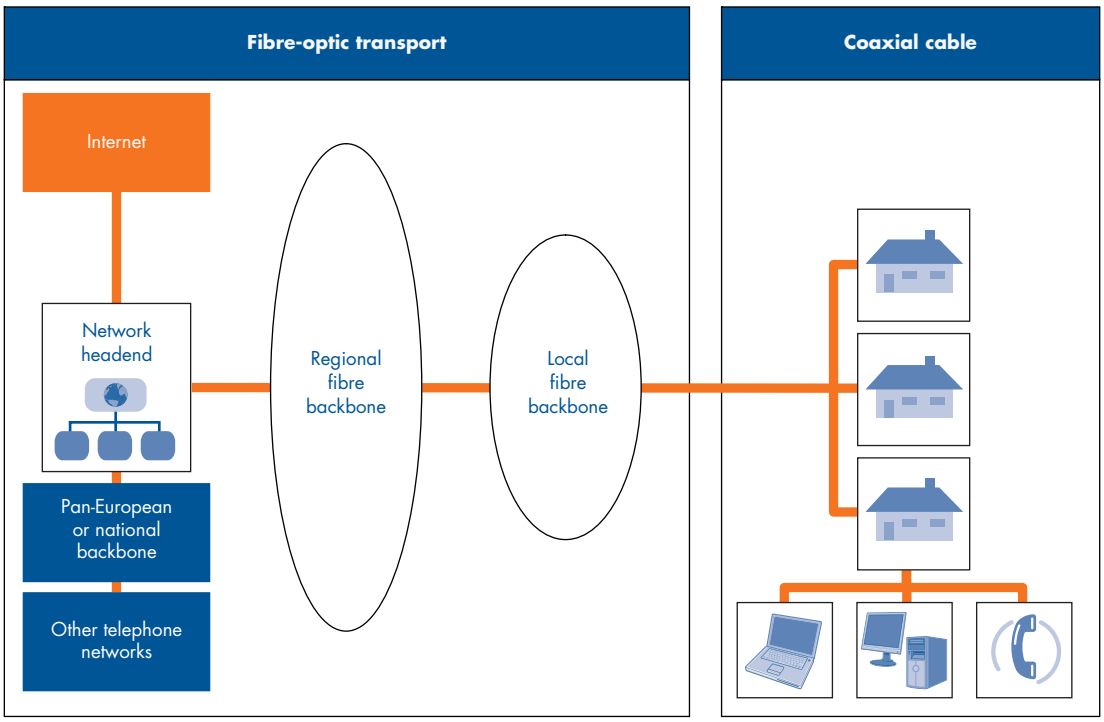
[22] Speeds vary within the ADSL family; e.g., indicative differences are ADSL: 8 Mbit/s; ADSL2: 12MBit/s; ADSL2+: 25 Mbit/s

Figure 14: Degrees of fibre deployment



Note: LE = local exchange; NAP = network access point; DP = distribution point
Source: ARCEP/WestLB (2008); JPM (2006)

Figure 15: Cable architecture



Upgrading the networks to HFC has permitted cable operators to offer a new range of services such as high-speed data and phone services that provide two-way capabilities. These new services are enhanced with the introduction of EuroDOCSIS 3.0, which enables cable operators to offer further increases in downstream and upstream speeds in excess of 100 Mbit/s.

Wireless and mobile networks

In the 1980s, mass market wireless services largely consisted of analogue voice and basic paging, reliant on first-generation wireless technologies. In contrast to first-generation wireless technology, second-generation (2G) wireless technology (including GPRS/EDGE and CDMA) introduced during the 1990s was capable of not only voice but also broader data and messaging services. Yet, 2G allowed only very limited speeds of a theoretical maximum of 55 Kbit/s—though typical usage speed was closer to 9 Kbit/s.

The advent of third-generation (3G) wireless technology suggested potential data access speeds of 2 Mbit/s. While initial 3G deployments did not immediately deliver those speeds, the level of deployment has grown—also thanks to technology evolution such as HSDPA/HSUPA—and delivered higher speeds and enabled new applications. Despite relatively high coverage of 3G networks in Europe today, in the first quarter of 2009 only 25 per cent of European mobile subscribers used 3G[23]. Most consumers still have 2G handsets and therefore cannot use 3G. Nevertheless, 3G has been a milestone in introducing wireless data transfer at speeds sufficient for basic Internet browsing and emailing.

Fourth-generation (4G) wireless technologies offer greater access speeds and are in a nascent stage of deployment. 4G encompasses both WiMax, basically an enhancement of current WiFi[24] with a much greater range, and long-term evolution (LTE), representing the next stage of WCDMA mobile technology beyond 3G. There are very limited commercial WiMax deployments to date and while wide-scale deployment of LTE is expected to occur across major European countries, industry experts believe it will only happen in a limited way till 2014. While 4G technology demonstrates headline access speeds close to those of fixed NGNs under laboratory conditions, some experts believe that in practice the speeds could be slower—perhaps closer to 10 to 20 Mbit/s—due to the natural constraints of spectrum, planning constraints and the economics of deployment of radio access.

Satellite networks

Satellites have been used for various means of communications ever since their deployment in the late 1960s. In the consumer segment, satellite TV has captured a significant market share in some markets like the UK. Satellites are also emerging as a means of providing Internet connectivity and were recently positioned as a solution to bridge the digital divide in broadband. For example, SES Astra already offers its Internet-via-satellite service Astra2Connect in 14 countries. Currently 40,000 customers use the service since its introduction two years ago[25]. EUTELSAT's Tooway service has offered 3.6 Mbit/s downloads

[23] Wireless Intelligence; Gartner

[24] WiFi is a trademark name for wireless local area networks (WLAN) based on the IEEE 802.11 standards and has become synonymous with wireless local networks

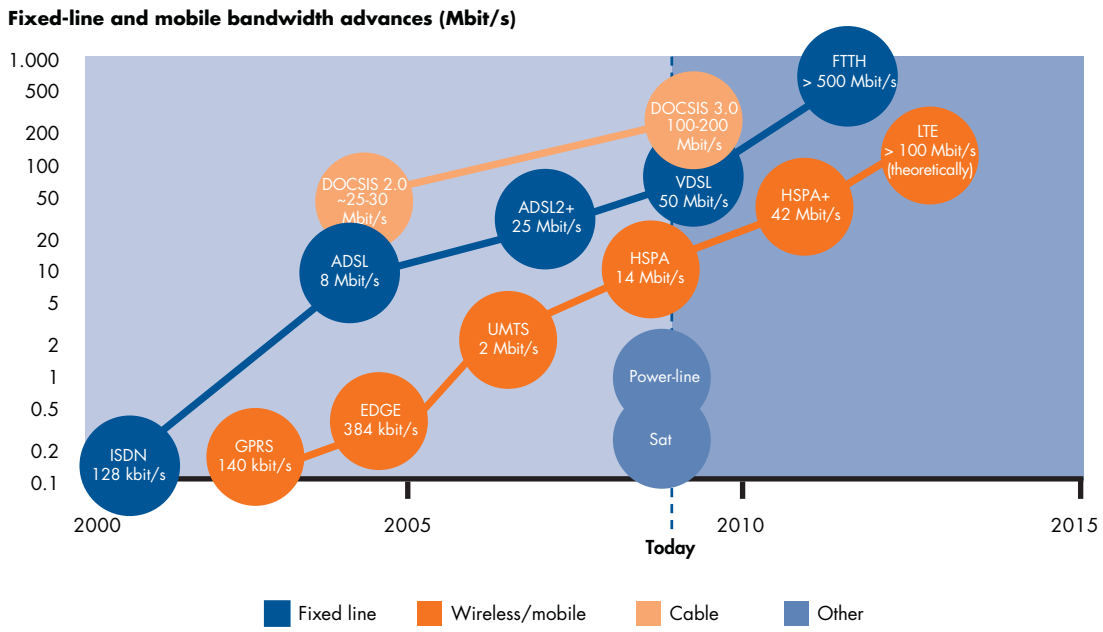
[25] http://www.astra2connect.com/press/index.php

and 384 Kbit/s uploads since July 2009. With the launch of its new satellite KA-SAT, it expects to increase bandwidth next year up to 10 Mbit/s downloads and 1 Mbit/s uploads[26]. However, due to its comparably low bandwidth in comparison to fixed NGA and its technical limits (for example, latency due to distance), satellite Internet connectivity services might remain a niche, in areas without other wireline or terrestrial wireless services.

Outlook

The continued innovation and improvement in any one of these technologies has the potential to create a first-mover advantage over the competition, for example, by offering greater access speeds to end-user customers. This dynamic provides an incentive to competitors to invest and upgrade their technology platforms to remain competitive, and ultimately provides the impetus for continuous innovation in technologies as shown in Figure 16. The traditional PSTN network gradually evolved through several technology stages, starting with the transition to ISDN and further to ADSL and currently continues with the migration to VDSL and FTTH. With each technology stage, the available bandwidth has significantly increased. Similarly, the cable networks first upgraded to DOCSIS 2.0 and are now upgrading to DOCSIS 3.0, allowing for significantly higher-bandwidths. Mobile technology has followed a similar technology evolution, increasing the available bandwidth with each technology stage.

Figure 16: All key technologies show great potential for significant bandwidth growth



Note: Maximum bandwidth shown for network technologies
Source: Deutsche Bank; WestLB; BMWI; Nokia Siemens Networks; Literature search

ILLUSTRATIVE

[26] http://www.portel.de/nc/nachricht/artikel/38858-eutelsat-hebt-breitbanddienst-toowayt-zum-1-juli-auf-36-mbits-an/

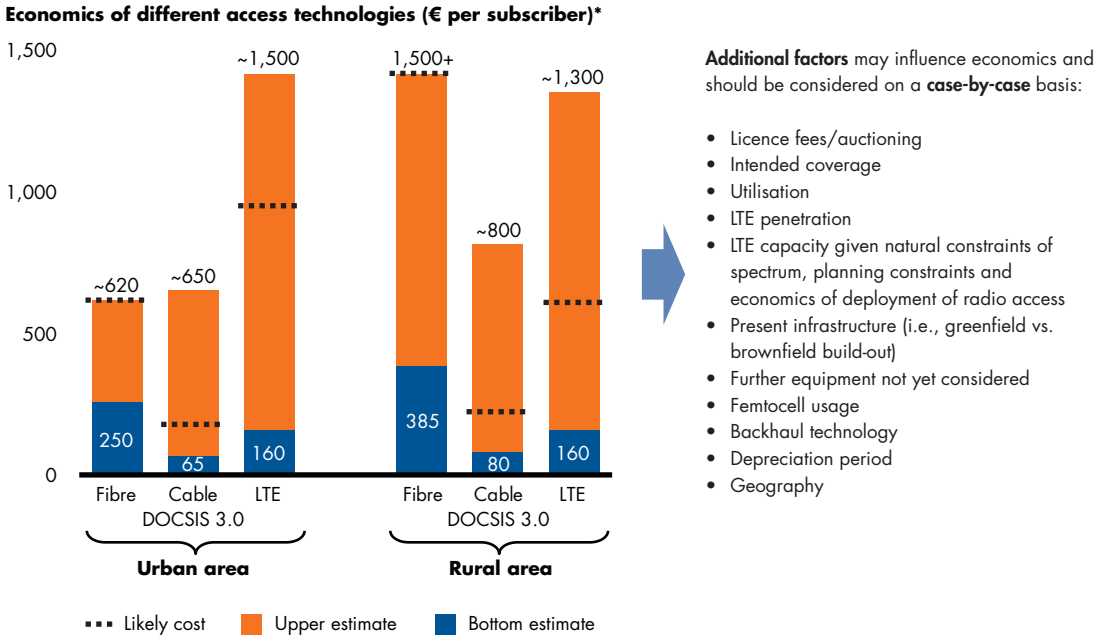
In the case of wireless access technologies, further innovation and development is expected, but technical limitations will make it challenging for wireless technologies to achieve the same bandwidth performance levels in the next few years as their wireline counterparts with the upgrade to NGA: Cable with EuroDOCSIS 3.0 providing bandwidth of around 100 Mbit/s and FTTH 100 Mbit/s. Wireless technologies could also provide similar speeds, but the consensus of industry analysts and experts is that, due to a variety of constraints, the practical deployment is likely to remain below 20 Mbit/s despite the future roll-out of LTE. The principal drivers of the differences are due to the anticipated capped spectrum ownership of European mobile operators; the fact that access speeds in radio access networks degrade significantly with increased active data users; the frequencies available; planning restrictions on sites; and the economics of very dense wireless networks deployment.

Similar to the way 3G wireless technologies competed with earlier connectivity broadband technologies (dial-up), 4G wireless will likely compete with existing broadband technologies (DOCSIS 2.0, ADSL), offering both the convenience of mobility and substitution in stationary use for certain bandwidth speeds. However, given that in the near future at least wireless will offer lower average speeds, it is likely that 4G wireless will not fully substitute fixed NGAs over the next few years—except in specific customer segments and geographic regions such as single-person households and rural areas. Indeed, 4G has the potential to become a complementary technology in rural areas where wireless technology may be used in conjunction with fixed infrastructures to reduce deployment costs and ensure better coverage. Our research indicates that 4G is likely to be particularly economical in rural areas with a potential cost of €600 to €700 per subscriber versus €1,400 for FTTH (see Figure 17). Cable upgrade costs for rural areas are also much lower in the €80–150 range; however, given low penetration of cable in rural areas today, the build-out would have to be a greenfield investment at a cost of €800 per subscriber.

The comparison of economics for NGA build-out costs also illustrates the cost advantage of cable compared with PSTN in upgrading to NGA networks. The nature of cable networks is such that it allows for a more modular upgrade to higher broadband speeds (EuroDOCSIS 3.0), which makes every incremental investment less risky ("invest as you grow"). That makes cable an important competitor to telecom operators in many areas with existing cable infrastructures. In Germany, cable has more than tripled its market share over the last five years, commanding more than 13 per cent[27] of new broadband connections in 2008, although the overall share of the broadband market is still only about 4 per cent. In the future, one likely scenario is that competition will increase between telecom and cable operators in countries with dual infrastructures, especially with the wider deployment of EuroDOCSIS 3.0.

[27] WestLB, Bain analysis

Figure 17: Economics of infrastructures



*For fibre/cable per subscribed household
Note: Likely cost is consensus of experts and current experience; high end of cable build-out assumes greenfield network
Source: J.P. Morgan; Company data; Daniel Stewart & Company; Connecticut Siting Council; Literature search

ESTIMATE

b) Consumer demand and preferences

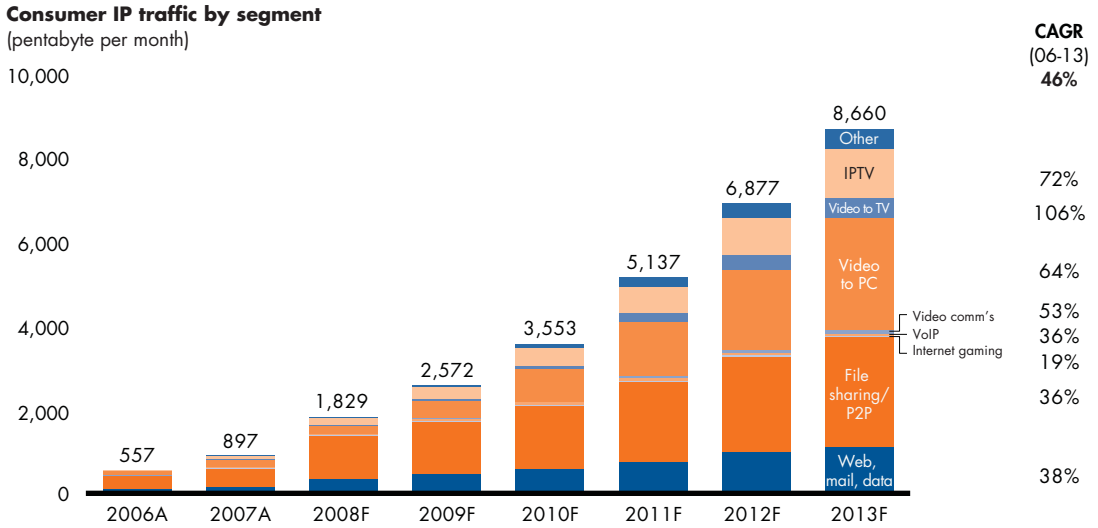
With the development of new technologies and the increase in the types of broadband offerings in the market, consumer demand has also evolved. We expect that consumers will increasingly adopt applications with a high need for bandwidth such as high-definition IPTV or VoD. The speed of adoption of these high-bandwidth applications, the monetisation model and the consumer's willingness to pay for these applications will drive the transition to NGA networks—as long as infrastructure owners can generate additional service revenues to cover the build-out costs.

Increase in demand for bandwidth

Consumer usage of bandwidth has increased significantly over the last few years. Average nominal downstream bandwidth in Western Europe was 1 Mbit/s in 2004 according to IDC[28] and is projected to climb to 23 Mbit/s by 2013. This increased bandwidth is driven by both the increased availability and build-out of broadband networks (supply), but also by the ever-increasing consumer demand for high-bandwidth services such as VoD and IPTV (see Figure 18). Forecasts from Cisco Systems and perspectives from experts estimate that IP traffic will accelerate and grow at 43 per cent per annum, doubling every 1.4 years. The demand for video services (such as Internet video to PC, Internet video to TV, IPTV) is the key driver for this growth. Video-driven IP traffic, which is 41 per cent of total traffic

[28] IDC 2009, Western European Consumer Broadband Access Services Market Analysis 2009–2013

Figure 18: Video-over-Internet usage is rapidly growing



Web, mail, data: includes Web, email, instant messaging, newsgroups and file transfer (excl. P2P and commercial file transfer such as iTunes)
P2P: includes peer-to-peer traffic from all recognized P2P systems such as BitTorrent, eDonkey, etc.
Gaming: includes casual online gaming, networked console gaming and multiplayer virtual world gaming
Video communications: includes PC-based video calling, webcam viewing, and Web-based video monitoring
VoIP: includes traffic from retail VoIP services and PC-based VoIP, but excludes wholesale VoIP transport
Internet Video to PC: free or pay TV or VoD viewed on a PC, excludes P2P video file downloads
Internet Video to TV: free or pay TV or VoD delivered via Internet but viewed on a TV screen using a STB or media gateway
IPTV: Commercial TV service within the footprint of a single service provider
Note: Cable VoD not shown
Source: Cisco (VNI FC & methodology 07-12 & 2008–2013 white paper)

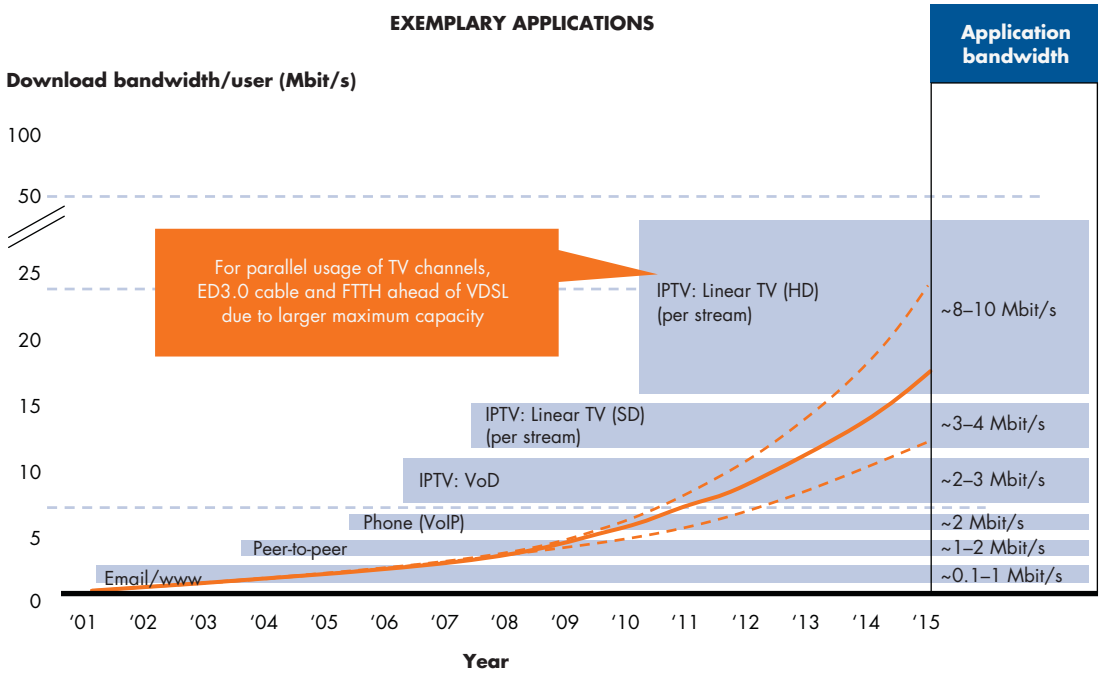
today, is expected to be 61 per cent by 2012 due to increased penetration of IPTV and Internet video to the computer. For example, 70 per cent of online[29] users in the US today watch video online and that percentage is expected to increase in the future; trends are similar in Europe.

Video-related applications require much more bandwidth than the transfer of text or voice-related data. A single high-definition (HD) video stream requires 7 to 9 Mbit/s. By contrast, a standard-definition (SD) stream requires only a quarter of the bandwidth, about 2 Mbit/s (see Figure 19). Other typical online applications such as Web browsing, voice over Internet protocol (VoIP) or VoD may benefit from bandwidths higher than 3 Mbit/s, although the improvement in quality is imperceptible.

While in the future the appetite for high-bandwidth applications is projected to grow, today, most consumers still remain at the low end of the bandwidth spectrum, with 84 per cent using connections under 8 Mbit/s (see Figure 20). The reason for this is multifold. First, many households in Europe still do not have access to high-speed access networks. Second, even if the service is available, not all households subscribe to the service. High-speed offers have only recently been introduced in most markets and consumers are either not aware of these offers or they are priced at levels at which consumers do not yet see a value in subscribing to them. Third, even if consumers subscribe to the service, experience shows they do not consistently experience 8 Mbit/s speeds. For example, in the UK,

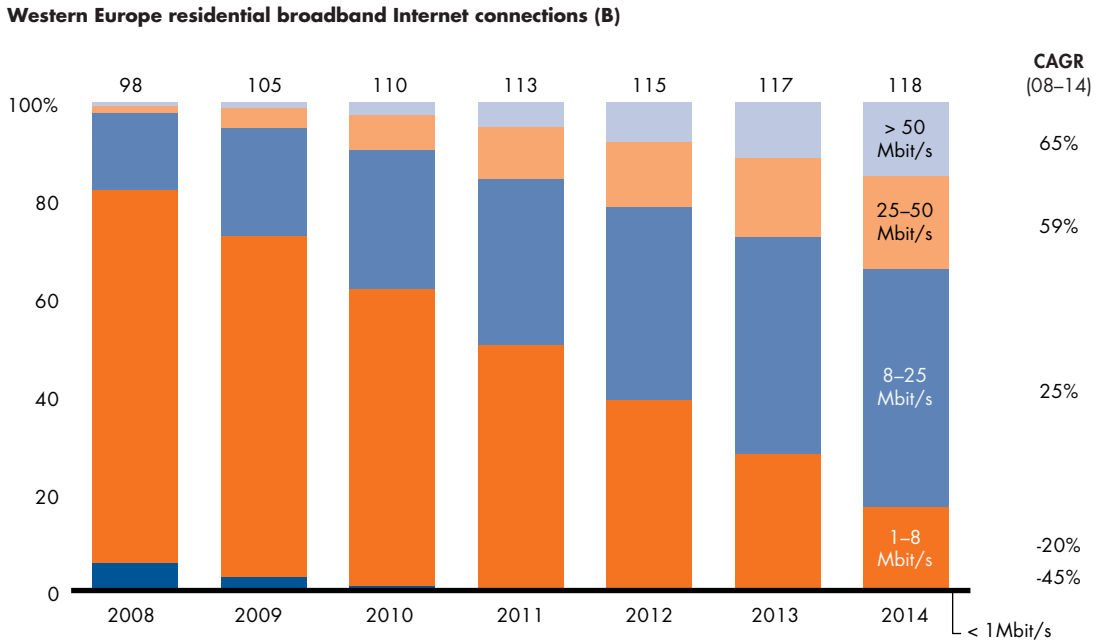
[29] Bain survey of US consumers

Figure 19: Bandwidth requirements of different applications



Source: Market reports

Figure 20: Anticipated segments in the next three to five years



Note: Based on Gartner data until 2012; 2013–2014 based on extrapolation of Gartner overall growth and segment penetration evolution trendlines
Source: Gartner 2008 (Dataquest Insight: The Future of Residential Broadband Internet Access Speeds)

approximately 60–70 per cent of the households have access to 8 Mbit/s service, 40 per cent subscribe to the service, but very few experience 8 Mbit/s speeds with average speed experienced at 4.1 Mbit/s[30].

According to a study conducted by Gartner, Internet connection speeds will increase rapidly over the next few years. Connections with speeds above 25 Mbit/s are expected to grow at more than 60 per cent per annum, while connections with speeds of 8–25 Mbit/s are expected to grow at 25 per cent per annum, substituting lower-speed connections. By 2012, Gartner expects approximately 20 per cent of the Western European market to have connection speeds above 25 Mbit/s.

Will supply of high-bandwidth connections be sufficient in the next five years? As always with fast-moving technology and unpredictable consumer demand, it is difficult to forecast with certainty. Nevertheless, we attempt to shed some light on this question by looking at two trends both based on "known" applications, that is, currently available offerings:

- Current usage of applications over broadband;
- Theoretical usage of high-bandwidth applications and the implied required bandwidth.

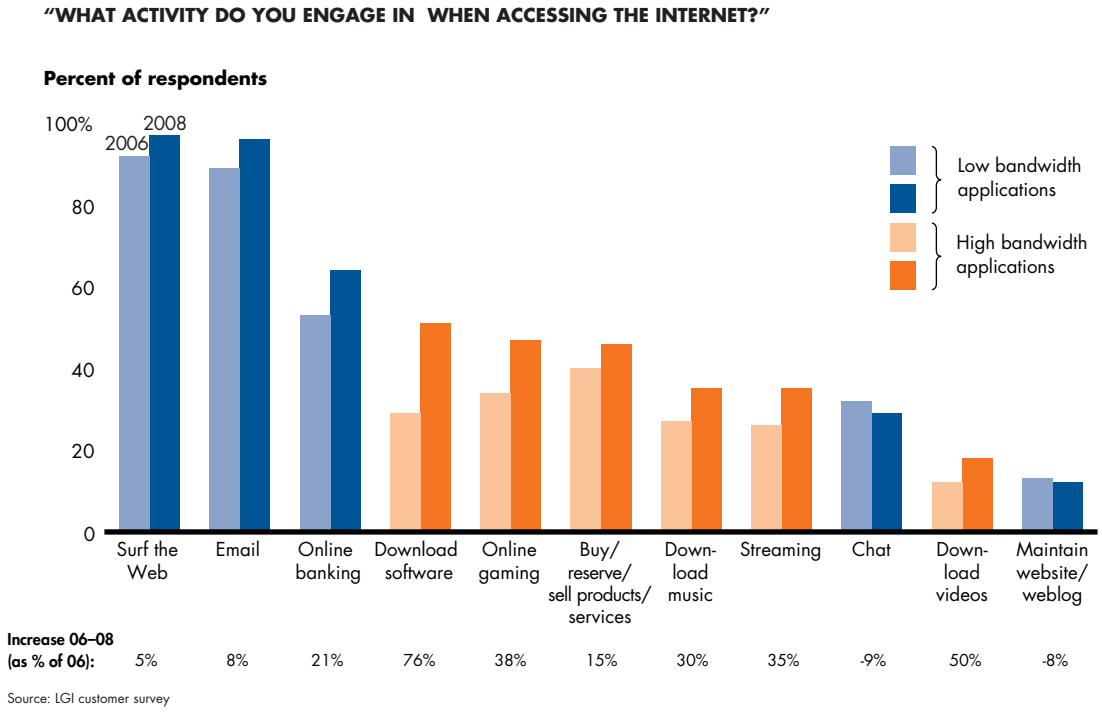
If we measure current application usage by the frequency of Internet activities, the most frequently used applications today are: surfing the Web, using email or banking online. They require relatively low bandwidths of less than 1 Mbit/s. The increase in how often the European consumer uses these applications has been relatively modest over the last three years. Consumer surveys show that the higher-bandwidth applications such as software downloading, online gaming, music and video downloading are used relatively less frequently today compared with some of the low-bandwidth applications, but the increase in usage of these applications has been rapid since 2006 (see Figure 21). If this trend continues, it can be expected that there will be greater consumer pull for higher-speed access.

The second element we need to consider is what cumulative download speed is required for consumers to be able to use high-bandwidth applications concurrently. To answer this question we looked at a hypothetical household that uses the Internet both for lower-bandwidth phone services, email, gaming and P2P sharing and also for bandwidth-hungry video applications such as IPTV and VoD. If the household has a single TV, the cumulative estimated bandwidth demand to use these services simultaneously would be approximately 15 Mbit/s. Adding two additional HDTVs can quickly double the required bandwidth to more than 30 Mbit/s (see Figure 22).

Therefore, getting to a point where the requirement for the consumer is in the range of capacity of 50 or 100 Mbit/s would either mean that households make use of more than five HDTVs or require the adoption of even higher-bandwidth applications that do not replicate known applications available in the market today—and which generate "new to world" utility for consumers (video, gaming, music and so on, tend to be substitutes of currently available services of "known" utility). Instead, industry analysts and experts believe it is more likely that the consumer demand for higher-bandwidth speed and the willingness to pay for it will evolve gradually over time and not in one quantum leap.

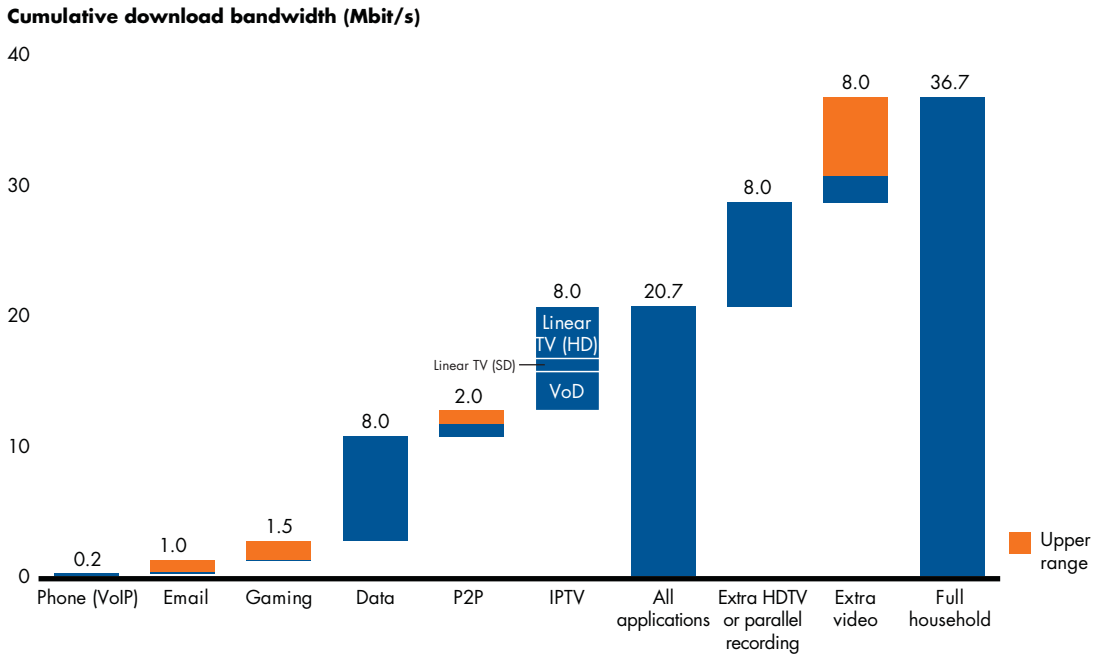
[30] Ofcom, UK Broadband speed 2009

Figure 21: High-bandwidth applications are growing fastest



Source: LGI customer survey

Figure 22: Adequate headroom in bandwidth to result in major upgrade of customer experience



Note: Assumes MPEG 4 video compression
Source: Market reports

SIMULATION

Demand for bundled services

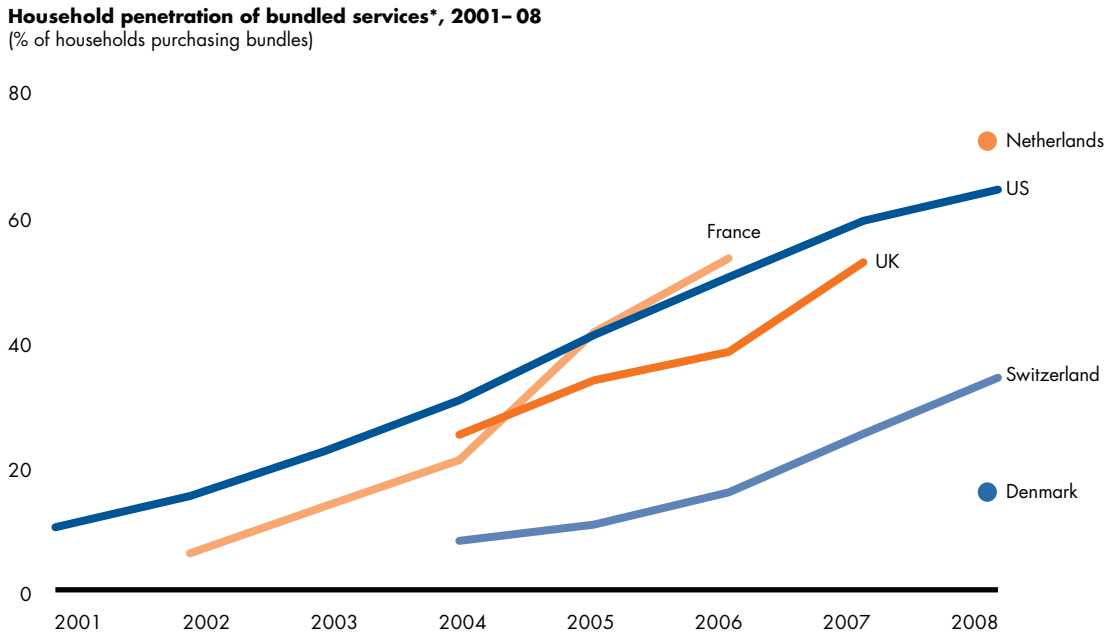
Networks today are able to deliver multiple services simultaneously. Consequently, given the economies of scope, they are increasingly offering bundled services. Bundling refers to the offering of two or more telecommunications services under a single package and can be in the form of a double, triple or quadruple offer. In 2008, according to IDC, bundles already represented close to 50 per cent of telecom revenues world-wide. Double-play bundles were most prevalent, representing 70 per cent of all bundle revenues. The most popular combinations are the so-called household bundles, which include "broadband plus TV" and are typically offered by cable operators and "fixed voice plus broadband" offered by telco operators. The most prevalent triple-play bundles include "fixed voice plus broadband plus TV", and are provided by telcos and cable companies. The broadband product is the anchor for bundles in the market today.

The penetration of bundled services varies by country significantly (see Figure 23). Countries with high penetration of bundles include France, the UK and the US while bundle penetration is significantly lower in Denmark and Switzerland. This is more due to the availability of attractive bundles in the market than by different buying behaviour of consumers in different countries. For example, in the UK, Virgin Media pursued the strategy to heavily incentivise full-product bundles, launching a quadruple-play offer in September 2006. BT followed suit in December 2006, launching its quadruple-play offering, BT Vision. Virgin reaped significant benefits from the bundled offer, reducing its monthly subscriber churn to 1.2 per cent in the first quarter of 2008, its lowest since 2004.

From the consumer perspective, bundle purchases today are primarily driven by the price discount that accompanies them. Research conducted by IDC, Forrester Research and Gartner demonstrates that US consumers cite price discounts as the predominant reason for selecting a bundled product—over choice and the ability to integrate services into a single bill (see Figure 24).

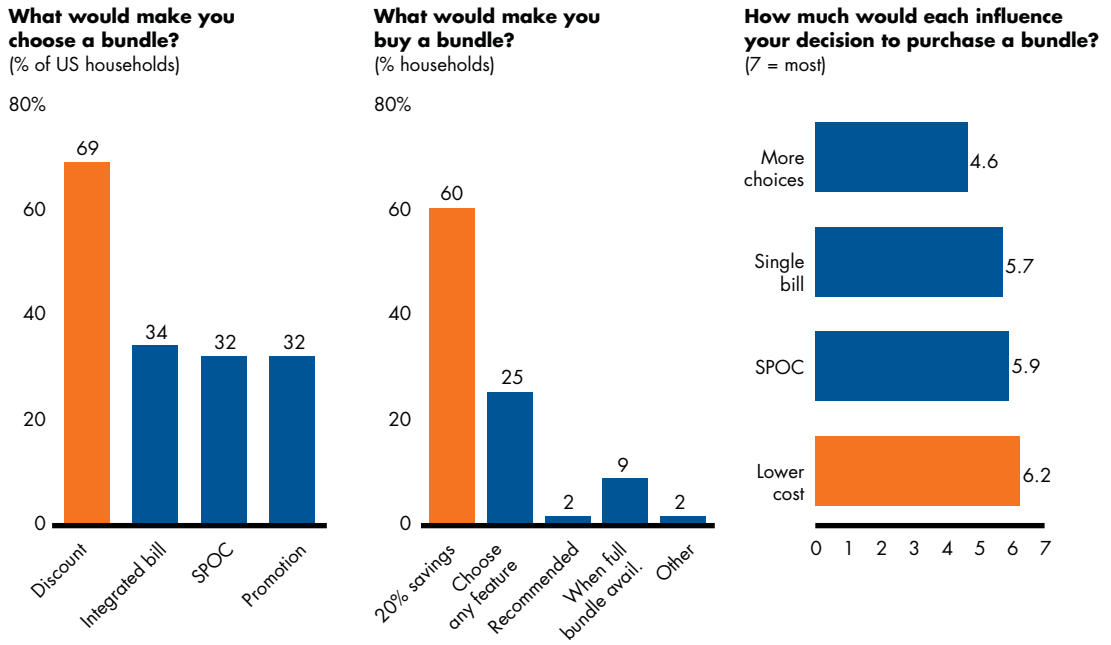
The offering of bundles could further accelerate the demand for high-bandwidth packages, as operators offer bundles of high-speed access together with high-bandwidth applications such as IPTV at attractive prices.

Figure 23: Bundle penetration varies by market



*Bundled services contain at least two products including a mobile product
Source: European Commission; IDC forecast; Ofcom; Ovum; European Audiovisual Observatory; Optus; Iinet; Bain estimates; Bain analysis

Figure 24: Lower price is a key driver of demand for bundled services



Note: Left/Center: "Bundles" means quad play. Right: Consumer segment polled. "Bundle" means voice-television triple play. "More choice" means a larger selection of available service plans for voice and television
Source: Left: Forrester Research 15 Nov '04. Center: IDC Dec '04; Right: Gartner Sep '04

5. Broadband upgrade economics

Current state and ambitions for broadband upgrades and NGA network expansion

Across Europe, the forces influencing the roll-out of NGA networks[31] are technological advances, consumer usage patterns, and an increased focus by regulators and governments on the societal and economic benefits of high-speed Internet. However, the future rate of telecom upgrades across the continent is still uncertain. The European Commission is determining its approach for NGA regulation including questions on how to regulate duct access, what level of risk premium to award for unbundled fibre loops and risk sharing between investors and access seekers. At the national level too, goals and regulatory approaches are in their infancy with most national regulatory authorities (NRAs) waiting to see how the debate in Brussels evolves.

Despite these uncertainties, the gradual roll-out of NGA networks is happening across the continent with increasing coverage and aggressive targets in certain markets. Former PTTs are upgrading their networks by adding more fibre and cable operators are upgrading to DOCSIS 3.0. According to Cullen International, a sample of 15 countries in Western Europe has already achieved coverage of 17 per cent[32] primarily with cable DOCSIS 3.0 and FTTC/N. The coverage and plans are even more ambitious in some countries with Swisscom announcing 80 per cent achieved coverage in Switzerland and Belgacom announcing 87 per cent achieved coverage in Belgium. Assuming that the targets for coverage in terms of per cent of households passed (including FTTH, FTTC and HFC cable) are achieved (see Figure 25), NGA networks could reach 35 per cent of European households over the next three to five years. However, the use of NGA network services by consumers is significantly lower, still at approximately 1 per cent, and is concentrated primarily in Scandinavia (Sweden leads the way at approximately 10 per cent as it started deployment of fibre in 2004, earlier than other markets) and the Netherlands[33].

FTTH/B roll-outs across Europe have been led by either former PTTs (France, Finland, Slovenia) or by municipalities and utilities such as in Denmark, Norway and Sweden. In the Netherlands, KPN is doing both—it has a joint venture with local provider Reggefiber for rural regions and is planning to roll out its own fibre in urban areas.

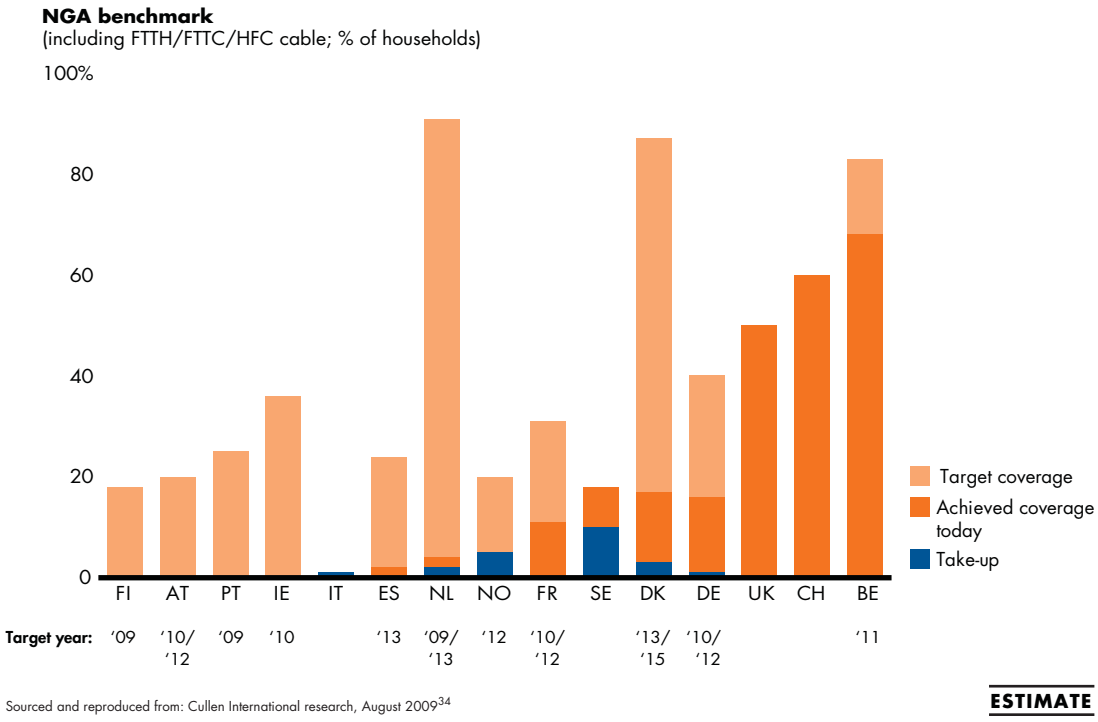
An interesting approach has been taken by Swisscom. The company initially favored a FTTN/C approach using VDSL technology to bridge the last mile to the house. In light of the competitive dynamics—municipal utilities starting to build FTTH in urban areas and Cablecom upgrading its network to EuroDOCSIS 3.0—Swisscom recently altered its strategy focusing on FTTH in urban areas while using VDSL for the more rural areas.

[31] While regulation for NGAs is yet being decided, the EC did provide a revised definition of NGAs in its June 12th draft recommendation which includes FTTH, FTTC /N and cable DOCSIS 3.0 technologies, but at least at this stage does not include mobile broadband networks (WiMax, 3.5G/4G) in the definition.

[32] We calculate 17 per cent as the weighed average of 15 countries by their population. These countries are: FI, AT, PT, IE, IT, ES, NL, NO, FR, SE, DK, DE, UK, CH and BE.

[33] Cullen International research

Figure 25: NGA deployment



Sourced and reproduced from: Cullen International research, August 2009[34]

Swisscom is implementing a multi-fibre deployment strategy by laying multiple (typically four) fibres in one duct, one reserved for Swisscom and the remaining three to be sold or leased to other telecom operators. According to Swisscom, this multi-fibre strategy "guarantees competition at the technology and service levels. Limiting fibres to one per household would be impractical since it would endanger the dynamic nature of the market and the technological innovativeness of the telecommunications industry over the next 30 to 50 years"[35].

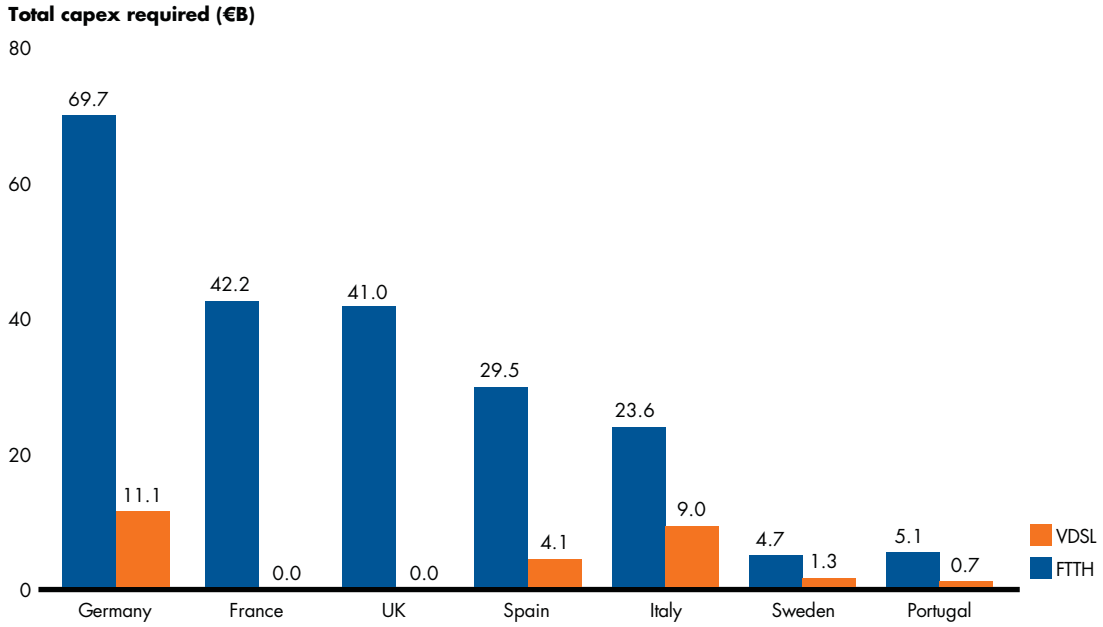
While progress is clearly being made on rolling out NGAs, questions remain over whether the target coverage will actually be achieved in many markets given the high capital cost of deployment. Building these networks requires major capital outlays. While the exact roll-out costs are notoriously hard to estimate given the multitude of factors involved with deployment, different studies[36] have estimated the required capital investment in Germany, the largest European country. These range from €11 billion (VDSL) to €70 billion (FTTH) for coverage of 90 per cent of households. The capital deployment costs of FTTH in France and the UK are €40 billion, Spain €30 billion, and Italy €23 billion (see Figure 26).

[34] http://www.cullen-international.com/report/2696/t1615#Table_1

[35] http://lw.pennnet.com/display_article/347556/13/ARTCL/none/none/1/Swisscom-touts-

[36] WIK-Consult, Ofcom, literature searches

Figure 26: Full fibre roll-out requiring high capital investment



Note: No empty/existing ducts assumed, i.e. 50% higher costs for FTTH; assuming 90% of households connected, FTTH costs as average of P2P and PON solutions; UK number is average estimate of £40 billion for 100% coverage converted to Euro at 1.15 exchange rate and estimated for 90% coverage
Source: WIK-Consult 2008; WestLB 2007

ASSUMES 90% OF HOUSEHOLDS CONNECTED

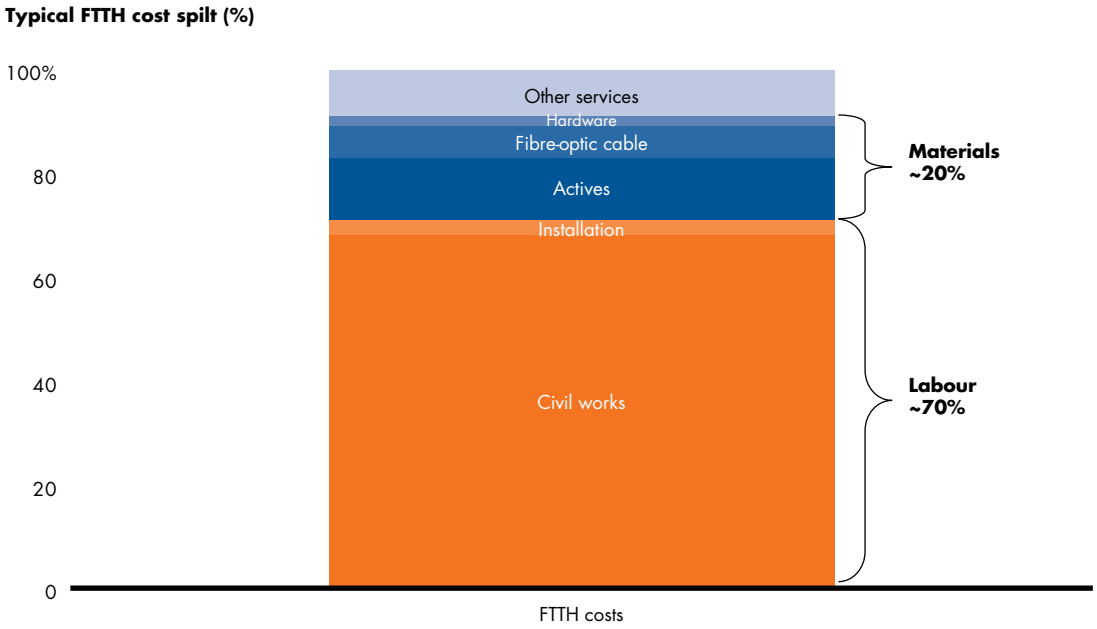
As an example of the magnitude of the challenge, we did a high-level analysis of high-speed broadband build-out costs and the corresponding average revenue per user (ARPU) increases required in order to recover these costs. A number of high-level assumptions[37] were made for the analysis based on our experience and publicly available estimates. We conducted the analysis for the "average" cost of build-out of an "average"/typical large Western European country. It should be noted that investment decisions and costs differ meaningfully with capex/household for FTTH easily varying six times between the cheapest and the most expensive region.

It is important to note—especially in the case of FTTH—that the costs of deployment consist of labour, materials, and other elements that vary both regionally, nationally and are decreasing over time. Labour typically represents over 70 per cent of the costs (see Figure 27) and is driven by national labour costs, labour regulations and the specifics of local networks (depth of ducts, equipment used). Material and equipment costs (primarily the fibre-optic cable) represent less than 20 per cent of capex with various other costs (services and so on) making up the remainder of capital expenditures.

The cost of deployment decreases over time due to decreasing cost of electronic hardware and the learning effects in the physical deployment of the infrastructure.

[37] EBITDA margin of 33%; depreciation of five years; 100% network roll-out

Figure 27: FTTH cost split

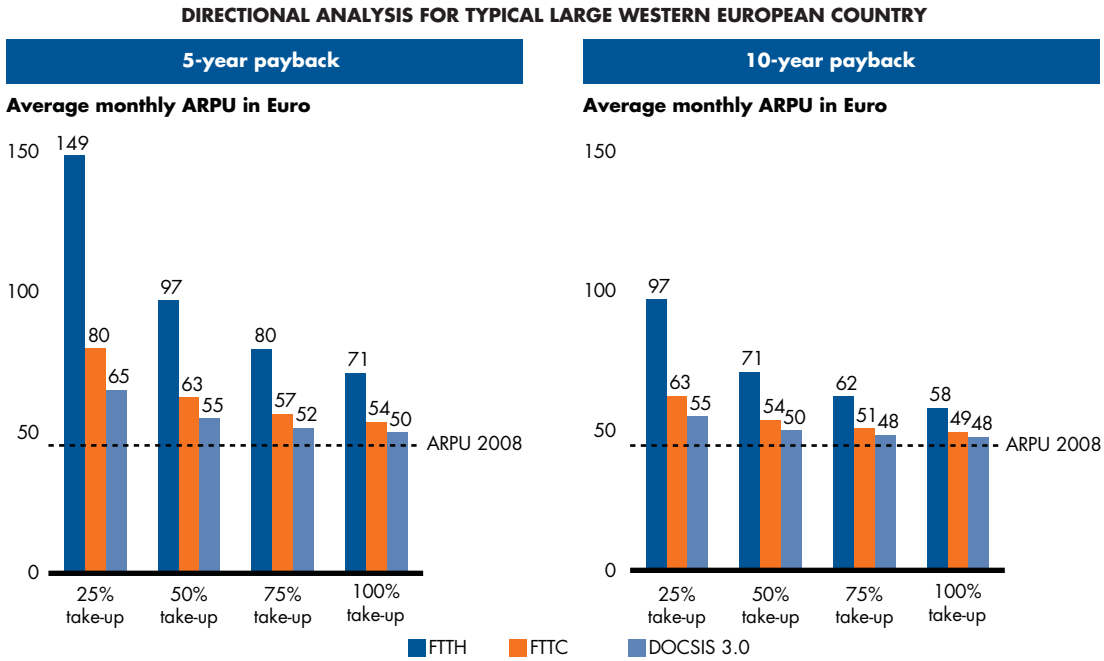


Note: Actives refer to active equipment such as routers
Source: J.P. Morgan 2006

Another important factor in our economic analysis was the operating cost impact of FTTH. The current copper infrastructure has high operating expenses due to the large number of central offices, high energy consumption and susceptibility to failure. A FTTH network lowers these operating costs. We estimate operating savings of around 25 per cent depending on the ability to close offices and reduce labour demand. If these savings are realised, FTTH becomes competitive with other technologies in urban areas.

The results of this exercise are shown in Figure 28. We assessed the theoretical ARPU increase required starting from a baseline of €46 per month (based on a blended average from a sample of European countries) that would be required to recoup NGA investment for the fixed access infrastructure. The ARPU represents combined subscriber fees for broadband, voice and TV. We analysed three options—FTTH, FTTC and DOCSIS 3.0 and assessed the sensitivity of the ARPU increase to the level of demand for services and the payback period. We assumed an average investment of €1,000 per household for FTTH, €350 per household for FTTC, and €200 per household for DOCSIS 3.0. These figures are based on a range of estimates and figures provided by telecom operators and analysts across Europe. We evaluated 25, 50, 75 and 100 per cent demand scenarios and 5- and 10-year payback periods, and assumed EBITDA margins of 33 per cent, which again are based on analyst and company averages.

Figure 28: Estimated ARPU increase required to recover cost of network build-out



Note: Assumes 33% EBITDA margin for all technologies. For FTTH, assumes ~€1,000 per household upgrade; for FTTC assumes ~€350 per household; for DOCSIS 3.0 assumes ~€200 per household; 2008 ARPU is €46
Source: Estimates based on internal Bain experience and interviews, public information on costs and recovery period of payback

As can be seen from Figure 28, even if demand increases to 100 per cent and required payback period is only five years, the ARPU increase needed to cover investments is 57 per cent, to €71 per month in the FTTH situation; 19 per cent, to €54 per month in the FTTC situation; and 11 per cent, or to €50 per month in the DOCSIS 3.0 situation. If demand for service is lower, then ARPU increases are much higher.

This analysis, although directional, has important implications when thinking about high-speed broadband build-out:

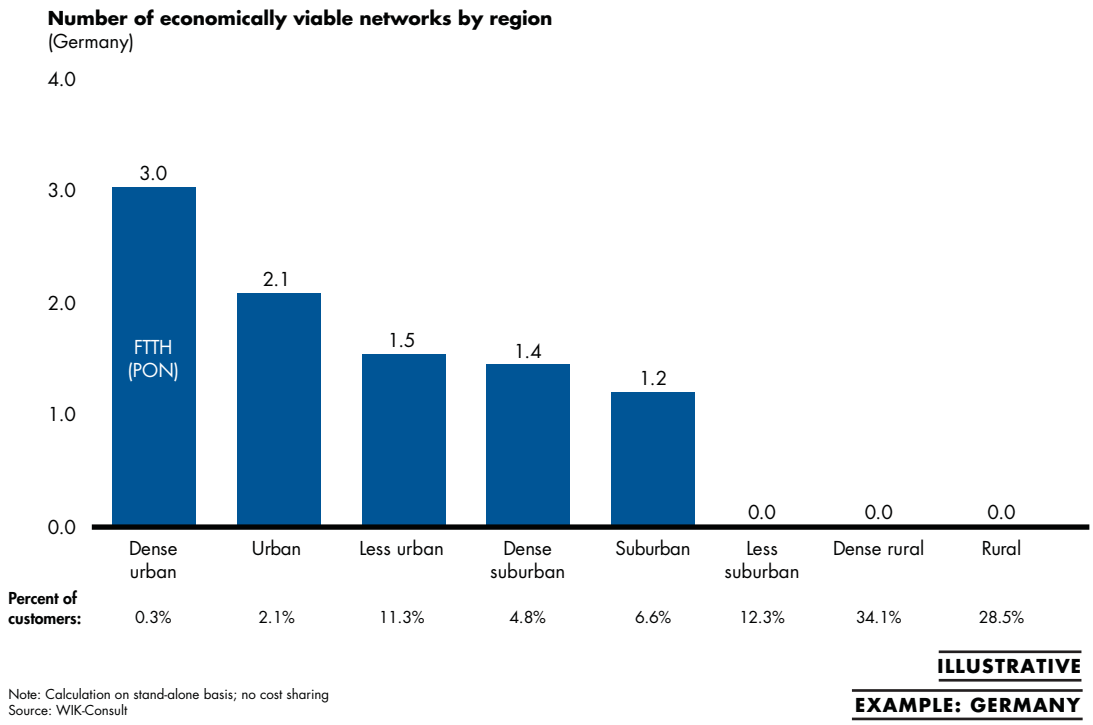
- Recovering the cost of upgrading to high-speed broadband in an economically sustainable way would require ARPU increases even if the least expensive alternative is chosen. The level of increase will vary depending on technology and payback expectations.
- FTTH roll-out is significantly more expensive than FTTC and DOCSIS 3.0, so in order to make the economics for operators feasible, one has to assume higher uptake of the service by consumers, otherwise the high roll-out costs will disproportionately burden a subset of the population, which chose to take up the service and may provide a disincentive for operators to build out the network given the required ARPU increase.
- In markets where cable is not available, former PTTs need to carefully weigh the options between building FTTC (which requires fewer investments in the near term, but is technologically inferior) and FTTH which requires high investments but has long-term operational cost benefits.

Estimating the cost of NGA roll-out can be a challenging exercise given the number of potential technological and regulatory options and wide variability in density and status of current networks. WIK-Consult[38] modeled the economics and required penetration levels for networks to achieve positive returns across six countries, three different technologies and eight sub-regions. It also considered first- versus second-mover economics. Regardless of the market modeled, the analysis reached conclusions similar to ours:

- Economics vary by technology, geography, market density and various other factors;
- Nationwide NGA roll-out is not profitable in any of the six countries analysed;
- Areas beyond profitable roll-out can only be reached with public funding or subsidies;
- Redundant FTTx networks (multiple networks) are only viable in certain denser populated regions.

In effect, the analysis concluded that given the very high roll-out costs, the majority of markets can support at maximum one or two NGA infrastructures. Only very dense areas that cover a few percentage points of total population would be able to support more than two fixed networks. Figure 29 illustrates the scenarios developed by WIK-Consult for the critical market shares for profitability—that is, the revenue-cost break-even—in Germany, where dense urban and urban areas that cover 2.4 per cent of total customers can support

Figure 29: Economic feasibility of parallel FTTH infrastructures



Note: Calculation on stand-alone basis; no cost sharing
Source: WIK-Consult

[38] http://www.wik.org/content_e/ecta/ECTA%20NGA_masterfile_2008_09_15_V1.pdf

up to two or three FTTH networks. On the other hand, less urban and suburban areas that represent 35 per cent of customers can support one to three networks depending on the technology. In rural areas where 63 per cent of the population resides, the economics of building out an NGA network are extremely challenging.

In addition to difficult economics, migrating customers to FTTH presents its own set of challenges, including issues such as:

- Whether customers would be allowed to maintain a copper connection in addition to the fibre one;
- How voice services would be delivered and priced to the consumer;
- How access to premises will be coordinated to install substantial FTTH equipment on or inside the home;
- If—and how—traditional "lifeline" services (where a household that does not pay for a voice package may still be able to call emergency services, even in the event of a power failure) will be provided via fibre.

The challenging economics and customer migration approach lead to an even broader question. Is broad NGA coverage across Europe the right objective for the EC and European countries over the next five years? While there is no easy answer, infrastructure competition and continuous innovation are likely to remain strong driving forces for the evolution of telecommunications technology—just as they have often in the past. Competition will invariably lead to greater NGA build-out, but at a pace sustainable for the market and more in line with increasing consumer demand for bandwidth. Technologically, most fixed infrastructures today are, in fact, already NGA-capable and only require the right financial investments.

Therefore, we define next generation competition as a "sustainable" infrastructure-based competition that enables a healthy, economically feasible pace of technological development and NGA network roll-out, while meeting evolving consumer demand for high-speed connections. Given the importance of defining "sustainability" of infrastructure competition in the market, our last chapter will provide a framework for assessing next generation competition in the market and apply this framework to evaluate the likely evolution of competition in a number of European markets.

6. The potential competitive evolution of Europe's telecommunications market

a) Framework description

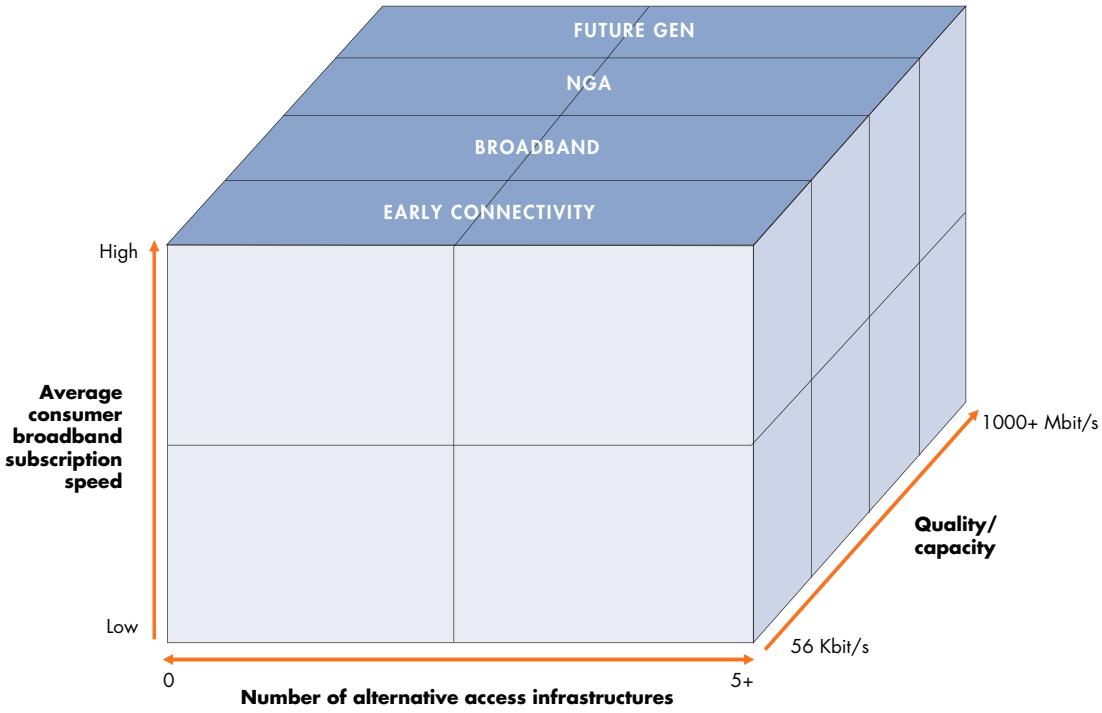
In order to evaluate historic, current and future competitive dynamics in the European market (with specific focus on the broadband and NGA market), we have developed a framework that describes the competitive state of the market along three key dimensions (see Figure 30):

- Number of alternative access infrastructures (competition in infrastructure supply);
- Average consumer broadband subscription speeds (demand);
- Network quality and capacity (measured by available broadband speed).

1. Number of alternative access infrastructures (competition in infrastructure supply)

The x-axis represents the number of networks (both fixed and mobile) that are available in a given market. This dimension shows us the level of infrastructure competition. It is measured by the number and penetration levels of networks. For example, a market with full coverage of copper network and 50 per cent coverage of cable networks has an infrastructure supply value of 1.5.

Figure 30: Framework overview



2. Average consumer broadband subscription speeds

The vertical dimension is a proxy for consumer demand and measures the average broadband speed consumers subscribe to in the market. It is a proxy for demand since actual consumer usage (both average and peak) is challenging to estimate given the lack of reliable data. Therefore, we assume that subscription speeds are approximately similar to usage speeds. For example, assume the speed of the average broadband connection in Western Europe today is approximately 4 Mbit/s and it could increase to close to 23 Mbit/s by 2013. In that case, the value of the y-axis would go from 4 to 23.

3. Network quality and capacity

The third dimension of the framework is the actual capacity of the networks in the market as measured by maximum broadband speeds provided. Existing networks continuously evolve and upgrade and thus move along this axis. Given this continuous evolution, it is not known what the potential development of networks would be. Copper networks gradually get replaced with more and more fibre, new wireless technologies allow for upgrades of mobile networks and so on.

This dimension allows us to differentiate between different qualities of networks with the differentiator being the maximum available speed of a given network. With this definition we can currently differentiate between three typologies of networks:

- **Early connectivity** networks are defined by speeds of less than 1 Mbit/s encompassing PSTN technologies and very-low-bandwidth ADSL. Recent developments in wireless technologies have added more choice in this market with 3G offerings providing access speeds on par with or better than fixed-line alternatives. The network supports usage of basic Internet services such as email, Web browsing and e-commerce. While technologies have evolved considerably since then, this market is still in existence in most countries. Even if network upgrades have occurred, some consumers still choose to purchase a lower-speed subscription.

- **Broadband** networks are defined by speeds of 1 to 50 Mbit/s and are currently served by ADSL and cable with DOCSIS 2.0 and 3.0 technologies. 3G wireless networks are just getting in the broadband range given experienced average speeds of less than 2 Mbit/s. As the evolution of wireless technologies continues, we expect that 4G wireless offerings will be able to compete with the capabilities of current fixed broadband technologies.

- **Next Generation Access** networks are defined by average speeds of 50 Mbit/s or more. The technologies that provide such speeds include hybrid copper-fibre networks such as VDSL (FTTN/C), pure fibre networks (FTTH—fibre to the home) and cable DOCSIS 3.0 technologies (discussed in greater detail in Chapter 5). Wireless technologies may not have the required capacity, in the near future, to qualify as NGA networks. These technologies allow customers to use all services used in the broadband market simultaneously while also viewing multiple HD video streams and additional next generation applications (such as telemedicine).

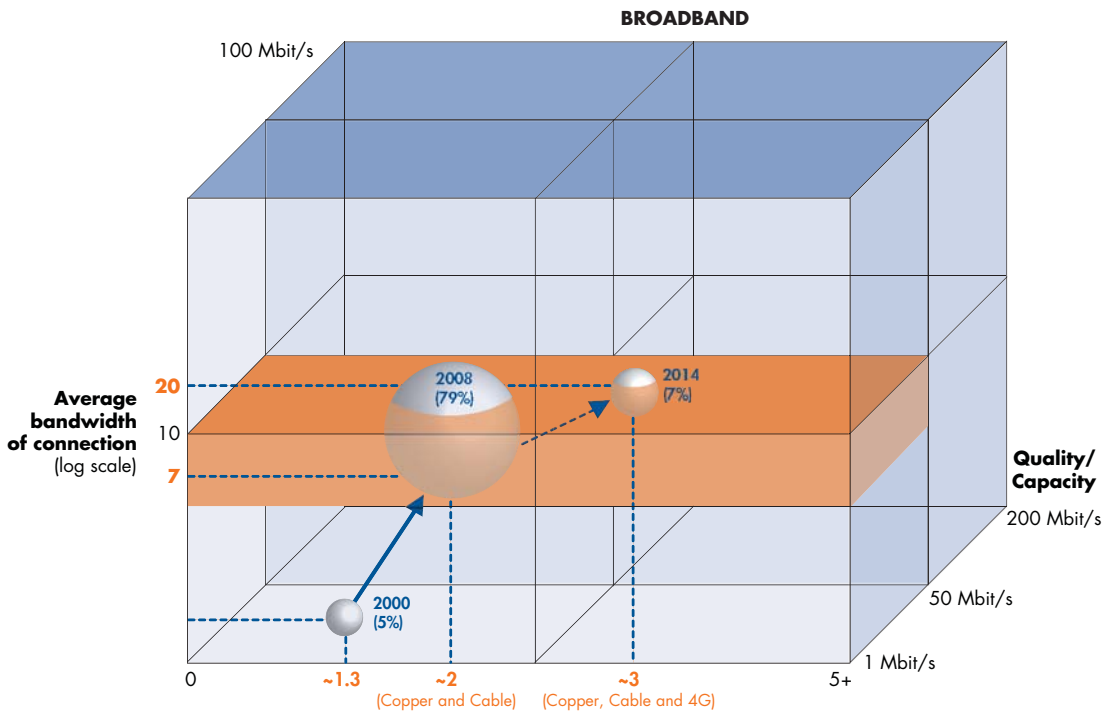
The Next Generation Access networks are not the end of the road. Future innovation and development will pave the way for Future Generation Access networks that we cannot envisage today.

Understanding the state of the market

These three variables come together in a framework that depicts the current state of a given market. In this state, we need to consider one more parameter to give a full picture of the market. This is the penetration level of a given service (i.e., broadband penetration), which is defined as the percentage of households in a given market that subscribe to the service. The penetration level is visually depicted by the size of the bubble.

Figure 31 illustrates this concept using the Netherlands broadband market as an example. In 2000, broadband had 5 per cent penetration, average connection speed was approximately 1 Mbit/s and 1.5 access infrastructure (cable and copper) provided broadband speed access. In 2008, broadband penetration has increased to 79 per cent, average bandwidth was 7 Mbit/s and 2.0 infrastructures were available. As the majority of consumers—the so-called "sweet spot" of the market—was on broadband networks in 2008, this "sweet spot" moved from early connectivity networks—in 2000 the majority of users were using connections under 1 Mbit/s—to broadband networks[39].

Figure 31: Market state depiction



[39] Telecom paper in September 2009 concluded that the Netherlands had reached the highest percentage (92.3 per cent) in the world of homes passed capable of receiving over 50Mbit/s. Other European countries followed on places 4 (Denmark 80 per cent), 5 (Sweden 72.1 per cent), 8 (Portugal 9 per cent), 9 (Norway 42 per cent) and 10 (Finland 40 per cent) largely driven by ED 3.0 and FTTH. (Telecompaper.com 2009)

b) Future market structures

European markets show different starting points in terms of available wireline infrastructure (see Chapter 3) and as a consequence different competitive dynamics resulting in various speeds of migration to higher-bandwidth access networks. There are few countries in Europe that achieve close to 100 per cent coverage of two competing wireline access infrastructures (mainly the Netherlands and Belgium with above 90 per cent penetration) and also few that only have one wireline access infrastructure everywhere (mainly Greece). Most European markets fall between these extremes with dual fixed access infrastructure in some regions, typically the urban areas, and only one fixed access infrastructure in less densely populated regions.

In order to understand the possible migration to NGA networks we separately analyse dual and single fixed access infrastructure regions and assess their likely evolution. For most of the European countries that do not fall into these extremes (like the Netherlands, Belgium and Greece), their evolution will be a mixture of the shown outcomes of dual and single fixed access infrastructure regions as described at the end of this report.

1. Potential evolution of dual fixed access infrastructure markets

Dual fixed infrastructure markets exist in countries where cable networks have been built with national or close to national coverage in the past in addition to the fixed infrastructure of the former PTT. In Europe those markets can be found at the national level in the Netherlands, Belgium and Switzerland and at the regional level in 49 per cent[40] of the UK, 54 per cent of Germany and 29 per cent of France. In these countries and sub-regions, cable operators and former PTTs already compete head-to-head today: Cable operators have entered the voice and Internet/broadband businesses of telecom operators, whereas telecom operators have recently entered the TV market with their own IPTV offerings to compete with cable TV.

Established dual fixed infrastructure markets benefit from the fact that they have competition on both the service and the infrastructure level. Service-level competition impact has its limits given the service provider is dependent on a single access infrastructure and this impacts the viability to differentiate on quality and service. It can even reduce the investment from challenger infrastructure players. Competition between infrastructures provides significant incentives to their owners to continuously invest and outperform, or at least remain competitive in terms of available bandwidth.

We focus on four key questions to understand the future market structure and the potential migration path towards further innovation of existing networks in these established dual fixed access infrastructure markets:

- Will both fixed access infrastructures upgrade their networks to higher capacities and what is driving the speed of this upgrade?

[40] Measured as homes passed as a percentage of all households

- Will infrastructure competition allow for full national coverage of broadband and NGA capacity networks and if not, what are the potential scenarios to bridge this gap?
- Is there likelihood of additional fixed broadband infrastructure build-out and how economically sustainable would these high-capacity networks be?
- What is the role wireless can play in a dual fixed infrastructure market?

We investigate each of these questions in more detail below and provide the rationale for their answers in order to illustrate our perspective on the future market structure and its migration path towards higher-capacity networks.

Upgrading the existing fixed infrastructures

The continuous upgrading of existing infrastructures to higher capacities has already started in dual fixed infrastructure markets over the last two to three years and is an ongoing process. Our analyses of these markets show very significant progress on broadband and NGA build-out for both cable operators and former PTTs:

- In dual fixed access infrastructure countries (the Netherlands, Switzerland, Belgium) and on a regional basis (UK, France, Germany cable regions) cable operators are already upgrading major parts of their networks to EuroDOCSIS 3.0. While roll-out numbers have not been announced, given the past and current investment level of cable operators, we estimate upgrade levels could reach over 90 per cent by 2010 in a majority of these markets. Therefore, NGA networks will become to a large extent available in areas with cable coverage, which is around 95 per cent of the population in the Netherlands, 99 per cent in Belgium and 88 per cent in Switzerland[41].
- Telecom operators have recently started to roll out VDSL and FTTH in dual access infrastructure markets. They have announced major investment plans; for example, Swisscom plans to invest €5 billion over the next six years, to accelerate build-out and transition its current network. Therefore, we expect today's availability of VDSL and FTTH—which stands at less than 5 per cent in the Netherlands, but more than 60 per cent in Belgium and Switzerland[42]—to increase significantly.

This high-broadband capacity network build-out has been the result of the competitive dynamics in the country or regional market. Both telecom operators and cable operators have an incentive to invest into higher-capacity networks to build a competitive edge in their offering by providing higher bandwidth to consumers. The first mover has the advantage of offering a superior product that cannot at that moment be matched by the lagging infrastructure owner—and as a consequence, gaining market share in those segments of the market that appreciate the higher-bandwidth offering. This first-mover advantage goes beyond the incremental revenues of the NGA network as some of these consumers opt for bundles of products that increase the operator's share of wallet with the customer.

[41] "European Broadband Cable 2008" – Screen Digest
[42] Cullen International research

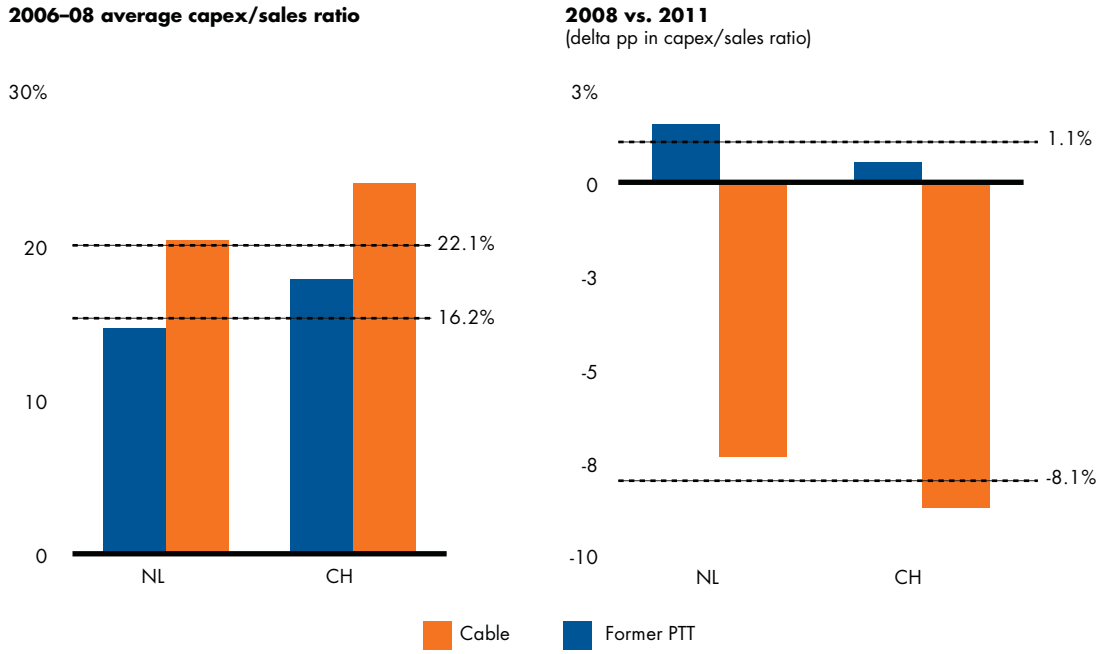
The speed of market share gain depends—among other factors (such as brand, customer service and so on)—on the superiority of the offer (in terms of higher-bandwidth) and consumer demand for such high-speeds. The greater demand for high-speeds picks up and goes beyond what the lagging infrastructure owner can offer, the higher the market share gain of the upgraded infrastructure owner will be. As a consequence, the other infrastructure owner has a strong incentive to upgrade its network as well in order to remain competitive and reduce churn and revenue loss. Given the time required to upgrade the network, this process needs to start ahead of demand, reaching the threshold of significant market share losses.

The market dynamic of gaining or losing customers depending on the ability to offer higher-bandwidth is the main reason why dual fixed access infrastructure markets are better positioned for a fast high-bandwidth network roll-out compared with single fixed-infrastructure markets. Assuming rational investment behaviour, an infrastructure owner in a single fixed infrastructure market will primarily base its upgrade business case on the additional ARPU it can generate with its customer base. This depends on the consumers' willingness to pay for higher-bandwidth and the applications offered through the high-bandwidth network to recover the significant required investments. In dual fixed access infrastructure markets, the infrastructure owners will also consider in their business case the revenue impact of share gains or losses of customers to the competing infrastructure owner, including the complementary product revenues with these customers. Experience shows that considering these competitive dynamics in the network build-out business case will lead infrastructure owners to invest in high-capacity networks faster, either to create a competitive advantage or to close the gap to the competing infrastructure owners. Therefore, competition among the two infrastructures provides strong incentives for their owners to continuously upgrade their networks and to invest in the next technology.

This competitive dynamic between infrastructure owners can be observed when analysing investment levels of former PTTs and cable operators in dual fixed access infrastructure countries (sub-regional data not available for the purposes of this analysis). We looked at the average capex/sales ratio of former PTTs and the largest cable operator in the Netherlands and Switzerland in two intervals over time: From 2006 to 2008 and the forecasted capex/sales ratio from 2008 to 2011 (see Figure 32).

In recent years, there has been an upgrade of cable, which is also reflected in a high average capex ratio. These high investments were driven by upgrading to bi-directional networks, CPE investments to drive penetration of advanced services; and recently by migration to DOCSIS 3.0. After this upgrade, it is reasonable to assume that investments will drop somewhat for the next three years and cable operators will focus on recovering a return on capital invested before they move towards the next generation of technology. This upgrade allows cable operators a competitive advantage—and some breathing space in terms of new investments—by offering bandwidth speeds which former PTTs only can match when they migrate to FTTH.

Figure 32: Cable operators with historically higher capex—reversal of trend expected



Source: Ovum; Credit Suisse; Annual reports

On the other hand, wireline investments of the former PTT operators show a different timing of their investment peaks. After the roll-out of their DSL networks, former PTTs have focused on marketing their DSL offering to their customer base before they invest in the next generation of technology. This is reflected in the lower capex/sales ratio compared to the cable operators in the period of 2006–2008. Given the competitive threat of cable operators entering the market with superior bandwidth offerings and given the increasing consumer demand for higher speeds, telecom operators have started to invest significantly into VDSL and FTTH. As a consequence, their capex/sales ratio will increase in the next three years whereas that of cable operators will decrease. Therefore, the investment behaviour of former PTTs and cable operators is "counter-cyclical" and shows the dynamic of one infrastructure investing to outperform the other followed by a catch-up phase.

This competitive "race" between infrastructure owners is the major driver of innovation in dual fixed access infrastructure markets and will foster a fast migration towards higher-bandwidth networks. The speed of network migration can be influenced by the following factors:

- **The risk appetite of the infrastructure owner:** Risk-averse investors will likely wait for high-bandwidth demand to pick up (pull approach) versus players with more aggressive strategies and risk appetite with pre-emptive NGA build-out to create the demand for higher bandwidth (push approach).

- **The rate of demand increase and willingness to pay for high bandwidth:** This is affected by the pick up of high-bandwidth applications like IPTV and VoD which vary by country.
- **Regulatory intervention:** As the regulatory regime (e.g., access of service providers to high-capacity network infrastructure; level of interconnection charges for use of the infrastructure) influences the attractiveness of the business case of infrastructure owners, regulatory intervention might increase or reduce the speed of the migration to higher-bandwidth networks. A study conducted by the European School of Management and Technology in 2007 and recently refreshed for additional European markets[43] concluded that higher intensity of access regulation discourages infrastructure investments in particular by cable operators and by challengers. Experience also shows that sometimes, uncertainty around the NGA regulatory regime might even delay investment decisions by infrastructure owners, based on how they perceive the risk of recouping the network investment[44].
- **Subsidies to speed-up network build-out:** Subsidies can provide additional incentives to infrastructure owners for an early, pre-emptive migration to the next technology level of networks. For example, in Singapore, the government decided to invest S$1 billion as subsidy to speed up the roll-out of a single NGA network for Singapore. Clearly, subsidisation of this nature is assumed to be balanced among providers to generate the desired effect.
- **Technology development:** Innovation and increasing scale can lead to a reduction in the cost of network equipment and therefore lower the threshold for profitable investments. However, this effect is limited as the equipment investments may only account for approximately 20 per cent[45] of the total investment cost of upgrading to NGA (for example, in FTTH).

Most of these factors are weighed to a different extent by different countries and therefore will lead to different network migration speeds among dual infrastructure markets.

Coverage of future high-capacity networks

Given the significant investment of NGA build-out, a key question for all infrastructure owners is to what extent they should upgrade their network. As the investments are largely incremental, an infrastructure owner could opt to migrate only parts of the network—for example, in urban areas—to higher bandwidth.

As discussed in Chapter 5, from a pure economic perspective, building out a NGA network with national coverage might not be feasible as some areas with low density will not generate enough revenues to justify the higher investments required in such areas. The threshold when network investments recover their costs depends on the expected demand and willingness to pay of consumers, the density of the area (lower-density drives higher costs) and the type of infrastructure/technology. Therefore, different

[43] ESMT Competition Analysis, Analysing the Relationship Between Regulation and Investment in the Telecom Sector, Friederiszick Grajek Röller November 28, 2007

[44] http://telephonyonline.com/residential_services/news/ftth-regulatory-challenges-0113/

[45] While in the case of FTTH deployment, equipment costs account for about 20 per cent, in the case of DOCSIS 3.0 and FTTC upgrades, the percentage of equipment costs is higher due to lower civil costs involved.

degrees of high-capacity network build-out are likely depending on the country and type of infrastructure owner:

- As explained in Chapters 4 and 5 cable benefits from lower investment requirements for upgrading to EuroDOCSIS 3.0 which can be less than 10 per cent on average of the initial cost of upgrading to an FTTH network, for example. Given the lower investment requirements, cable operators seem to have chosen to upgrade their existing networks entirely to NGA. However, in areas with no existing cable infrastructure it would seem reasonable to believe that any new cable builds would be the exception rather than the rule, due to the very high costs of a greenfield approach.
- NGA investment requirements, both for VDSL and FTTH, are significantly higher for telecom operators and can reach levels beyond €1,400 per subscriber for FTTH in rural areas[46]. As shown in Chapter 5, recovering this investment must be predicated on very significant ARPU increases, which can be challenging to justify. As a consequence, we see former PTTs with a national telecom infrastructure, investing first in the urban areas and more selectively investing in rural areas where the economics justify the high investments. Several former PTTs have announced plans to build FTTH networks in the largest cities while using FTTC/VDSL in smaller midsize cities. In Switzerland for instance, Swisscom has abandoned its VDSL plans in the more urban areas and instead plans to cover Zurich, Geneva, Basel, St. Gallen, Berne, Lausanne and the canton of Fribourg with FTTH by 2015, while VDSL is intended to be rolled out in the more rural areas.
- The economic perspective of former PTTs too will be influenced by competitor actions. For example, it's not hard to imagine that if cable operators were to enter rural areas with high-capacity broadband offerings, it might lead to a build-out of VDSL and FTTH by the PTT to secure the revenues streams from the existing customer base in rural areas.

Therefore, the risk of white spots in broadband or NGA coverage is generally higher in dual fixed access infrastructure countries in the following circumstances:

- Where the existing cable infrastructure does not have national coverage;
- Where population density is low;
- Where the willingness of consumers to pay for higher-bandwidth is low.

A key question for policy-makers is how can the gap in high-capacity broadband network coverage be bridged and what potential scenarios exist. These scenarios are driven by competitive dynamics, technology development and governmental intervention:

- **LTE Wireless:** White spots where the economics are unattractive for wireline infrastructure owners to invest in high-capacity networks could be covered by wireless technology, which requires relatively less investment in low density areas. Mobile

[46] See Chapter 4, Figure 17

operators as well as satellite operators like Astra have already positioned themselves in the current broadband policy discussion as a potential solution to bridging the digital divide. Industry analysts believe mobile technology will be able to provide speeds of up to 20 Mbit/s with the migration to LTE, addressing a significant part of future consumer demand. With further technology breakthroughs, the bandwidth of mobile technology could further improve—however, many experts believe that given the technological limitations of wireless technology it is not likely to reach the upper bandwidth speeds that cable's EuroDOCSIS 3.0 and FTTH can provide.

- **Governmental subsidies:** Governments always have the option to use subsidies as a tool for driving the market. Some European governments might decide, for social-economic reasons, for example, to subsidise the build-out of high-capacity broadband networks in economically unattractive areas to ensure full national coverage.
- **Auctioning** of exclusive rights to build alternative mechanisms contemplated include reverse auctions for exclusive licences in particular areas: Two players have to bid against each other to win the exclusive rights to build in the area.
- **Direct consumer cross-subsidies:** In the UK, a proposed solution to the funding problem is to have consumers, in addition to the government, subsidise NGA network build-out. The proposal is to levy a 50 pence tax on all fixed telephone lines to go towards a Next Generation Fund in order to deliver next generation broadband coverage to 90 per cent of the UK population by 2017[47]. The fund is expected to yield £150–175 million per year, which will be used as an investment to connect the final third of the population that still does not have broadband access. This additional investment is an attempt to help operators make the connection to the last third of the population as economically viable as connecting to the first two-thirds of the population.

To summarise our conclusions, the likelihood of full national fixed high-bandwidth coverage is high for dual fixed access infrastructure markets, which today have two fixed infrastructures with national coverage. White spots can be addressed by either mobile technology with bandwidth of up to 20 Mbit/s based on LTE or by other proactive actions that encourage higher-speed network access in low density areas.

Likelihood of additional fixed broadband infrastructures

Competing broadband infrastructures need to share the same future revenue pool within the regional market they are serving. In the early market development phase this revenue pool can be larger due to the stronger marketing and sales power of more market participants leading to faster penetration of high-speed Internet services and applications; this effect can also be achieved by the introduction of service competition and does not require the build-up of several high-capacity broadband infrastructures in parallel. In the long run, the number of available infrastructures does not fundamentally change the market potential, and as demonstrated in Chapter 5, multiple infrastructures are economically viable only in the denser parts of the market.

[47] http://www.culture.gov.uk/images/publications/digitalbritain-finalreport-jun09.pdf

Sharing the revenue pool among more than two fixed infrastructure owners makes it more difficult to justify the high investments required for the network build-out. Therefore, the business case for each of the infrastructure owners becomes challenging when more than two broadband infrastructures compete with one another. Given the uncertainty of demand for high-bandwidth and of consumers' willingness to pay for higher speeds, there is a low likelihood that investors will take this high investment risk.

This conclusion is supported by the evolution of infrastructure competition in the telecom market since liberalisation. Across Europe there is no evidence for the build-up of more than one competing residential access fixed-line infrastructure in addition to the one of the former PTT in the consumer market, except for market niches primarily in the business customer segment (for example, fibre-ring networks in large metropolitan areas to serve large business customers).

Therefore, the likelihood of three or more competing fixed broadband infrastructures is very low in the consumer market. Despite this conclusion, in some countries we can observe the emergence of new, very selective broadband infrastructure owners in addition to (but not neccessarily in direct competition with) the former PTT and cable operator:

- **Existing wireline service competitors** or wireless might decide to invest into wireline infrastructure and build own high-capacity broadband networks. For example, in Germany Vodafone and some other players are considering plans to build local fibre network in selected cities—however, in cooperation with Deutsche Telekom to avoid the build-up of redundant access infrastructures in the same region. Therefore, they would build the fibre network in areas where Deutsche Telekom does not have fibre and each infrastructure owner then sells access to its infrastructure to the competitor to allow for service competition[48]. This type of cooperation of NGA build-out is less likely to create competing networks, and instead lead to complementary ones.

- In a few countries like Switzerland we observe the **market entry of utilities** rolling out local fibre networks with the objective of building a wholesale business. These utilities sometimes do not want to enter the retail (consumer) business given the lack of scale and capabilities and instead plan to offer their network capacity to service providers that want to serve the connected households. The economic viability of their business case remains to be seen if there are already two existing infrastructures in the same area—the former PTT's and the cable operator's—and both infrastructures are migrating to NGA. Many local utilities have opted to cooperate with the former PTT to avoid infrastructure competition, which leads to unattractive economics.

- While the likelihood of market entry of **new fibre operators** might seem low given the very high cost of new greenfield build-outs, in a few European markets this phenomena can be observed. Such a new market entrant typically focuses on regional markets where there is only one existing fixed infrastructure and does not compete on a national scale in dual fixed infrastructure markets. The long-term sustainability of these players

[48] http://www.ftd.de/it-medien/it-telekommunikation/:kartellverfahren-gegen-deutsche-telekom-vodafone-und-ewetel/50004701.html

is yet to be proven and there is a significant likelihood that these players get acquired by one of the existing infrastructure owners. A first evidence of this potential development can be observed in the Netherlands where Reggefiber has entered the market as a new fibre operator building FTTH networks in selected cities and communities. Since May 2008 Reggefiber has teamed up with KPN to create a joint venture and jointly build fibre networks in the Netherlands.

Therefore, it is fair to assume that there is low likelihood of more than two profitable competing high-capacity fixed access broadband infrastructures that cover a substantial part of the market in dual fixed access infrastructure markets—and profitability remains a challenge beyond two players. While infrastructure providers do emerge at a regional level, they have a limited reach and none has national scale or size. Moreover, additional infrastructure owners tend to be complementary players in the market, cooperating with an existing infrastructure owner rather than a full competitor to both the former PTT and the cable operator in that market.

Potential role of wireless technology

Given the competition between the fixed infrastructures in the dual infrastructure markets the question arises whether the role of wireless will be reduced to a complementary one by providing bandwidth for use on the move or if wireless can also substitute for stationary use and therefore compete with the fixed infrastructures. The market drivers which determine the answer to this question are the same as in single fixed access infrastructure markets, although the outcomes can be different.

Fixed infrastructures compete with each other—among other factors—on price-per-bandwidth and push their higher-bandwidth offerings into the market. This, in turn, tends to accelerate the demand for these offerings. The more rapidly the bandwidth demand in a market grows, the more challenging it is for wireless to compete with fixed infrastructure. However, wireless does play a particularly important role in certain niches of the dual fixed access infrastructure markets:

- For single-person households who do not have high-bandwidth demand, wireless can be a substitute, especially if priced at the same or even lower level than wireline offerings. However, as bandwidth demand of these households grows over time, some single-person households might also opt for the higher-bandwidth offerings of the fixed infrastructure players.
- For those rural areas where migration to high-capacity broadband fixed networks is not economically viable, wireless can fill the gap to avoid a digital divide—although these areas may not be able to get the same maximum bandwidth speeds as those areas which will be covered by fixed networks.

The role of wireless as a complement to fixed broadband infrastructures for use of higher-bandwidth services on the move will be very relevant and offer consumers a unique mobility proposition. In particular with the migration to 4G, consumers will be able to use bandwidth of up to 20 Mbit/s for mobile use.

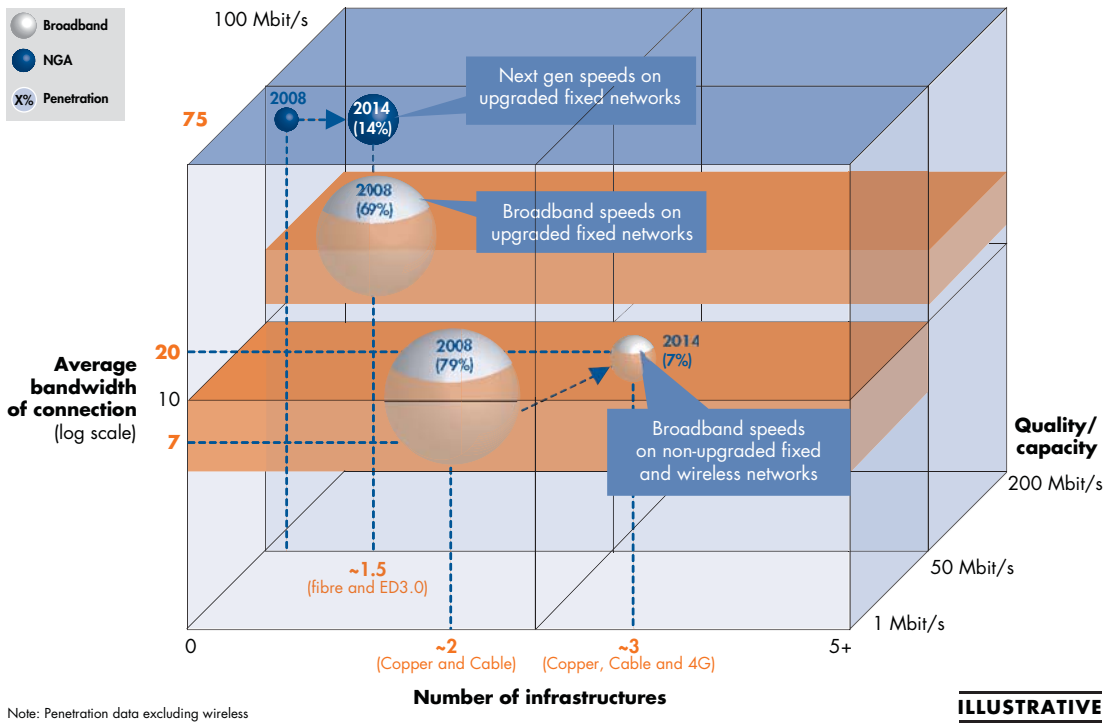
Conclusions: Potential migration path for dual fixed access infrastructure markets

To illustrate a potential scenario around the most likely migration path to higher-capacity broadband networks in dual fixed access infrastructure markets we take the Netherlands as an example.

The competitive state of the market in 2008 can be seen in Figure 33. The average download speeds for consumers was 7 Mbit/s with 99 per cent of subscribers using broadband speeds of 50 Mbit/s or less. Two competitive infrastructures serve the market with national coverage—cable and copper putting the number of infrastructures available at 2.0. These networks were broadband capable with a very small portion upgraded to NGA speeds (limited FTTH roll-outs) and an even smaller portion of consumers (less than 1 per cent subscribing to NGA-level services"[49]. What we can conclude about the market in 2008 is that:

- The market had a degree of infrastructure competition which enabled high penetration of broadband and facilitated the supply of broadband capacity to meet current consumer needs.
- The emerging NGA market was still too small in 2008 to capture a significant share of the total market.

Figure 33: Possible competitive evolution in a double infrastructure market: The Netherlands



Note: Penetration data excluding wireless

[49] "Consumer Broadband Speed Evolution, Selected Western European Countries, 2006-2012" - Gartner

In 2014, the market and competitive landscape could become more complex. One potential scenario may have the following characteristics:

- By 2014 the expectation is that wireless LTE may have been rolled out partially in the Dutch market by at least two of the three mobile operators (KPN, T-Mobile and Vodafone) with possible roll-out levels of 40–60 per cent,[50] which would "add" one more network that can serve the broadband market. This would result in an increase in the degree of infrastructure competition (as represented on the horizontal access in Figure 33).
- According to external available estimates, it is expected that fixed networks will have substantially upgraded to NGA technology with cable 100 per cent upgraded and KPN around 30 per cent upgraded[51]. In our methodology, this would mean that fixed NGA network availability is at least 1.3, with a small part of the market having only broadband capacity coverage. This implies that the "supply" of NGA level networks is there—i.e., the market is ready for consumers to pick up those services.
- Consumer service demand could be on average 29 Mbit/s according to Gartner forecasts and extrapolations of those forecasts. At this time, 15 per cent of the market would subscribe to NGA-level speeds while 85 per cent would still have only broadband subscriptions[52]. However, the vast majority of those consumers would be covered by NGA capacity networks. The consumer service uptake situation leads to a number of interesting observations. First, although NGA network "supply" is there, consumer "demand" for these high-speed offerings is still emerging. Second, the broadband market still represents the majority of the market and is now served by wireless, broadband-level fixed and NGA upgraded fixed networks.

In this scenario for the Netherlands, the competition among wireline, coupled with the emergence of a supplementary wireless infrastructure, may lead to an effective build-out of high-bandwidth infrastructures. These may be underutilised for the next few years but will be ready to meet the longer-term consumer needs for high-bandwidths.

2. Potential evolution of single fixed access infrastructure markets

For single fixed access infrastructure regions—which can include either an entire country (Greece) or a region within a country (Austria, Sweden, Norway, Denmark)—with only one existing fixed telecommunications infrastructure, three key questions come into focus when analysing the transition to higher-capacity broadband networks:

- How fast will the existing fixed access infrastructure be upgraded to higher capacities and what drives the speed of build-out?
- Is there the likelihood for more than one fixed broadband infrastructure and in which cases could this become a reality?

[50] No concrete roll-out plans exist yet, but we assume that roll-out of LTE starts in 2012 and given the size of the country, 80% penetration is reached in four years with two of the three wireless networks investing in upgrades.

[51] Cullen International

[52] "Consumer Broadband Speed Evolution, Selected Western European Countries, 2006-2012" – Gartner

- What role can wireless play in single fixed access infrastructure regions with regard to moving towards next generation competition and higher-capacity network build-out?

The answers to these questions will determine to what extent and how fast migration to higher-bandwidth networks will happen in the future.

Upgrading the existing fixed infrastructure

Starting with the first question, the existing fixed access infrastructure in many countries is the copper/fibre network of the former PTT. In most cases, this is likely to be the high-capacity infrastructure in the future, as upgrading an existing network ("brownfield" approach) is significantly cheaper than building a new fixed access infrastructure from scratch ("greenfield" approach). There have been limited greenfield regional roll-outs but they have not gone to a national scale. (A brownfield operator can use its existing backbone network and some of its ducts to reduce build-out costs.)

Due to the lack of infrastructure competition, the existing infrastructure owner only has an incentive to invest into innovation of the network if there is a compelling business case which justifies the high network investments. The attractiveness of this business case depends on several key drivers, among those are:

- **Level of increased revenues from high-speed Internet and applications** (for example, VoD, IPTV): As the take-up rates will vary by country, the attractiveness of the business case will differ by country.
- **Regulatory regime:** The open access regime and the level of interconnection charges influence the economics of the business case for the infrastructure owner.
- **State of existing network infrastructure:** The typology of the network operations drives the savings in operating expenses a network operator can achieve when moving to FTTH/C. These savings differ strongly between operators.

Uncertainty around these drivers (in particular, around the demand for high-speed Internet and applications and consumers' willingness to pay for it, and the regulatory regime), might delay investment decisions by infrastructure owners. This phenomenon can be observed today where some telecom operators are currently evaluating their network investment decisions.

Regulators are focusing on areas where the existing infrastructure owner has no incentive to upgrade infrastructure in low population density areas. To ensure broadband network build-out in such areas, the EC has released guidelines on the applicability of state aid and has earmarked €1B to help rural areas get online[53]:

- In "white" areas—characterised by the current absence of broadband infrastructure and the unlikelihood of near-term development—the EC strongly favours financial governmental aid as only means to guarantee ubiquitous coverage.

[53] European Commission Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks

- In areas where a single broadband infrastructure exists—so-called "grey" areas—the European Commission takes a more cautious stance calling for a detailed assessment of each case. Here governmental aid may be suitable if the existing network is not able to deliver services to a certain degree of quality and or not at a price comparable to its peer countries.
- "Black" areas are identified by the EC as areas where more than one network exist or deployment is in process, these areas are considered to be unsuitable for state intervention.

Some markets outside Europe have followed various routes to deal with government intervention. For example, in Singapore, the government decided to invest S$1 billion as a subsidy to speed up the roll-out of a single NGA network for Singapore. This funding was split between an Operating Company (OpCo), to be allocated S$250 million, and a Network Company (NetCo,) which received S$750 million. A SingTel-led consortium (SingTel being the former PTT), won the tender to become the NetCo, whereas the cable operator StarHub won the tender to become the OpCo. Retail companies were allowed to use this NGA network at a price set by the regulator. As both major infrastructure owners, the telecom and the cable operator, are involved in building and operating the new NGA network, they have a strong incentive to use the NGA network instead of their own not-upgraded infrastructure to deliver high-bandwidth services to the consumers. It is still too early to assess the success of this new model given the the NGA migration is still ongoing, however, it has led to an accelerated NGA roll-out.

Australia is currently exploring alternative approaches with regulatory intervention to accelerate the migration to NGA networks. Among those options currently debated are the build-up of a greenfield NGA funded by the government (and separate from the former PTT Telstra), functional separation of Telstra into a network company and a retail arm, and the sell-off of its cable infrastructure.

Likelihood of more than one fixed broadband infrastructure

Given the very high investments required to build a second greenfield fixed access infrastructure, the likelihood for more than one fixed broadband network is lower for single fixed access infrastructure regions—but cannot be ruled out. Depending on the competitive dynamics, more than one fixed broadband infrastructure might be feasible under certain conditions:

- The former PTT might choose to lay several fibres to the households and offer the additional fibres to competitors. This approach has been chosen by Swisscom (see Chapter 5) by laying four fibres to the households in large cities. However, this is less likely to happen in rural areas.
- New fibre operators might enter the market and compete with the former PTT. An example mentioned in Chapter 3 is small start-ups created by local utilities in Germany (NetCologne, M-Net) that are building out their fibre networks. Utilities in markets like Switzerland have also entered the telecommunications market by building local fibre networks. These operators are often focused on regional markets which could have high population density but a small footprint (for example, Paris) and are not competing with a full national broadband network.

Therefore, it is fair to assume that single fixed access infrastructure regions are more likely to move towards one high-capacity network; although there is a potential for additional infrastructures covering the more dense urban parts of those countries where the economics are more attractive.

Role of wireless in single infrastructure markets

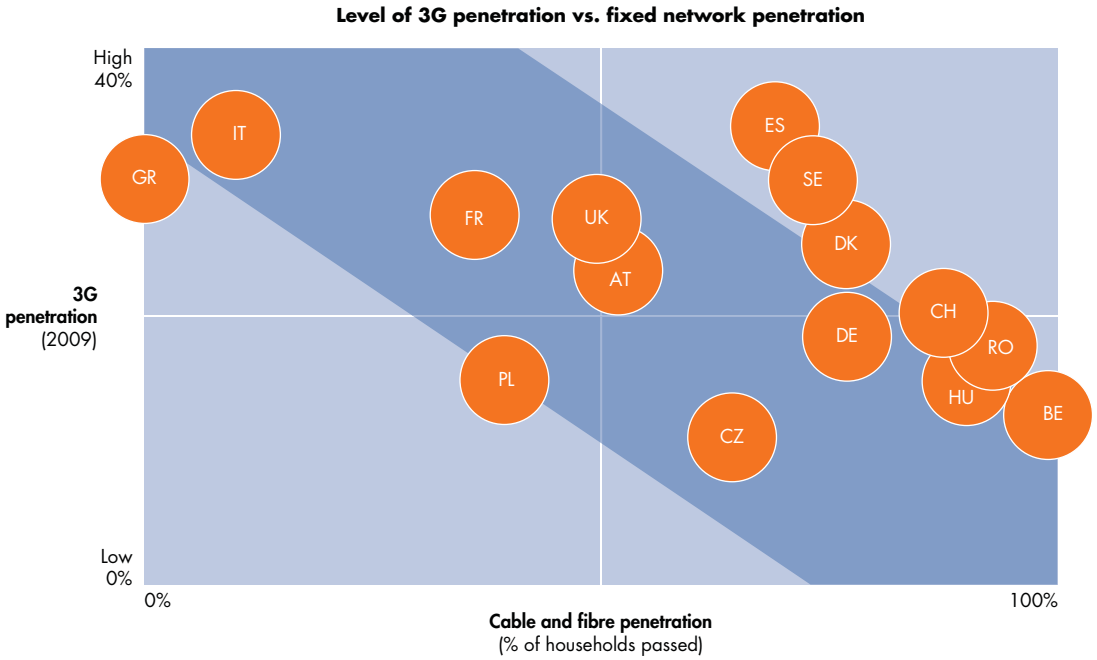
Given the lack of existing fixed access infrastructure competition in these regions, the question arises whether wireless can become a viable competitor to the existing fixed access infrastructure in broadband. The answer to this question will depend on the following drivers:

- The pace of 4G roll-out which would be able to provide bandwidth of up to 20 Mbit/s. In some countries like Sweden, Denmark, Norway, Finland and the Baltics, 4G roll-out is planned for 2010 (for example, TeliaSonera) and beyond. However, for most other European markets, roll-out is not expected to start until well after 2010 with France Telecom indicating a likely start of roll-out in 2012. The earlier 4G gets implemented, the more competitive wireless will be against wireline.
- The evolution of consumer demand with regard to bandwidth requirements and willingness to pay. In countries with low current demand for high-bandwidth applications like IPTV and VoD, bandwidth requirements for the majority of consumers will stay in the range that wireless technology, in particular 4G, will be able to serve. Therefore, more gradual bandwidth demand growth means that wireless technology can more effectively compete with wireline technology.
- Technology evolution: Today, wireless technologies have technical limitations in their ability to provide similar bandwidth speeds to wireline technologies. However, if significant innovation leaps in wireless technology can be achieved, the competitiveness of the wireless infrastructure versus wireline infrastructure will increase.

As the first two drivers will vary by country, we expect the importance of wireless infrastructure as competitor and substitute to wireline infrastructure in a single infrastructure market to differ by country and region. In regions with fast 4G roll-outs and slow uptake of high-bandwidth services, wireless can play a significant role as competitor to fixed infrastructure. The potential of this development can already be observed today in the broadband market where in markets like Austria wireless broadband has substituted fixed-line broadband, in particular for single-person households (for details see Chapter 1). However, 4G will not be considered as a true alternative for power users with bandwidth requirements which exceed the range where wireless can compete effectively.

Moreover, we see wireless 3G penetration to be significantly higher in markets with single fixed access infrastructures in Europe (Greece, Italy), implying that wireless companies will also be aggressive competitors to the existing fixed infrastructure owner in the future (see Figure 34).

Figure 34: 3G wireless penetration is higher in countries with less fixed infrastructure



Source: FTTH Council; Wireless Intelligence; Screen Digest

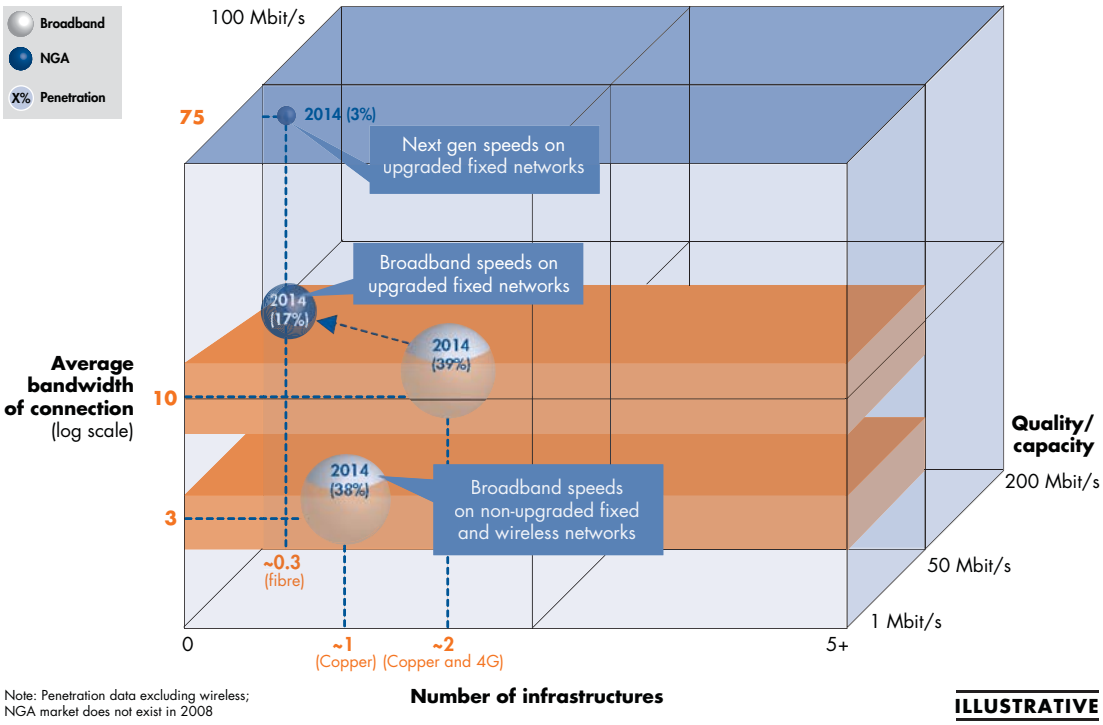
In addition to competition, in single fixed infrastructure regions, wireless technology can also play a significant role as a complement to the existing fixed infrastructure, in particular for:

- Use of high-bandwidth applications on the move (if required bandwidth is below 20 Mbit/s).
- Rural areas where the build-out of fixed high-capacity broadband infrastructure is economically not viable.

Conclusions: Potential migration path for single fixed access infrastructure regions

Drawing on the conclusions above we expect the most likely competitive outcome in the single fixed access regions to be continued fixed infrastructure concentration with one major infrastructure provider. The opportunity for a second fixed access infrastructure to be built on a nationwide basis is limited, given the high costs and challenging economics at play. Limited roll-outs could occur but on a regional basis where the economics make the investment attractive due to high population density. Wireless technology will play an important competitive role in these markets acting as a competitor of the fixed network, but only for lower bandwidth speeds. To promote continued competition and innovation in the market, regulators would consider service competition as an option, but face the challenge to set access prices at levels that allow for positive return on investment of the fixed infrastructure owner as an incentive to further invest into the upgrade to NGA.

Figure 35: Possible competitive evolution in a single infrastructure market: Greece



Note: Penetration data excluding wireless; NGA market does not exist in 2008

To show the most likely migration path to next generation competition in single fixed access infrastructure regions we have again taken a country due to data availability. As Greece is the only country with virtually no second fixed access infrastructure, we have applied the framework we introduced at the beginning of the section to Greece.

The competitive state of the market in 2008 can be seen in Figure 35. The average download speeds for consumers was 3 Mbit/s with 100 per cent of subscribers using broadband speeds of 50 Mbit/s or less. A single fixed access infrastructure served the market owned and operated by OTE, the former PTT now 30 per cent owned by Deutsche Telekom. No alternative fixed infrastructure providers exist in the market, but there is service competition on OTE's network.

To illustrate the future potential outcome we have used a scenario for 2014 with the following characteristics:

- By 2014 wireless LTE has been rolled out at least partially in the Greek market by at least two of the three mobile operators (OTE, Vodafone and Wind) with possible roll-out levels of 40–60 per cent[54] which would add one more network that can serve the broadband market and create competition for the former PTT. As mentioned above, non-former PTT wireless operators might choose an aggressive upgrade approach given limited competition at the fixed infrastructure level.

[54] No concrete roll-out plans exist yet, but we assume that roll-out of LTE starts in 2012 and given the size of the country 80% penetration is reached in 4 years with two of the three wireless networks investing in upgrades.

- Given limited infrastructure competition, in September 2008 the Greek Ministry of Transport and Communications announced a national FTTx strategy aiming to connect 2 million households (50 per cent of total) by 2017 with deployment starting in 2009[55]. The proposed plan was to invest in a single passive infrastructure with three investors awarded contracts. The network would be then open to service providers (communications providers) that would provide retail services to end users. The estimated cost of the project is €2.1 billion with €700 million contributed by the government over seven years. Due to the bureaucratic challenges of this plan OTE recently announced plans to start upgrading its network to VDSL to speed up the delivery of high-speed services to consumers.

- Given challenges with supply of NGA-capacity networks, average uptake speeds are forecasted to be 13 Mbit/s in 2014 based on extrapolated Gartner forecasts. About 3 per cent of the market would subscribe to NGA-level speeds while 97 per cent will still have only broadband subscriptions[56]. Wireless could play an important role in broadband, both in increasing supply of services and also in bridging the digital divide.

In summary, it is less likely that the Greek market will achieve self-sustaining momentum towards penetration levels on par with dual fixed access infrastructure markets like the ones at the opposite end of the spectrum (for example, the Netherlands). Regulatory intervention, subsidisation and open access to the former PTT's network are more likely to end up being the tools used to achieve coverage with at least one network.

3. Implications for countries with single and dual fixed access regions

Very few European countries have just a single national fixed access infrastructure (Greece) or dual national fixed access infrastructures (the Netherlands, Belgium, Switzerland)[57] covering the entire country. Most European countries fall in between these two extremes. They have some degree of dual fixed access infrastructure, ranging from 10 per cent coverage in Italy to 77 per cent in Germany. Such countries therefore show the characteristics of both single and dual fixed access infrastructure regions.

For these countries one possible path for the evolution of their telecommunications market might be as follows:

- Within the same country, the regions with dual fixed access infrastructure have a higher likelihood for migration to higher-bandwidth networks than those regions with a single fixed infrastructure. These dual fixed access infrastructure regions benefit from the competitive dynamic between the infrastructure owners where one player might choose to upgrade the network to create a first-mover advantage and acquire more customers.

[55] http://www.telegeography.com/cu/article.php?article_id=24902

[56] "Consumer Broadband Speed Evolution, Selected Western European Countries, 2006-2012" – Gartner

[57] Chapter 3, Figure 12

- The single fixed access infrastructure regions in these countries might also still experience the migration to higher-bandwidth networks. In such regions, consumer willingness to pay for higher speeds can be high enough to justify the required investment or the infrastructure owner (for example, the former PTT or cable operator) might opt to offer the same service level in its entire franchise, independent of the difference in the economics between regions. An example is Swisscom, which introduced its IPTV offering on a national scale despite very challenging economics in Switzerland's less densely populated areas. Similarly, cable operators these days seem to upgrade their entire networks to DOCSIS 3.0 instead of "cherry picking" regions.
- Given the different dynamics in dual and single fixed access regions in these countries, the migration to higher-bandwidth networks could happen in dual fixed infrastructure regions earlier than in single fixed access infrastructure regions. Infrastructure owners may often be more likely to invest first in those areas where they are facing the strongest competitive threat.
- The higher the share of households with dual fixed access infrastructures in a country, the more widely will high-bandwidth networks become available, driven by the competitive dynamic between infrastructure owners.
- The market entry of new fibre operators is more likely to happen in the single fixed access infrastructure regions of these countries as the business economics of a new operator is more challenging if the available revenue pool needs to be shared between three instead of two market players. However, the business economics are also influenced by the density and attractiveness of an area, so market entry of new fibre operators can also happen in very attractive (high density, high willingness to pay for high-speeds) dual fixed access infrastructure regions.
- The risk of digital divide in single or dual fixed access infrastructure regions in these countries can be reduced by the roll-out of next generation wireless technologies and the evolution of these technologies.

Therefore, countries with both regions—single and dual fixed access infrastructure—will experience migration to higher-bandwidth networks; however, the degree of migration will vary significantly between countries. It will depend on, for example, the extent of dual fixed access infrastructure regions and the availability of local-loop infrastructures. Where this migration does not happen, policy-makers are expected to consider alternative approaches to foster the migration to NGA networks. In these markets, the open issue still remains of how to then create a self-sustaining momentum that will generate the next wave of innovation.

Bain & Company has been commissioned to undertake an objective analysis of the key trends in Europe's digital broadband infrastructure. The results of this study may hold insights for many of the key players in this evolving industry as they try to plan for developments over the next five years, anticipate the role of regulatory authorities and structure their investments accordingly.

For additional information, please visit **www.Bain.com** or contact Cheryl Krauss at **Cheryl.Krauss@Bain.com**.