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DEVELOPMENTS OF NEXT GENERATION NETWORKS (NGN): COUNTRY CASE STUDIES

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DEVELOPMENTS OF NEXT GENERATION NETWORKS (NGN): COUNTRY CASE STUDIES

1. INTRODUCTION

The move to Next Generation Networks (NGN) has been discussed in the ICT community for some time. Not only discussed. Developments in the market reflect the move, where a number of market players around the world are already operating NGN core networks, increasing numbers of market players are deploying NGN access, and others have made significant commitments to roll out fibre access networks (FTTx) or have migration plans for moving to all-IP networks.

Many previous discussions on this topic concluded that there is no single way of migrating to NGN. Operators can choose (and actually are choosing) different strategies and scenarios of migration, and rollout plans. Some say that NGN core networks represent a logical commercial development for all operators as they increase efficiency, facilitate service and pricing innovations and allow lowering backbone transmission costs. For example, British Telecom calculated that its new NGN core network could deliver savings of GBP 1 billion per annum by 2008/09.[1] According to the European Competitive Telecommunications Association (ECTA), some of its members, such as Telecom Italia, Telekom Austria, Cable & Wireless, Viatel, MCI, and COLT, already operate converged core networks and have already been carrying voice traffic using ATM and IP technology rather than traditional circuit switching for several years.[2]

If the main driver for operators to deploy NGN core networks is likely to be the long-run cost savings associated with such investments, then in contrast, there may not be the same cost savings, if any, associated with NGN access networks. In any case, it is unlikely that widespread fibre-to-the-home (FTTH) networks will make a good business case everywhere.

Although, traditional thinking is that FTTH networks would typically make sense only "in a city bristling with skyscrapers"[3], a new report by Tariff Consultancy Ltd finds that FTTH services are becoming increasingly competitive with conventional Triple Play broadband services in Europe and are already undercutting more traditional ADSL2+ services. [4] Another consultancy, IDATE, calculates that FTTH network operators can achieve profitability within seven to eight years in urban areas of most European countries. However, this calculation assumes that the operators share costs on passive infrastructure such as trenches and ducts.[5] As a result, some operators are investing in NGN access, some - making commitments, some are still holding on.

The variety of operators' plans and activities is leading to a diversity of regulatory actions by regulators and governments concerning NGN. In some countries, they are leaving it to market players to decide, when and how much to invest, and in others, like Portugal[6], governments are offering credit lines for the rollout of NGN. Some countries, like Korea and France, have broadband rollout plans set by governments, in other countries, like the United Kingdom (UK) and Ireland, stakeholder groups are established in order to facilitate the process of migration to NGN. Moreover, concerning the regulation of NGN, it can be seen that there is no global consensus on which regulation to apply. A particular concern, expressed by ECTA, is that different approaches are being taken in different countries on the regulation of NGN fibre access networks. [7]

The aim of this document is to present the current situation of NGN development in different regions of the world and to examine what effect the transition towards NGNs is having on regulation.

The paper starts with a clarification of the meaning of NGN. It then provides an overview of Voice over IP (VoIP), Internet Protocol Television (IPTV) and FTTH markets, and continues with an analysis of NGN development in different countries.

2. WHAT ARE NGNS? HOW DO WE UNDERSTAND NGNS?

There are different views of what constitutes NGN. From a technical point of view, NGN is defined by the International Telecommunications Union (ITU) as "a packet-based network able to provide Telecommunication Services to users and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent of the underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users." [8]

From this broad definition, a number of fundamental characteristics and aspects of NGN can be derived (See Box 1 for the detail list of NGN characteristics):

- It usually refers to the transmission of packet-based data using the Internet Protocol (IP) as a standard. Therefore different sources often use the term "all-IP network" as a broadly equivalent to NGN;
- A typical NGN will be able to deliver services in a technology-neutral manner, independently of the underlying technology (fibre, copper, coaxial, wireless, etc.) or the underlying architecture. The transport of the packets does allow for a differentiation of end-to-end Quality of Service (QoS) characteristics;
- Service provision is decoupled from transport – unfettered access by users to different service providers;
- Open interfaces support interworking with legacy networks;
- Converged services are delivered over fixed and mobile networks. The delivery of services will include mobile, nomadic and fixed users.

Box 1: Characteristics of NGN

The NGN is characterized by the following fundamental aspects:

- Packet-based transfer;
- Separation of control functions among bearer capabilities, call/session, and application/service;
- Decoupling of service provision from transport, and provision of open interfaces;
- Support for a wide range of services, applications and mechanisms based on service building blocks (including real time/streaming/non-real time services and multi-media);
- Broadband capabilities with end-to-end QoS and transparency;
- Interworking with legacy networks via open interfaces;
- Generalized mobility;
- Unfettered access by users to different service providers;
- A variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks;
- Unified service characteristics for the same service as perceived by the user;
- Converged services between Fixed and Mobile networks;

- Independence of service-related functions from underlying transport technologies;
- Support of multiple last mile technologies;
- Compliant with all Regulatory requirements, for example concerning emergency communications and security/privacy, etc.

Source: ITU-T, http://www.itu.int/ITU-T/ngn/definition.html

Put simply, NGN can be viewed as a "communication network that allows unfettered access to all communication products and services, irrespective of the service provider or network connection".[9]

However, it is worth pointing out that there are two broad types of network that currently enjoy the title of NGN. This concerns developments taking place in core, or backbone, networks and developments that occur in the access part of telecom networks. As the development of NGN core and NGN access networks require different time spans, different amounts of investments and different strategies, it is important to make a clear distinction between ***NGN core*** and ***NGN access*** networks.

NGN core network developments usually refer to the replacement of legacy transmission and switching equipment by IP technology in the core, or backbone, network. This includes changing telephony switches and installing routers and other equipments. The migration from traditional to NGN core network potentially entails several structural changes, such as to the core network nodes and in the number of network hierarchy levels. As a result, a reduction in the overall number of interconnection points is likely to take place. Although NGN core networks tend to be based on fixed infrastructure, the possibility of improving interconnection with mobile networks is being explored to facilitate access to IP services from anywhere.

For fixed operators, the expected cost savings from an IP core network is the key driver for investment to upgrade their network. For mobile operators, a more important consideration when upgrading their core network is the ability to offer richer IP multimedia services to customers.[10]

NGN access networks developments typically refer to the network segment which connects an end-user to the nearest location which houses the network access provider's equipment. [11] As the ITU definition of NGN implies, NGN access can be delivered by a number of different technologies. These include fibre, copper, coaxial lines as well as different wireless options.

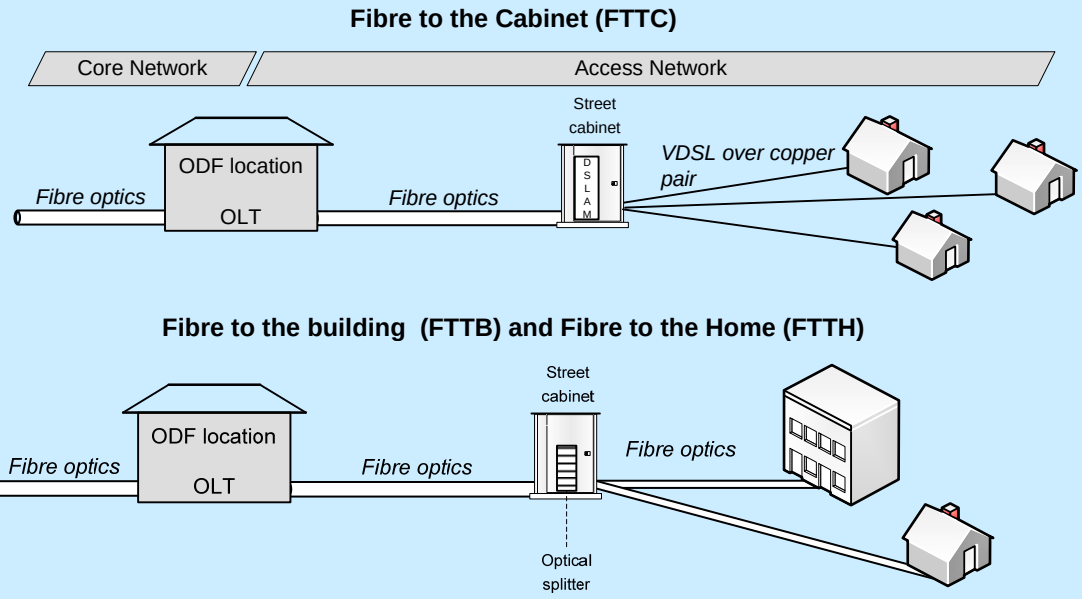
In Europe, NGN access networks are mainly considered to refer to the introduction of fibre into the local loop, either to a street cabinet (+/- max 1km from the customer premises) in conjunction with VDSL2 or ADSL2 deployment or the deployment of fibre all the way to customer premises (typically apartment blocks rather than individual houses). This means that an operator can chose between the following options (for illustration see Figure 1):

- **Fibre to the cabinet (FTTC)** - Deployment of fibre to a street cabinet and provision of broadband based on VDSL/VDSL2 over copper loops from the street cabinet to end-user premises.
- **Fibre to the building (FTTB)** - Deployment of fibre until the basement of a building and provision of broadband based on VDSL/VDSL2 over in-house copper wiring.
- **Fibre to the home (FTTH)** - An end-to-end fibre solution to end-user premises. In this scenario, the entire copper loop is replaced by fibre, along with the main distribution frame (MDF) and street cabinets, although some of these may be used for the optical

distribution frames (ODF) and optical splitters. FTTH deployment can be achieved by deployment of either a point-to-point (P2P) or a passive optical network (PON) topology.

The broadly-defined term **fibre to the premises (FTTP)** is sometimes used to describe FTTH and/or FTTB.

Figure 1: Options for fibre access



Source: Cullen International

The literature on investment costs of NGN fibre access networks suggests that due to the uncertainty surrounding future technology standards and customer demand for new services there are likely to be high costs and risks of these investments. Some technology such as PON by nature difficult to unbundle in the way that copper can be. More expensive technologies such as P2P are able to be unbundled but are generally more expensive to deploy.[12] There are different estimations of how much it could cost to deploy a fibre network. Although the cost of a FTTH rollout will vary from country-to-country, one consultancy estimates the cost to be in the vicinity of USD 1 500 per household in the Middle East market.[13] Several years ago, the average cost per FTTH subscriber in urban areas in North America was over USD 2 000 but it is now down to USD 1 000. Verizon (US operator) reports that at the end of 2005 the cost per FTTP was USD 1 021; by the end of 2006 that had fallen to USD 850.[14] The European Union estimated that deploying FTTx in its Member States would cost over EUR 300 billion.[15] The good news for operators is that costs for such infrastructure are going down. A study, prepared by the Australian government, even says, that the cost difference between copper and FTTP is relatively modest compared to the total value of a newly built house, the life of the investment and when considering the increased functionality of future-proof FTTP networks.[16]

Aside from fibre, there are a number of alternative technologies capable of supporting NGN access. These include, coaxial cable, mobile and fixed wireless networks. Even if recent debates in the ICT community has been mainly focused on wired NGN access (especially fibre), it is not really appropriate because NGN access does not only refer to the deployment of fibre. Therefore

fibre access shouldn't be considered as the only option for NGN access. Given that mobility is increasingly a key requirement for users, wireless solutions such as WiMax and Long Term Evolution (LTE) have the potential to support high bandwidth and concurrent usage that may be demanded in the future.

Table 1 shows different access technologies and their theoretical down and upstream bandwidth.

Table 1: Bandwidth speeds for different access technologies

Access Technology	Upstream	Downstream
ADSL	1M	8 M
ADSL2	1M	12M
ADSL2+	1M	24M
VDSL2	2M to 25M	5M to 50M
Dial-up	56k	56k
Cable Modem	2M	2Mto 25M
Docsis 2.0	27M	38M
Docsis 3.0	120 M	160 M
FTTP	500M on PON	500M on PON
HSPA	1400k	1400k
WiMax	40M	40M
LTE	<10M	<20M

Source: Commerce Commission of New Zealand, OECD.

To sum up, there is no single NGN solution. It is up to each network operator to develop and implement its network upgrade, depending on the state of its infrastructure, on the specific market situation, and on regulatory framework conditions. The cost of network upgrade will depend on such things as, the current state of the network architecture, the technology chosen, population density (for economies of scope and scale), geo-typical restrictions, and building standards, etc. The type, extent and timescale of NGN deployment is dependent on:

- Characteristics of the fixed national market;
- Involvement in the mobile market;
- Competition pressure from alternative network providers i.e. cable operators;
- Obsolescence of the legacy network(s);
- Deployment strategy (overlay versus replacement);
- Demand for broadband services;
- Other.

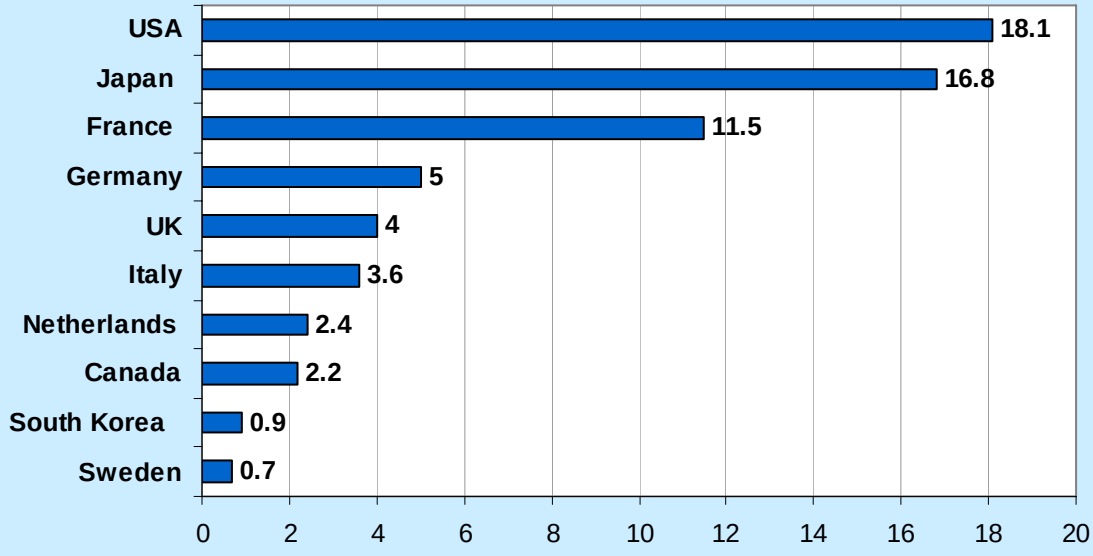
The following section presents a short overview of the biggest VoIP and IPTV markets worldwide, as these services in many countries are considered to be important drivers for NGN.

3. OVERVIEW OF VOIP, IPTV AND FTTH MARKETS

Probably the best example of the "all-IP" move is the rise of VoIP services. The rise of VoIP increases vulnerability of incumbent operators, as voice accounts for over 80 percent of their revenues. Therefore, many incumbent operators are currently building NGNs based on IP technologies to be able to offer bundled services, including VoIP.

In the last few years, VoIP services have continued to grow strongly, they are steadily replacing voice calls from traditional public switched telephone networks (PSTN) in many developed and some developing countries. According to some market analysts, the global number of VoIP subscribers reached some 80 million in 2008.[17] According to iLocus, there were estimated 69.2 million VoIP subscribers worldwide as of the first quarter of 2008.[18] America had the highest number of subscribers (18.1 million) followed by Japan (16.8 million) and France (11.5 million). Figure 2 represents the top 10 countries worldwide in numbers of VoIP subscribers.

Figure 2: Retail VoIP subscribers (in millions, 2008): Top 10 countries



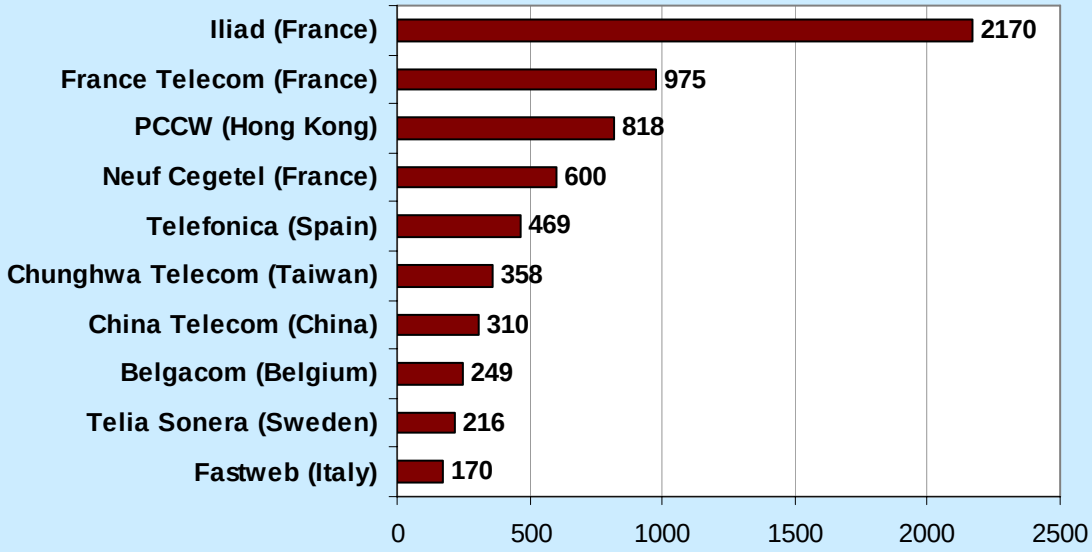
Source: iLocus

Different factors have accelerated the growth of VoIP services in different markets. In Japan, a ubiquitous broadband market, more than half of the high-speed Internet connections were associated with a VoIP subscription at the end of 2007. By comparison, in the nearby Republic of Korea (with a similar broadband take-up), VoIP subscribers with a dedicated prefix amounted to only 200 000. In that sense, high broadband penetration appears to be a necessary - but not sufficient - condition for the success of VoIP.[19] Has NGN deployment any role to play in the VoIP market development? Or vice versa?

Another service, which is also often considered as one of the main drivers of NGN deployment, is IPTV. On the one hand, it provides operators with a new revenue stream (as voice revenues are declining) and an opportunity to build services around broadband connections that should make it harder for customers to leave. On the other hand, there is little evidence yet that delivering TV services over a broadband connection will directly help boost operators' profit margins.[20] It has potential but its future is still uncertain.

The number of IPTV subscribers worldwide is steadily growing as well. There were 10 million to 15 million subscribers in 2008, according to different estimates. [21] Fixed-line incumbents and Internet Service Providers (ISPs) are launching commercial services in many regions, including in China, India, and throughout Europe. Europe accounts for most of the IPTV growth over the past year and now represents about half of all subscribers worldwide. The number of subscribers in Asia-Pacific and North America has also doubled over the past 12 months. In South Asian and East Asian countries, the growth is slower but sustained, yet in Latin America and Africa the IPTV market still hasn't quite taken off, although commercial services have been launched in a few countries.[22] Figure 3 gives the overview of 10 operators that have the most IPTV subscribers worldwide. Operators from Europe and Asia have leading positions in the chart.

Figure 3: Global IPTV Top 10 Carriers (by subscribers, in thousands, 2008)

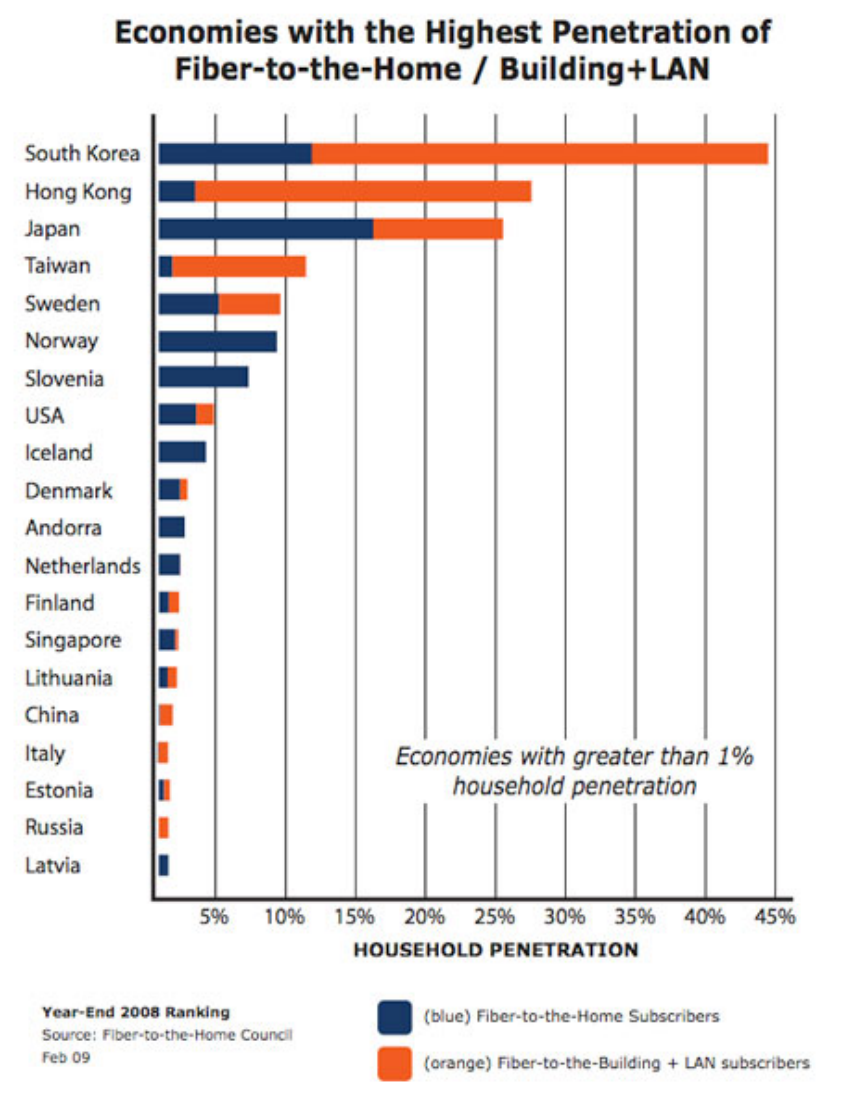


Source: Lightreading

Since 2007, the FTTH Council issues the rankings of top FTTH economies twice a year. It tracks the level of FTTH market penetration in economies where more than one percent of households are connected directly into high speed fibre networks. Asian economies have always been leaders in FTTH market penetration and in 2008 they maintained their leadership, as South Korea (44 percent of the market), Hong Kong (28 percent), Japan (27 percent) and Taiwan (12 percent) continued to hold the top four places respectively. This is followed by European FTTH leader – Sweden (See Figure 4)[23]. In fact, the Europe-only ranking, issued in

December 2008, indicated Sweden as number one, and the UK as number 25 (the last one of the ranked countries).[24]

Figure 4: Top FTTH economies worldwide, February 2009



Source: FTTH Council, 2009

It is mainly European and Asian countries that dominate in all three categories (VoIP, IPTV and FTTH). This illustrates strong positive correlation between the demand of these services and development of infrastructure. However, it is interesting to see, what are the specific factors leading to much faster growth in some regions, but slower in the others.

In the following sections the paper turns to the analysis of current NGN developments in different regions of the world. It will cover both market and regulatory developments with regards to NGNs. As not only regulators, but often governments have an active role to play in promoting

broadband in a country, related activities of governments will be observed in some case studies as well.

4. NGN IN EUROPE

4.1. Austria

Background information

Population	8.39 million
Fixed penetration	40.8
Mobile penetration	102.5
Fixed broadband penetration	19.4
Mobile broadband penetration	29.5
Internet users	67
ICT Development Index (Rank 2007)	**20**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Telekom Austria (the incumbent operator in Austria) began to install NGN core network elements in 2004. In fact, according to announcements, by the end of 2004 the company had already invested **EUR 780 million** and **was planning to invest an equal amount over a five-year period**.[25] Investments covered state-of-the-art infrastructure, innovation, research and development. Telecom Austria's plans included upgrading some parts of its operational support systems, the launch of VoIP services for residential customers in 2005 and the full conversion of the network to NGN by 2012.[26] Today, Telekom Austria is already carrying its voice traffic using IP technology.[27]

The Austrian incumbent operator is also planning to restructure its access network. A recent (February 2009) announcement confirms this intention: Telekom Austria recently acquired 76 percent stake in CableRunner Austria GmbH in order to optimize the fibre optic network roll-out.[28] According to an ERG report, Telekom Austria plans to roll out a FTTC infrastructure in cooperation with both municipalities and other utility sector stakeholders. [29] This rollout should include the implementation of 20 000 – 30 000 fibre nodes significantly shortening the copper local loop to 600 - 800 m subsequently allowing the deployment of services with a minimum data rate of about 20 Mbps. The company sees no business case for a widespread FTTH network, but has expressed its interest in using fibre in combination with VDSL, as Deutsche Telekom is doing in Germany.[30] Such technology could sustain a "reasonable" 20 Mbps service to each and every household. However, no immediate or very detailed plans to roll out NGN access were announced. Therefore, it could be said, that Telecom Austria has chosen "wait and see" strategy for its NGN access deployment.

Regarding services to be delivered via NGN, Telekom Austria already launched a triple play product comprising telephony, broadband Internet and TV services. Since the beginning of 2007, it began offering a TV service in urban areas in order to improve its ability to compete with Cable TV (CATV) triple play offers (voice/broadband/TV). In 2007, Telekom Austria was offering IPTV

over ADSL2+ in nine of Austria's biggest cities.[31] It ended 2008 with 63 700 IPTV subscribers, which is up from 10,930 at the end of 2007.[32] In January 2009, Telekom Austria said it had reversed a 12-year trend of fixed-line loss by aggressively bundling broadband with mobile, enabling it to add 2 580 fixed-line subscribers in December 2008.[33]

Vienna utility operator Wienstrom in recent years performed trials offering FTTH services to end customers in selected areas of Vienna.[34] Meanwhile, Wienstrom has withdrawn from the retail market and is offering fibre access as a wholesale service to other operators (currently to Telekom Austria, NeoTel and Conova). Wienstrom had 10 000 homes reached by FTTH and is planning to reach 50 000 homes by the end of 2009. Total coverage planned is 960 000 homes, with an estimated investment of about **EUR 10 million.** [35]

Other utility operators like Grazer Stadtwerke are offering retail services based on FTTH infrastructure. In addition to retail broadband services, some local operators, like Infotech Ried, also started to provide (local) TV services based on their own platform; in parallel, they have developed system solutions for carriers, service providers and wholesale operators to build and operate an IPTV platform based on a multi-access broadband Ethernet network.[36]

Regulatory developments

The Austrian National Regulatory Authority (RTR) started a discussion process on NGN issues in June 2007 by launching three papers for public consultation. The paper "Next Generation Regulation" discusses the consequences of the deployment of NGNs for regulatory access obligations, investment incentives for communication service providers in next generation networks, future interconnection billing models, migration issues with regard to points of interconnection and etc. The responses to this consultation paper have been subject to a public discussion during a regulatory workshop for operators and other stakeholders in October 2007.

Another dialogue covers the future billing method to be used when settling interconnection costs between next generation networks and the question of whether "Bill and keep" might be a preferable billing method within an NGN environment compared to the existing system of Calling Party's Network Pays (CPNP). IP interconnection has not yet been subject to proceedings before RTR.

In addition, an NGA-NGN industry working group has been established in February 2008 to further discuss aspects of migrating an incumbent' s PSTN to a NGN. In a first step, the group concentrates on NGN access issues. The two major topics currently discussed are the issue of spectrum management on the local loop and various aspects of access to street cabinets.

4.2. Belgium

Background information

Population	10.5 million
Fixed penetration	44.6
Mobile penetration	102.7
Fixed broadband penetration	26
Mobile broadband penetration	2.7
Internet users	67
ICT Development Index (Rank 2007)	**24**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2007, Belgacom (incumbent operator in Belgium) announced its plan to get rid of a whole range of legacy systems and converge everything onto a single IP/MPLS network, [37] adopting an approach very similar to that of its neighbor – KPN in Netherlands. Belgacom declared during its general meeting in April 2008 that in the context of the modernization of its network and the transition to IP technology about 10 percent of its exchanges would be closed down. The plan 'Move to all IP' will be carried out during the period 2008-2012 but the planned exchange closures will not be completed by 2012.[38]

The plan to upgrade the Belgacom access network to higher speeds is named *Broadway*. For the *Broadway* project, Belgacom is upgrading its access network progressively to a combined copper and fibre optic network. This upgrade includes placing additional fibre between the local nodes and the distribution frames. Belgacom is planning to run FTTC in the major Belgian cities. According to the ERG report, about one third of the street cabinets were equipped with optical fibre in 2007.[39] Other sources of information report that at the end of 2007 there was a 40 percent of planned coverage achieved by the investments of **EUR 382 million**. The whole project has the target of covering 80 percent of homes with FTTx/VDSL by 2011 with the investment of **EUR 647 million**.[40]

Belgacom's NGN deployment strategy is based on updating its access and core networks in a relatively short period of time (the project, initiated in 2004, is planned to end in 2011). The strong pressure of cable operators could be named as one important reason for such a strategy. Cable operators have 34 percent of market share in Belgium, whereas the incumbent operator has 44 percent. Cable operators announced the launching of a 100 Mbps offer based on EuroDocsis 3 in the short term, which increased the strategic interest of Belgacom for VDSL2.

Regarding services being delivered via NGN, Belgacom launched the first commercial services of its *Broadway* project in November 2004. At the end of 2005, television was launched both on ADSL (only one TV channel) and VDSL. In 2007, Belgacom launched a VoIP residential service as an option of its Internet service. At the end of March 2008, the total Belgacom IPTV subscriber base was 349 250 and the total number of VoIP subscribers – 16 000.[41] IPTV average revenue per user (ARPU) in 1Q of 2008 was 17.4 EUR compared to 13.4 EUR a year

before. Belgacom is considered to be one of the 10 top IPTV carriers (by number of subscribers) in the world (see Figure 3).[42]

Regulatory developments

In 2008, the Belgian regulator (BIPT) studied the consequences of Belgacom's FTTx roll - out on alternative operators. BIPT was concerned that the new network would eliminate alternative players from the market (as alternative operators would have less physical connection points to access the incumbent's network), and consequently limit the options of end users. BIPT launched the consultation on the effects of NGN impact from January up to February 2008. Based on the results of this consultation, BIPT took a final decision concerning the addendum complementing its previous decision on the broadband access market. This new decision evaluates the impact of NGN developments on the broadband access market in Belgium. Among others, the following remedies were imposed on Belgacom in respect to NGN:

- ***Transparency measure***: Belgacom has to provide BIPT and alternative operators with its detailed plans to develop networks, per region over a 5-year period. The plans must be adapted and communicated each year.
- If Belgacom decides to close down a site for access to the local loop or sub-loop, Belgacom has ***to leave this point open for at least five years*** after the announcement to the regulator and other market players.
- Belgacom has to submit for approval to BIPT and afterwards publish a ***bitstream reference offer***. This offer has to provide for enough diversification possibilities. The same levels of quality as the current bitstream offer must at least remain possible and there have to be enough interconnection levels. The ***bitstream offer has to include access to the use of the VDSL1 technology*** for the remote optical platforms where no VDSL2 technology is available.

In addition BIPT has imposed the following deployment rules[43]:

- Belgacom is authorized to roll out VDSL in the 1.1 – 2.2. MHz band, using ETSI frequency plan 998, and using the DMT (discrete multitone) modulation.
- Belgacom must, however, anticipate in good faith on developments that are considered by the BIPT to be within the realm of the reasonably possible in the future, in particular the possible development and commercialization by other operators of services based on ADSL2+ and Enhanced SDSL.
- The BIPT reserves the possibility of authorizing, in the future, the utilization of both VDSL and ADSL2+ in the 1.1 – 2.2. MHz band. The BIPT recognizes, and states, that this would inevitably require Belgacom to adapt its VDSL-based services, and that Belgacom can choose to do this by reducing the capacity utilized by VDSL (in terms of the utilization of the copper spectrum) or by ensuring co-existence of VDSL (deployed from street cabinets) and ADSL2+ (deployed from MDF) in terms of power output/signal strength.
- A demand also exists from new entrants to use internal cabling of apartment buildings to provide VDSL services from DSLAM installed in the basement of the buildings with fibre or leased line access. BIPT has launched a consultation to determine the best way to process such usage; a first consultation about a full unbundling at the level of the building distribution frame has proved that it is not feasible (too complex).

4.3. Denmark

Background information

Population	5.45 million
Fixed penetration	51.9
Mobile penetration	114.5
Fixed broadband penetration	36
Mobile broadband penetration	12.2
Internet users	81
ICT Development Index (Rank 2007)	**3**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2006, the Danish incumbent operator TDC announced its planned migration to NGN. According to the plan, within the next two years (by 2008-2009), 75 percent of the Danish households should have access to 20 Mbps broadband and triple play, such as HDTV, data and telephony. In 2010, it is expected to cover 90 percent with 20 Mbps and 75 percent with 100+ Mbps broadband. The plan operates with establishing a common NGN across the four existing TDC networks – mobile, fixed, data and CATV – into one IP-based network.[44] The total investment of this plan has not been announced yet.

In fact, Denmark is one of the top economies with the highest penetration of FTTH. This is due to the active involvement of power companies which have been investing massively in the rollout of FTTH networks, and playing a significant role in infrastructure competition:

- In 2004, Energi Danmark ESS (an energy supplier) announced its plans to invest **DKK 15 million (EUR 2 million)** in a fibre optic cable network in south Jutland, to supply broadband internet connections with a speed of up to 9.2 Mbps.[45]
- Dansk Fibrenet is planning to invest **EUR 1.3 billion** by 2015 to reach 40 percent coverage of the country by FTTH.
- EnergiMidt, a Danish utility company, started investing in FTTH in 2004.[46]
- A small rural community in southern Denmark is implementing a seven-year FTTH project, which aims to provide FTTH connections for all households, enterprises and institutions in the area through a public-private partnership with the local energy company. The project started in 2002 with support form the EU and the Danish Government. Initial public investment was about **EUR 1.4 million**.[47]

To date, these FTTH networks cover mainly urban areas, but also have considerable coverage in rural areas, having already reached 400 000 households in total. It is anticipated that the total number of Danish households (2.5 million households and half a million enterprises) will be reached in eight years' time. The number of fibre subscriptions increased by 23.2 percentage points within a year (87 991 fibre lines in January 2009), amounting to 4.3 percent of all broadband connections.[48] However, energy companies deploying FTTH networks have expressed concern about difficulties in attracting customers onto their own network because of

various local district plans, issued by municipalities, which include in many cases a mandatory membership and payment to a local CATV network.

In July 2008, 7.39 percent of the Danish population were using bundled services (406 040 subscribers). The vast majority of these subscribers (88.1 percent) use quadruple-play services including broadband, voice telephony, IPTV, and mobile telephony, while the remainders (11.9 percent) use triple-play services.[49]

Regulatory developments

The Danish regulator, National IT and Telecom Agency (NITA), has taken some initiatives to build knowledge on NGN developments:

- In 2006, a NGN hearing was held.
- In 2007, a conference on NGN was organized by NITA.
- A public consultation, held in autumn 2007 on the existing LRAIC fixed model, demonstrated that in view of the significant technological developments in the market (roll-out of fibre optic networks, the upgrade of the incumbent's copper network), a revision of the model was necessary. NITA is currently working on this revision. LRAIC prices for 2010 are to be determined on the basis of the revised model.
- As alternative operators expressed the view that insufficient information was given by the incumbent on its rollout plans, NITA has addressed these issues in its draft decisions on the physical network infrastructure access market.

Interestingly, the Danish government has promoted broadband uptake with a tax incentive introduced three years ago whereby employers pay for their staff's broadband connections, if the employees are working from home. In doing so, both employers and employees get a direct deduction on their taxable income. This measure has been popular among employers.[50]

4.4. France

Background information

Population	61.9 million
Fixed penetration	56.5
Mobile penetration	89.8
Fixed broadband penetration	25.2
Mobile broadband penetration	13.7
Internet users	64.0
ICT Development Index (Rank 2007)	**23**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Before launching major plans to roll out NGN access networks in France, most operators have migrated their core networks towards NGN, based on Gigabit Ethernet or a mixture with ATM/SDH technology.[51] The French incumbent operator (France Telecom) has started rolling out its NGN core network, based on an overlay strategy: equipments are progressively removed from the PSTN and new customers are connected primarily to the new network. Interconnection with the France Telecom NGN network is available at nine points of presence, belonging to the 18 global points of presence available for its PSTN interconnection at the regional level. Nonetheless, no date of the "PSTN switch over" has been announced so far.

France is among the top three countries in Europe for fibre deployment. Much of the market's success has been achieved by alternative operators, which in turn has stimulated France Telecom to adopt an aggressive fibre roll-out. France Telecom was the first European incumbent to announce an FTTH deployment strategy.[52] In 2006, three main French fixed line operators – France Telecom, Iliad (Free) and Neuf Cegetel – announced their plans to roll out their FTTH networks in Paris and other main cities in France.[53]

According to some consultancies, it will cost French operators between **EUR 10.4 billion** and **EUR 11.3 billion** to provide FTTH coverage for 40 percent of France's population. According to operators' announcements:

- France Telecom planned to invest **EUR 270 million** by 2008 and **EUR 3 to 4.5 billion** by 2012. Currently, deployments are taking place in Paris, Lille, Lyon, Toulouse, Poitiers, and Marseille.
- Iliad (Free) planned to invest **EUR 160 million** by 2008 and **EUR 1 billion** by 2012. Developments are taking place in Paris, Lyon, Montpellier and Valenciennes. In addition to that, Iliad (Free) bought Citefibre in 2006 – a FTTH operator. At the beginning of 2009 Iliad (Free) confirmed its target of 4 million homes covered by 2012 by FTTH. [54]
- Neuf Cegetel announced plans were to invest **EUR 300 million** by 2008. Developments are taking place in Paris, Pau, Toulouse, Rennes, Bordeaux, Strasbourg, and Nancy. Following the example of Iliad (Free), Neuf Cegetel acquired Erenis – a FTTB operator – in 2007.

Table 2 provides estimated numbers of FTTH in France in 2013 by different regions.

Table 2: FTTH in France in 2013

Region	Estimated number of FTTH
Ile-de-France (Paris)	3 000 000
Provence-Alpes-Côte d'Azur (Marseille)	430 000
Rhône-Alpes (Lyon)	400 000
Nord-Pas de Calais (Lille)	220 000
Aquitaine (Bordeaux)	190 000
Midi-Pyrénées (Toulouse)	160 000
Alsace (Strasbourg)	140 000
Pays de la Loire (Nantes)	90 000
Languedoc-Roussillon (Montpéllier)	80 000
Brittany (Rennes)	70 000
Champagne-Ardenne (Châlons-en-Champagne)	60 000
Basse-Normandie (Cean)	50 000
Lorraine (Metz)	40 000
Poitou-Charentes (Poitiers)	30 000
Haute-Normandie (Rouen)	4 000

Source: Tactis.

By the beginning of 2009, France Telecom had deployed fibre in approximately 40 municipalities, Numericable (a cable operator) had upgraded to fibre in around 30 major urban centres and SFR (including Neuf Cegetel) and Iliad (Free) are concentrating efforts in areas where France Telecom is less active. ARCEP (French National Regulatory Authority (NRA)) estimates that between 3 and 4.5 million homes were passed by fibre at the end of 2008.

France Telecom offers triple play services (VoIP, Internet and TV) at 1 000 MDFs from 13 000 MDFs total. At the end of 2007, 5 million local loops were unbundled in France (from 32 million local loops) and the volume of VoIP communications represents one third of the volume of communications from fixed lines. Triple play services are widespread within residential customers whereas VoIP remains limited within the business market.

Regulatory developments

In 2007, ARCEP (French NRA) launched two public consultations on FTTH. The first dealt with the competitive situation concerning access to ducts and the possible regulation. The second one - with the infrastructure sharing among operators of the last segments of optical local loop to limit the amount of works carried out in buildings.

Access to ducts. In general, digging trenches and laying cables to buildings makes up the biggest part of the cost of rolling out the optical fibre local loop. In less densely populated areas, the cost of such civil engineering works is higher and rapidly becomes profitless. In France such civil engineering represents between 60 and 80 percent of total cost of a new fibre network.[55] The objective of ARCEP consultation was to enable all operators to have access to these

infrastructures, to encourage investments and infrastructure-based competition in the local loop segment.

On 15 September 2008, France Telecom published a reference offer for access to its civil infrastructure. This satisfies the obligation contained in the market analysis decision adopted by the ARCEP on 24 July 2008, which requires France Telecom to provide access to its civil infrastructure (ducts, manholes) under transparent and non-discriminatory conditions, and at cost-oriented tariffs. All operators, regardless of the technology they use, can now employ France Telecom ducts to deploy fibre.

Sharing fibre local loop. Usually, it is not reasonable for each optic local loop operator to have its own dedicated cables and optical connectors in each building and each apartment. Several operators may therefore share the last part of the fibre local loop. ARCEP consultation on this matter discussed technical, financial and legal issues arising from such infrastructure sharing. In the middle of 2008, ARCEP launched a consultation on this issue once again. The first part of the consultation covered the role of the building operator, authorized to install and operate fibre in the private property. The second part of the consultation dealt with the agreement practice between operators and building owners or managers. The third part of the consultation covered the degree of sharing of the fibre local loop among operators, which raises the question of the location of the sharing point.

The consultation process was followed by the Law on modernizing the economy, of 4 August 2008, which included a number of provisions for network sharing. The first operator to install fibre in the premises must thus satisfy all reasonable demands for access to the last part of the network from third-party operators. The Law stipulates that the installation of fibre be governed by an agreement between the building operator and the owner or manager of the property. As a result, the major providers Numéricable, Orange and SFR have agreed to share fibre installations between themselves and open them to other operators.

Pursuant to the adoption of the Law on modernizing the economy, ARCEP also published its recommendations on infrastructure sharing. It recommends the establishment of sharing of the last part agreements that include all operators, and which make it possible to test the different solutions in several large metropolitan areas. ARCEP recommends a best practice whereby the building operator would offer to install additional last fibre part on behalf of third-party operators. ARCEP has also published a sample agreement allowing joint property owners and social landlords to contract an operator to manage the fibre installation inside the premises.[56] This document includes the essential guarantees for property owners, while limiting the administrative burden on operators. Market players can already use the sample agreement.

Planned activities of ARCEP. Before the end of 2009, ARCEP plans to publish an ultra-fast broadband roadmap to track the progress being made by roll-outs and sharing of the last part mechanisms, and the use of France Telecom ducts.

As some local authorities launched public initiatives to built networks in areas with a lack of private initiative and competition, in order to ease the arrival of alternative operators with local loop unbundling, ARCEP will conduct and publish a study to define and evaluate the effects of the intervention of the local authorities (municipalities, departments and regions) on the development of telecom and Internet infrastructures in France. ARCEP plans to hold a seminar bringing together all those who have made a contribution to these developments, and publish the results by the end of 2009.

4.5. Germany

Background information

Population	82.5 million
Fixed penetration	65.1
Mobile penetration	117.6
Fixed broadband penetration	23.7
Mobile broadband penetration	10.5
Internet users	72
ICT Development Index (Rank 2007)	**13**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The Germany incumbent operator Deutsche Telecom plans a step-by-step approach to a unified IP network. Integrated voice-data services will be offered using *an NGN overlay concept*. The PSTN platform will be fully substituted around 2012.[57] According to BREKO (the association of alternative operators) 51 percent of its affiliated companies want to have implemented IP in their backbone networks by 2009.[58]

In 2005, Deutsche Telecom announced plans to deploy fibre between the MDF and the street cabinet (FTTC), and to install VDSL solutions with **EUR 3 billion** investments. As of January 2007, the network deployment covered 12 metropolitan areas with about 5.9 million potential customers. Based on its original plans, operator was aiming to deploy fibre in Germany's 50 biggest cities by 2008. The incumbent operator claims to be still delaying the wide deployment of fibre due to regulatory uncertainty. However, it continued expanding its high-speed VDSL access network in 37 German cities with 9 million potential customers, which is targeted at the provision of HDTV for about 30 percent of the households at streaming speeds of up to 50 Mbps. Currently, more than 21 percent of all households have access to such high-speed connections.[59]

Deutsche Telecom made its FTTC/VDSL investment plans subject to the suspension or abolition of *ex ante* regulation for competitive access to the new networks. In other words, Deutsche Telecom has committed to the German government to make these investments only if the government provides a "regulatory holiday" from the obligation that Deutsche Telecom would have to offer wholesale access services to competitors at regulated prices. Deutsche Telecom argues that its investment should get protection from regulation because "new products" like IPTV are offered over them.[60]

However other market players started to deploy their own infrastructure. In 2006, Versatel, a fixed network operator, announced its intentions to build its Internet Protocol (IP) and Dense Wavelength Division Multiplexing (DWDM) nationwide networks. At the same time Netcologne (a city network operator providing services over its own infrastructure in Cologne and surroundings, owned by an energy utility) began constructing a FTTH network in Cologne. It is intended that within five years the whole city will be covered. Netcologne planned to invest **EUR 250 million** over three years.[61]

HanseNet, a German telecom operator, launched the FTTB project in Hamburg in June 2008. In the following November, HanseNet started the first phase with 50 buildings. The second phase kicked off recently and is expected to add fibre optics to another 500 buildings.[62]

The German broadband company HeLi NET Telekommunikation GmbH & CoKG announced in 2009, that it is deploying a FTTH network in the Hellweg-Lippe region. The new fibre network for multi-play services will be launched under the name City2020 and will be an open FTTH network. HeLi NET is a partnership between local energy companies from the municipalities of Hamm, Ahlen, Soest, Lünen, Kamen, Bergkamen and Bönen. The deployment of the first clusters to the cities of Hamm, Lünen and Kamen is already underway.[63]

In 2009, Media Broadcast announced its NGN as an all-in-one network, which is available throughout Germany and provides service to radio, media and business customers. NGN integrates data and voice traffic from IT and telecommunications platforms, links data centers and connects archives or enterprise applications. Through the NGN, in conjunction with the telecommunications network node, users have the capability and flexibility to route global connections into major urban centers in Germany. In addition, these functions can be utilized on the entire international end-to-end connection.[64]

Regulatory developments

There are two main issues relevant to migration to NGN which have been addressed by regulation policy in Germany:

- Amendment of the German Telecommunications Law regarding (non-) regulation of “new markets”, and
- Interconnection between IP-based networks.

Important amendments to the German Telecommunications Law took effect in February 2007. In principle, these amendments could imply an abolition of regulation for Deutsche Telecom’s new investments in VDSL technology. In light of these amendments, the German regulator did not impose unbundling obligations on Deutsche Telecom’s VDSL deployments; the regulator (BNetzA) did, however, attempt to impose obligations to make ducts available from the central office to the street cabinet. As a consequence, the EU Commission has launched an infringement proceeding against Germany in the European Court of Justice in Strasbourg.[65]

However, at the beginning of 2009 Deutsche Telekom announced that it is to sublet its optical fibre data network to other telecom companies. Timotheus Hoettges, chief executive of the company's T-Home division, said the move to rent out capacity on Telekom's VDSL network was voluntary and not in response to any regulatory pressure.[66]

In 2005, BNetzA launched a Project Group called “Framework for Interconnection in IP-based Networks”. This expert group submitted its final report in December 2006. The report notes the importance of the separation of service and network, and the impact of the centralization of control functions. In 2007, a hearing on this report was opened.

However, as noted in the recent EC report, the deployment of and migration to Next generation access networks is still a point of regulatory concern and causes regulatory uncertainty. The medium-term strategy of both the incumbent and other players concerning NGN access does not seem to be transparent. The incumbent's ongoing investment in FTTH is currently limited to VDSL in big cities for the transmission of IPTV and triple play, while a few competitors have also made small-scale fibre deployments. Although the BNetzA declared that it intends to set a comprehensive and transparent framework for NGN access, it has not yet taken conclusive action.[67]

4.6. Greece

Background information

Population	11.17 million
Fixed penetration	53.9
Mobile penetration	110.3
Fixed broadband penetration	9.1
Mobile broadband penetration	10.1
Internet users	33.0
ICT Development Index (Rank 2007)	**34**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Announcements in the press indicate that Greek operators are following the general trend to invest in NGN core networks. Unfortunately, amounts of planned or even already implemented investments are not made public.

In 2006, Tellas, the major alternative telecom operator in Greece, has reached an agreement with a company supplying products and services for NGN, for the supply and the development of a NGN.[68] The NGN solution should guarantee the full interworking with Tellas existing legacy infrastructure for voice services and enables the delivery over an IP network of new enhanced telephony and rich content services for residential and business customers.

In 2007, Greece's incumbent telecommunications operator OTE selected a company for a NGN deployment as well.[69] The solution supports both legacy TDM and IP-based infrastructure allowing it to remain flexible in its service offerings and migrate to IP gradually over time.

In 2009 hellas online, one of fixed-line telecommunications services providers in Greece, operating the second largest network in the country, announced that it is making significant infrastructure investments to enhance the quality and reach of its broadband services. hellas online's fiber optic network extends to more than 3 500 kilometers nationwide, enabling the company to offer residential and business voice and data services, including IP telephony, virtual private networks and fibre access services.

As of July 2008, 2.85 percent of the Greek population used bundled services. The majority of these subscribers (2.31 percent) used double play services including telephony and broadband while 0.54 percent used triple play products (fixed-mobile telephony and broadband).[70]

Regulatory developments

From the regulatory point of view, EETT (NRA of Greece) has taken several actions in order to support the development of NGNs:

- EETT has updated the authorization regulation with several rules regarding the VoIP services.

- EETT has proposed a regulation regarding the rights of way for the development of wireline networks. The aim of the regulation is to provide a clear set of rules for the operations that are required in order to build ducts to support the development of electronic communication networks on public properties in the Greek territory and it is expected to make it easier for the network operators to acquire the relevant licences.
- In July of 2007, EETT hosted a workshop on NGN access, in order to begin a discussion regarding the development of NGN access (specifically the FTTx technology) in Greece.

In 2008, the Greek government has decided that it is necessary to invest in a new fibre optic network that significantly upgrades the country's broadband and cable television capabilities. As the development of NGN access network is more the initiative of Greek government, these plans and investments are more transparent. According to announcements, it will cost **EUR 2.1 billion** and take seven years to build the network.[71] That would give at least 2 million households and enterprises access to broadband services in at least 52 cities and towns.[72] The network will offer speeds of at least 100 Mbps and provide HDTV, video telephony, quicker Internet connections and other high-bandwidth services. The network will be developed through a public-private partnership and is eligible for funding from the European Investment Bank. The international tenders will be held in the second half of 2009, with the contracts lasting 30 years. The focus of the fibre optic network would be the large urban areas. As regards the remote areas – given the topography of Greece – the emphasis would be on wireless access.

4.7. Ireland

Background information

Population	4.38 million
Fixed penetration	49.1
Mobile penetration	115.9
Fixed broadband penetration	18.7
Mobile broadband penetration	38.9
Internet users	57.0
ICT Development Index (Rank 2007)	**18**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2006, Irish incumbent operator Eircom announced plans to migrate to an NGN core network and to deploy fibre in its access network in selected urban areas.[73] The announced plans were to invest around **EUR 1 billion** over next 3 years (by 2009).[74] [75] For 2007, Eircom revealed a **EUR 60 million** investment for upgrading to NGN. The incumbent planned first to upgrade the core network and then invest in the access network. Concerning the latter, trials of VDSL2 solutions are ongoing at two exchanges and 50 cabinets. Once the results of these trials have been analyzed, the incumbent will be in a position to make the necessary investment decisions.[76]

In 2009, however, Eircom announced that it is reviewing the level of investment to its NGN as a result of the economic downturn.[77] Current Eircom's plans are to upgrade its network from copper to fibre at urban centres and regional towns throughout the country by 2011. It is also upgrading its current network to deliver speeds of 1-24 Mbps. Eircom did not however give a definite figure on investments this time.

Close to 10 percent of the Irish population subscribed to bundled offers (mostly double play) of electronic communications services in 2008.[78] This share has the potential to increase in the near future, as operators are pursuing active marketing strategies.

Regulatory developments

The incumbent's transition to NGN had already been accompanied by regulatory action in 2007, when Irish regulator (ComReg) published its position statement on regulatory aspects of NGN.[79] The purpose of this statement was to provide the industry with guidance as to ComReg's intended approach to the regulation of future wholesale products in an NGN environment. In February 2008, the market players communicated to the incumbent their expectations as to future wholesale products. The incumbent, however, will wait until the VDSL2 trials are completed before elaborating on specific wholesale products.

ComReg continues to pursue discussions with both alternative operators and the incumbent, and plans to take the NGN developments into account in its analysis of the wholesale

broadband access market. The changing economic environment has also meant that the consideration of plans for incumbent's structural separation has been suspended.

The alternative operators have urged ComReg to put in place clear rules concerning the incumbent's bundles, particularly in light of its low-priced offers. ComReg launched a public consultation on the treatment of regulated services within bundled retail offers in January 2008, but the final decision was still under consideration at the end of 2008.[80]

Besides ComReg's actions, the Department of Communications, Energy and Natural Resources published their Consultation Paper on Next Generation broadband, in July 2008.[81] The objective of this paper was to consider the challenges for the government in positioning Ireland as a leading country in the provision of broadband infrastructure and in the developments of new digital applications.[82]

4.8. Italy

Background information

Population	58.95 million
Fixed penetration	49.0
Mobile penetration	153.1
Fixed broadband penetration	18.4
Mobile broadband penetration	41.3
Internet users	38.0
ICT Development Index (Rank 2007)	**22**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Telecom Italia has completed the migration of its **core network to IP** in 2004 and has indicated this has saved them 75 percent of their operating costs.[83] [84]

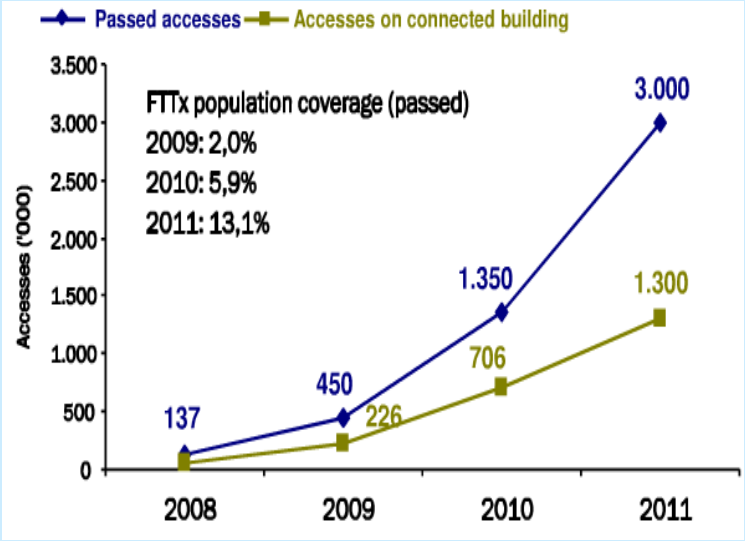
In 2006, Telecom Italia officially announced their intention to launch the migration of the access network to NGN.[85] The company stated that it would not implement an FTTH-only strategy to deploy its NGN access network. Instead, it will adopt a multi-technology strategy depending on market environment and demand using a mix of FTTH, FTTB, FTTC and VDST2.[86]

In 2007, the first announcements about the beginning of roll-out of a fibre network appeared. Telecom Italia's plans were to start in Milan, with the overall objective of covering 65 percent of the population. The network will offer a bandwidth of up to 100 Mbps compared with 20 Mbps for the current fastest ADSL service and will cost **EUR 6.5 billion** to build over a ten-year period.[87] According to the initial plan, the population coverage for fibre network (with a speed of up to 100 Mbps) would be 0.2 percent in 2007, 2.2 percent in 2008, 5.2 percent in 2009 and eventually reaching 65 percent of the population and up to 1 140 cities and towns. The population coverage for broadband with a speed of up to 4 Mbps will rise from 95 to 98.5 percent in 2009, while the ADSL2 is expected to cover 67 percent in 2009. Both ADSL offers are eventually expected to cover 100 percent of the population. The managers estimate efficiency improvements, such as the elimination of about 1 600 exchanges, will generate more than **EUR 1 billion** in cost savings by the end of the project. The financing of the NGN will stem from the group's ordinary CAPEX program.

According to the presentation of Telecom Italia at the FTTH Conference, 11-12 February 2009, Telecom Italia will continue to roll out its fibre access network regardless of the current economic downturn, while other Italian competitors have stopped fibre deployments. Telecom Italia's planned coverage by 2011 is presented in Figure 5.[88]

Figure 5: Telecom Italia, FTTx deployment, 2008-2011

FTTx passed coverage	*2008*	*2011*
Milano	18%	100%
Roma	-	70%
Torino	-	55%
Napoli	-	50%
other 16 towns	-	30%



Source: Telecom Italia, 2009

Fastweb, the main competitor of Telecom Italia, originally rolled out a fibre-optic network so that it could compete with the incumbent, but stopped once DSL became an option with local loop unbundling. The volume of its DSL subscribers soon exceeded the number of fibre customers. Fastweb's fibre network covers 2 million potential customers and it has about 250 000 customers connected through FTTH.[89] This is considered to be one of the most extensive FTTH infrastructures in Europe. Fastweb planned to launch a 100 Mbps Internet access service in Italy dedicated to small and medium-sized enterprises before the end of 2008. However, the market shares of these two Italian operators are still very unequal: in fixed access, Telecom Italia holds a 95 percent market share, and in broadband a 68 percent share.[90]

Regulatory developments

A few regulatory decisions should be mentioned here in respect to NGN:

- AGCOM (Italian NRA) has introduced an IP interconnection obligation to operators with significant market power (SMP) according to the principle of technological neutrality, temporary adopting the same PSTN economic conditions. At the same time, a working paper on IP interconnection by AGCOM has gone through a public consultation process.
- AGCOM has set a symmetric obligation to adopt the most efficient way to interconnect networks and allow the interoperability of VoIP services.
- AGCOM has introduced the obligation for operators to give access to their technical interface/protocols and to all the technologies necessary to allow interoperability of VoIP services. Standard protocols should be adopted whenever possible.

In addition, a new law was approved in Italy in 2008 stating that fibre networks are strategic primary infrastructures, and therefore they can use existing public ducts.

Another important and interesting issue concerns the process of implementation of functional separation in Italy. In 2002, AGCOM released a decision introducing the concept of

“administrative separation”. [91] The aim of this separation was to allow non-discriminatory access to the network services offered by the SMP operator, Telecom Italia. Telecom Italia’s response to this decision was to establish separate commercial units - TI Retail and TI Wholesale.

More recently, there have been moves towards a more hands-on regulatory model. In May 2007, a public discussion document was published by AGCOM and the Italian Ministry of Communications in relation to functional separation, along with a proposed supplement to the Italian Electronic Communications Code that would allow AGCOM to impose functional separation on an SMP operator as a last resort in the event of all other forms of regulation being unsuitable.[92] The EC wrote a letter to AGCOM, following the announcement of plans to separate the incumbent's network access unit. The letter complained that the regulator had broken with procedure by giving implied approval to the separation, without first notifying the Commission.

In February 2008, Telecom Italia announced that it would establish a new unit, to be called Open Access. The new unit would be completely autonomous and separate from Telecom Italia’s other commercial operations. It will form part of a new division called Technology and Operations. Apart from Open Access, the new division will also have a network branch to design and build a modern network, an information technology branch, and a technical infrastructures branch for real estate, plant and facilities management. [93] It is a "voluntary" corporate restructuring, developed with the approval of AGCOM.

This in fact might be seen as something similar to the separation of BT's operations in the United Kingdom.[94] Indeed, although both promise to offer equal access to an incumbent's fixed network, Telecom Italia's Open Access will be structurally different from BT's Openreach because unlike the latter, Open Access will not have a separate, independent board.[95]

4.9. Latvia

Background information

Population	2.27 million
Fixed penetration	28.3
Mobile penetration	97.4
Fixed broadband penetration	6.4
Mobile broadband penetration	2.4
Internet users	55
ICT Development Index (Rank 2007)	**36**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In Latvia FTTH access solutions have been deployed by both the fixed incumbent and some alternative network providers in some pilot sites in cities, in particular in new build sites. If these initial deployments turn out to be successful, the fixed incumbent could launch broader fibre deployments later on in certain densely populated residential areas.[96]

At the beginning of 2009, Latvian incumbent Lattelecom announced plans to roll out a new fibre optic broadband network under its '*Network of the Future'* project to provide new services, including HDTV.[97] The fibre optic network is expected to initially deliver speeds up to 100 Mbps, with the operator claiming this would increase to 500 Mbps by the end of 2009 or early 2010. Lattelecom has completed a pilot project of 100 Mbps FTTH in the Zolitude district of Riga and hopes to replace most of the DSL network in Latvia with FTTH in three years.[98]

In April 2009, alternative operators IZZI and Baltkom started offering cable Internet with speeds of 100 Mbps in parts of Riga.[99] Both Baltkom and IZZI are offering combined Internet and digital cable packages.

The fixed incumbent's broadband market share has increased over the past year to reach 46.4 percent in January 2009 compared to 44.2 percent a year ago. It ranges from a relatively small share in Riga, which is due to the significant infrastructure-based competition, to a much higher share outside the capital, where the incumbent's DSL lines remain the dominant infrastructure. The main broadband competitors are ISPs and cable operators. It is estimated that in Riga the residents of multi-apartment buildings would normally have a choice between three to four alternative broadband providers and price competition is accordingly strong.[100]

Regulation

There are specific broadband market conditions in Latvia where it remains relatively easy and cheaper for alternative operators to duplicate infrastructure. For example, according to estimates made by some operators, it is possible to recover the costs of a broadband network in a densely populated urban area within three years.

SPRK (regulatory body in Latvia) is nevertheless concerned about the lack of interest in unbundled local loop (ULL) and wholesale bitstream products by alternative operators which is why, in September 2008, it issued a consultation document concerning the fixed incumbent's reference offers for unbundled access to local loop and broadband access, as well as concerning terminating segments of leased lines and the minimum set of leased line markets, in which regulatory remedies were also imposed in 2007. In this document, the SPRK announced that it will use the feedback from this consultation to analyze and, if necessary, to make amendments to these reference offers.

4.10. Lithuania

Background information

Population	3.37 million
Fixed penetration	23.6
Mobile penetration	145.2
Fixed broadband penetration	15.0
Mobile broadband penetration	4.5
Internet users	49.0
ICT Development Index (Rank 2007)	**33**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

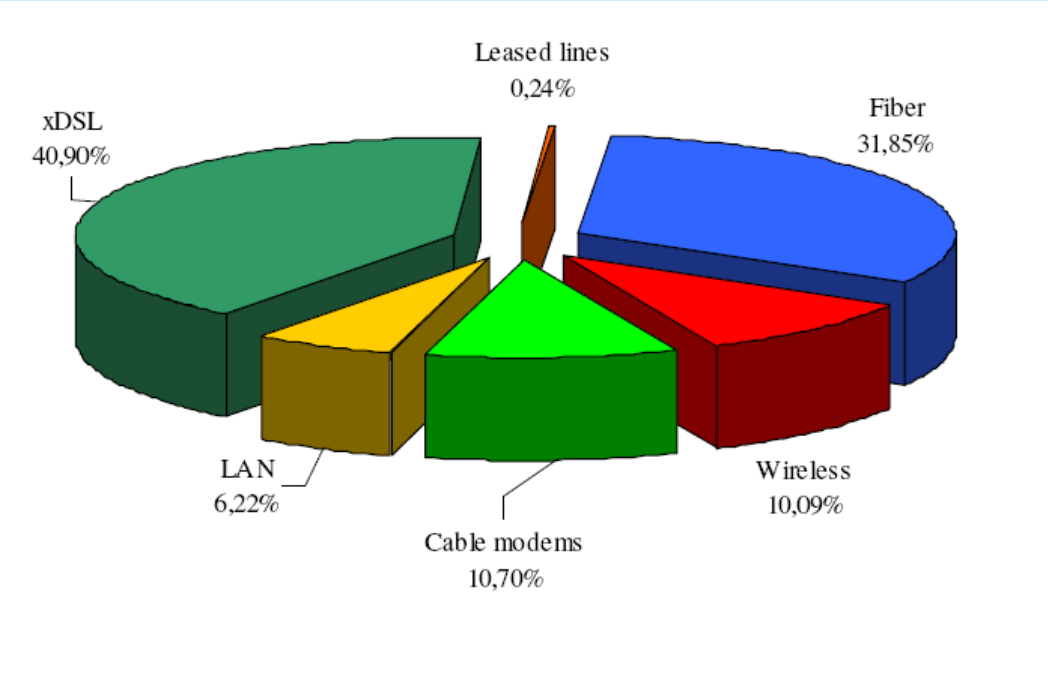
Market developments

Lithuanian incumbent operator TEO LT completed the deployment of a MPLS-based IP core network in 2003. By deploying a MPLS-based IP core network it aimed to respond to rapidly increasing demand from customers for high-speed Internet access and data connectivity in Lithuania. In the future, this core 10 Gbps routing infrastructure will help underpin next-generation services such as video content delivery.[101] According to TEO LT, the backbone network upgrade has improved reliability as it is structured according to different customer needs and features redundant network nodes. Investments in the upgrading of the backbone network amounted to more than **LTL 30 million (EUR 8.7 million)**, and since the beginning of 2006, TEO LT has also invested about **LTL 10 million (EUR 2.9 million)** in data centers.[102] The upgrading of the core part of the network was fully completed in 2007.[103]

In 2007, TEO LT announced its FTTH project. According to TEO LT, it is one of the most important network modernization projects of the company. Over three years, it will invest more than **LTL 100 million (EUR 29 million)** in the new optical access network and roll out a network capable of 1 Gbps to the home. In general, optical fibre is installed up to a building's inlet box from which copper cables are installed to individual apartments. Due to their physical characteristics, such copper cables limit the speed of data communication, and TEO LT will eventually install optical fibre up to the user's apartment – that will provided the customer with speeds up to 1 Gbps. The fibre network will provide users with the possibility of enjoying high-quality services through a single Internet access line: to make telephone calls, to watch digital TV, to browse the Internet, and to send video records simultaneously. Initially, TEO LT plans to offer residents of the five biggest cities in Lithuania the opportunity to use the advantages provided by the fibre network. In Vilnius the provision of fibre access was launched in June 2007.

As noted by ECTA, a number of new EU member states such as Lithuania and Estonia are leapfrogging legacy copper technology by installing fibre access lines.[104] In the first quarter of 2009 almost 32 percent of all broadband connections were based on fibre technologies in Lithuania (See Figure 6), with 170 300 subscribers connected via FTTB and 22 900 via FTTH.[105]

Figure 6: Fixed broadband connections by technology in Lithuania, I quarter of 2009

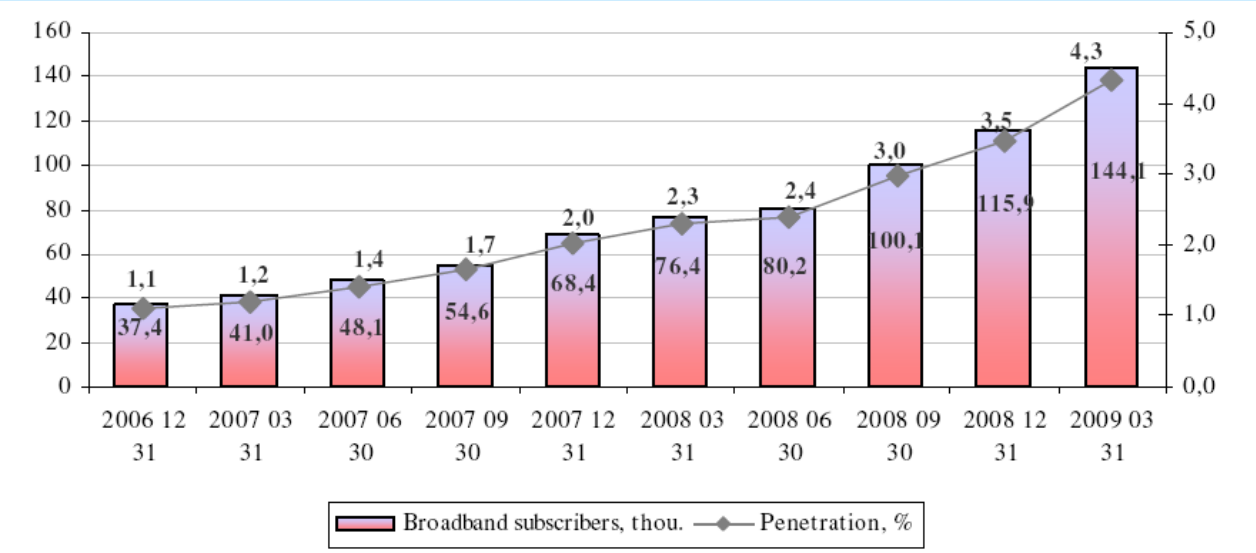


Source: RRT, Report on the electronic communications sector, IQ 2009.

In September 2007, three companies received licences to use the 3.5 GHz spectrum band for wireless broadband access. By May 2009, one of them – LRTC, a broadcasting service provider, had expanded its coverage to five cities in Lithuania with its WiMax network. LRTC expects more than 100 000 subscribers to use its WiMax service by early 2010.[106] The other two companies are also investing in WiMax network developments.

All three mobile operators in Lithuania have extensive coverage of 3G (HSDPA) services and the number of mobile broadband subscribers is constantly increasing (See Figure 7).

Table 7: Dynamics of mobile broadband subscribers in Lithuania



Source: RRT, Report on the electronic communications sector, IQ 2009.

Regulation

Some discussions between RRT (Lithuanian NRA) and the incumbent as regards the future regulation of NGN are already ongoing, but no thorough public debate has been initiated yet. RRT considers that any launch of a national debate should await the conclusion of discussions at the level of the European Regulators Group (ERG).[107]

At the end of 2008, RRT published its guidance on VoIP regulation. The purpose of this paper was to provide the industry with guidance of regulation of VoIP services and to get the industry's feedback. A public consultation was launched from December 2008 up to February 2009. The revised version of the guidelines is under preparation.

It should be noted, that the first phase of roll-out of the publicly funded rural fibre backbone network (called RAIN - Rural Area Information Technology Broadband Network) was completed in 2008. RAIN is a phased broadband infrastructure development to bring broadband to Lithuanian municipal offices, citizens, and enterprises in under-served rural areas.[108] The initial market reaction appears to be positive: much fibre, amounting to approximately 7 000 km in total, is already rented. The network is operated on a wholesale basis only, and is open to access by operators. Two municipal broadband projects were also launched in 2008.[109] The objectives of the second phase (2007-2010) of the project are to connect 100 percent of public administration institutions and to create possibilities for small and medium-sized enterprises and residents to connect to broadband networks within 98 percent of the territory of Lithuania, i.e. to create the missing infrastructure, which would provide broadband services for existing and new operators. Planned investments for the second phase stand at **EUR 72.5 million**.[110]

4.11. The Netherlands

Background information

Population	16.45 million
Fixed penetration	44.7
Mobile penetration	117.5
Fixed broadband penetration	33.5
Mobile broadband penetration	13.4
Internet users	84.0
ICT Development Index (Rank 2007)	**4**

Source: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

At the end of 2005, KPN announced that over the next few years it wanted to migrate its network to a NGN. The migration to a NGN is intended to give KPN a cost-effective broadband IP network that will allow it to provide better services. KPN's plans included the realization of unbundled access at the street cabinet level. KPN also planned to phase out almost all of its main distribution frames (MDF) locations. KPN called this operation the migration to 'all-IP'.

KPN predicts that replacing existing infrastructure with a new, IP-based one will cost between **EUR 1 billion and EUR 2 billion** on top of its regular CAPEX (EUR 1.7 billion in 2004). KPN did not put a definite date on when the migration will be complete, nor when it will turn off its PSTN. KPN also announced that it would start IP Multimedia Subsystem-based (IMS) voice services over broadband from early 2007. The development is part of KPN's **EUR 1-1.5 billion** spend on its all-IP network, to be completed by 2010.

However, KPN also reckons that by 2010 it will be able to cut EUR 850 million from its 2005 operating expenditure level of EUR 9.65 billion, as shown in the table below. [111]

Table 3: Saving from NGN

Phase	Year	OPEX savings per year	Cumulative OPEX savings
Phase 1: All IP Backbone	2005	150 million EUR	150 million EUR
	2006	150 million EUR	300 million EUR
	2007	150 million EUR	450 million EUR
Phase 2: All IP Access Network	2008	200 million EUR	650 million EUR
	2009	200 million EUR	850 million EUR

At the time of the KPN initial planning (in 2005), Reggefiber, an optical fibre company, was founded to provide open-access fibre networks across the Netherlands. It was a stakeholder in several local initiatives in the Netherlands (such as OnsNet and AlmeerNet) and also operates its own network, Glashart. In 2007, KPN announced that it was going to move its customers to Reggefiber's network. A year latter, in May 2008, KPN announced plans to take a 41 percent shareholding in Reggefiber. This indicated that KPN was considering a move from an FTTC/VDSL to an FTTH strategy.

In December 2008, the Dutch competition authority approved the KPN-Reggefiber joint venture on condition that it practices maximum wholesale fees for FTTH unbundling in the range of 14.5 – 17.5 EUR/month (depending on geography) with an annual uplift to reflect inflation.[112] KPN became one of the companies offering services over the open access network. Shortly after that, operators announced that KPN and Reggefiber are planning to roll out FTTH services across the Netherlands, with investments that could reach **EUR 6–7 billion** in an FTTH network which will cover the vast majority of the Netherlands over the next five to seven years.[113]

The evolution of the KPN network has motivated the main Dutch cable operators to announce pilot developments of moderate scope: 40 000 homes in Amsterdam using Docsis 3.0 and 10 000 homes passed in Baxmeer using FTTH P2P.[114]

It is important to notice that the Netherlands has also benefited from innovative municipal involvement in fibre roll-outs, particularly in Amsterdam and Rotterdam. The sector has also been characterized by the wide range of non-telecommunications operator activity, including the direct involvement of construction companies, individuals digging their own trenches, real estate investors and pension funds. Given these collective efforts, the Netherlands has shown than FTTH can be developed through the initiative of players other than the major telecommunications operators and cable operators. For instance one of Amsterdam municipality GNA, offering open access, plans to cover 420 000 homes by FTTH, investing **EUR 300 million** by 2013. The Portaal Housing Association plans to reach 130 000 homes by FTTH and it is also offering open access to its infrastructure.

The developments of FTTH in the Netherlands have shown the arrival of a new kind of market entrant: real estate financers investing in networks. The first entrant was ING Real Estate, who, together with Reggefiber, five housing corporations and the municipality of Amsterdam, invested in Glasvezelnetwerk Amsterdam (GNA). Another new player was Rabo Bouwfonds Dutch Communication Infrastructure Fund (RBCIF) a fund established by Bouwfonds Asset Management, the real estate division of Rabobank. RBCIF recently acquired CAIW, a cable operator, which constructed a pilot FTTH-network in 2006 to 700 homes. The arrival of Real Estate financiers was a new phenomenon.

To sum up, at present, the Netherlands seems to be well positioned to maintain its rank as European broadband leader.

Regulatory developments

In 2006, the Dutch independent post and telecommunications authority (OPTA) published its position paper on all-IP. At the beginning of 2007, OPTA called on KPN to produce a solution, acceptable to all parties involved, for KPN's proposed phase-out of MDF Access as part of its all-IP plan. OPTA encouraged KPN and alternative operators to reach a negotiated solution regarding MDF switch-off.

This call was answered by KPN by starting discussions with the three largest MDF customers. This resulted in three signed Memoranda of Understanding (MoUs) on 13 July 2007. The MoUs contain conditions under which MDF customers are willing to co-operate with moving

out of the MDF locations. One of these conditions is that KPN will maintain MDF access for coverage of 50 percent of Dutch households. Another condition is that KPN will develop an adjusted wholesale broadband access offer, which gives other parties the opportunity to continue their MDF Access business model.

In November 2008, OPTA issued a consultation document entitled "Tariff Regulation for Unbundled Fibre Access – Policy Rules"[115]. These policy rules contain the policy principles that the OPTA drafted for the price regulation of unbundled fibre. The key elements encourage investment and foster competition. OPTA puts forward regulatory principles, as well as tangible one-off and monthly maximum fees (e.g. monthly rental 14.5 -17.5 EUR per FTTH fibre pair), for the Optical Distribution Frame access (ODF-access) offer and related facilities (co-location, backhaul) of the envisaged Reggefiber-KPN joint venture.

OPTA also proposed that the Reggefiber-KPN joint venture would be included in the KPN designation as the operator with SMP in the market of wholesale network access at a fixed location. KPN and Reggefiber have opposed OPTA's proposed SMP finding, although they publicly committed to providing voluntary fibre access.[116]

In December 2008, the Dutch Competition Authority (NMa) approved the KPN-Reggefiber joint venture on condition that it practices maximum wholesale fees for FTTH unbundling in the range of 14.5 –17.5 EUR/month with an annual uplift to reflect inflation.[117] Some of the conditions required from the Dutch regulator and NMa to include a guarantee that other operators have non-discriminatory access to the network at a fixed wholesale rate.

4.12. Norway

Background information

Population	4.37 million
Fixed penetration	42.4
Mobile penetration	110.5
Fixed broadband penetration	30.6
Mobile broadband penetration	21.7
Internet users	85
ICT Development Index (Rank 2007)	**6**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2005, the Norwegian incumbent Telenor announced that it has started upgrading its broadband network to a Next Generation IP MPLS network in order to meet increased demand for integrated data, voice and video services (triple play).[118] Telenor is upgrading its entire network to a new network, including the distribution, access and core. The core network will be changed into a pure IP network by 2010. Unfortunately, the amount of investment has not been made public.

In 2007, Telenor unveiled plans for its major FTTH and IPTV-related investments, which have since begun.[119] In the second half of 2007, Telenor selected a preferred supplier for advanced broadband access solutions, encompassing FTTH as well as FTTN and VDSL2.[120] This allows the operator to cost-effectively transform its access network - in line with its "all-IP" strategy. Initial deployments are expected by the end of 2007, and will be extended later to other Telenor affiliates. Telenor has announced its intentions to use a mix of PON, DSL, and WiMax to reach the country's 4.6 million inhabitants.[121] The operator is rolling out fibre-based access in Norway's main cities to keep up with its smaller rivals and deliver entertainment services that they hope will help to reduce churn and deliver extra revenues. The carrier is also investing in VDSL2-enabled DSLAMs where fibre to the home is not appropriate.[122]

According to the FTTH Council, Norway was one of leading countries in the world for FTTH penetration, with around 9 percent of household's at the end of 2008. Many initiatives in Norway have led this country to this position.

It is mainly power utility companies that are driving investment in fibre networks in Norway:

- Two power utility companies – Alta Kraftlag and Varanger Kraft – have deployed FTTH networks. The two deployments together cover an area of 48 649 km. Alta currently has a fully operational triple play network, while Varanger has an open access, enabling multiple providers to compete over the same network and giving users ultimate choice.[123]
- In May 2007, PacketFront, a provider of open-access FTTH broadband networking, signed a contract with Norway's largest power utility company, Hafslund, to build an open-access FTTH network in Ostlandet, an area around Oslo. In the first stage, Hafslund have agreed to offer IPTV and other broadband services to selected

cooperative housing areas in Oslo.[124] In terms of population, the region of Ostlandet contains about 50 percent of the 4.6 million inhabitants of Norway.

- Lyse Tele, the local energy corporation, is rolling out an FTTH network in Stavanger (population of 110 000). Although, as PointTopic explained in April 2007[125]: "*When households in the city of Stavanger in Southwest Norway want to get broadband from Lyse Tele, they have two options: either to wait until the engineers dig a trench for them or do it themselves. An amazing 80 percent chose to get out their shovels and dig their own. Lyse Tele's broadband services, like many of its kind in Scandinavia and the Netherlands, are special. They are fast, symmetrical and cheap. Monthly prices for stand-alone service range from as little as USD 26.50 to USD 31.00 for a symmetric 10 Mbps FTTH broadband service. They are delivered over optical fibre, and no longer use copper wires.*"

Lyse Tele was the first broadband operator to launch triple-play offers comprising high-speed symmetric broadband internet, IPTV and IP telephony services in Norway. Lyse Tele has established a franchise concept, Altibox, which currently comprises 34 partners from different regions of Norway, as well as one from Denmark. Altibox partners are owned by local or regional energy companies. As of November 2008, Altibox had connected 120 000 FTTH customers.[126]

In 2008, broadband network operator Asker og Bærum Fibernett announced its plans to build open access fibre networks in the municipalities of Asker and Bærum on the outskirts of Oslo.[127] The project aims to connect up to 50 000 homes in the next four to five years.

Beside fibre, other NGN access technologies are intensively being deployed in Norway:

- Mobile operator Telenor is upgrading its existing WCDMA 3G network in Norway with High Speed Downlink Packet Access (HSDPA) technology. With HSDPA, data can be transmitted through the mobile network at speeds up to 14 Mbps. The initial upgrade at Telenor supports up to 3.6 Mbps.
- Norwegian cable operator Get is using its IP NGN technology to upgrade its network to support accelerating broadband traffic demand.[128] Get is the second major cable operator in Europe to deploy EuroDOCSIS 3.0 downstream channel-bonding technology. The upgrade supports the delivery of broadband services to 380,000 homes in Norway and will make it possible for Get to develop bundled services combining video, data and voice over a single ultra-high bandwidth broadband connection.

Regulatory developments

No specific regulation with regards to NGN is introduced in Norway, as the Electronic Communications Act is supposed to be technology neutral, and NGNs are therefore not regulated any differently to other technologies.[129] The majority of operators offer an open access, while opening the network for others to provide services.[130]

However, as it is noted in an ERG case study, the NPT (Norwegian NRA) has a continued dialogue with the incumbent and other stakeholders in this field and will continue to exchange information/views with regard to the future of NGN.[131] According to a NPT presentation made in September 2008, the regulation of NGN should bear in mind the Internet tradition of openness and neutrality and principle of minimum regulation.[132]

The principle of technological neutrality is also embedded in the policy of regulation of VoIP services in Norway. VoIP service offerings that are designed for any-to-any communication and are publicly available are considered to be publicly available telephony services. Therefore,

these VoIP services are subject to all obligations to which providers of electronic communication services and publicly available telephony services are subject under the Electronic Communications Act and the Regulations on Electronic Communications Networks and Services.[133]

The aim of the Norwegian Government is to ensure that everyone in Norway, regardless of where they live, have access to broadband. By 2005, this policy resulted in broadband being available to around 95 percent of the population. However, the importance of the issue now is to stimulate demand and get “people on line”. The Government recognizes that there are some small local communities where the total demand is too small to attract market investment in infrastructure, in which case some direct funding may be required.[134]

4.13. Poland

Background information

Population	38.02 million
Fixed penetration	27.1
Mobile penetration	108.7
Fixed broadband penetration	9
Mobile broadband penetration	29.3
Internet users	44
ICT Development Index (Rank 2007)	**39**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market development

In 2002, the Polish incumbent Telekomunikacja Polska (TP) contracted a technology provider to provide NGN technology valued at **EUR 20 million**.[135] This means, that TP started to upgrade its core network to NGN relatively early. While Netia, Poland's largest alternative fixed telecommunications provider, started to introduce IP solutions as the basis for the countrywide deployment of its next-generation core network in 2007.[136]

In January 2008, TP started to first move in the direction of fibre access network development. Due to cooperation with one of development companies, TP Group has installed an optical fibre infrastructure in a new building in the Wola district in Warsaw. This made it possible to activate the TP multipackage together with the 50-10 Mbps Internet access. [137] In September 2008, the incumbent published a strategy on the subject, estimating the cost of necessary investment at between **PLN 14 and 28 billion (approximately EUR 4.1 and 8.2 billion)**, and pointing out that future investment will depend on cooperation with public authorities. TP asked for changes in the regulatory policy (no functional separation for example and a geographical approach to competition issues) and more government involvement (tax policy, public-private partnership/ventures, e-government services, more effective use of EU funds) to support development in telecommunication services. According to TP, the main barrier to broadband access development is not the level of retail prices but the lack of proper infrastructure. From 2009 to 2011 within the framework of a "broadband partnership", TP will invest **EUR 400 million** in passive optic networks. TP has also presented data showing that the amount of data transferred over the fixed network had risen threefold in the previous 24 months, and quadrupled over the mobile network.[138]

Some alternative operators also announced their readiness to upgrade technologies or invest in fibre networks, taking advantage of the availability of EU funds.

Bundled offers were becoming more common as operators entered new markets in order to offer additional services. However, double-play remained the favorite choice as price was a determining factor.[139]

Regulatory development

As no substantial developments in NGNs were taking place in Poland, the regulatory approach to NGN is not clearly defined. In October 2008, UKE (Polish NRA) published an expert opinion on TP's policy document on supporting telecommunications investment for 2008-2011.[140] Based on this opinion, the President of UKE then presented an opinion for consultation on the building and operation of NGN in Poland.[141]

4.14. Portugal

Background information

Population	10.66 million
Fixed penetration	39.5
Mobile penetration	126.6
Fixed broadband penetration	14.4
Mobile broadband penetration	29.3
Internet users	40
ICT Development Index (Rank 2007)	**31**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market development

It has to be mentioned, that detailed information on technological evolution of the PT (Portugal Telecom) group is scarce. In 2005, PT selected a technology supplier to implement a NGN IP network. The incumbent has conducted a test on FTTH but claims that its investment in fibre deployment should be subject to more favourable regulatory treatment.[142] The President of Portugal Telecom has stated that the company will not start investing in a fibre-based NGN without receiving guarantees from the relevant regulatory bodies that it will be not be forced to open the network to competitors. The move follows similar - and successful - demands from UK incumbent BT. Portugal Telecom reached 312 000 subscribers for its pay-TV service 'Meo' (delivered via IPTV, satellite and mobile) by the end of 2008, adding 110 000 customers in the last quarter of the year alone.

Things have changed, however, after the Portuguese government announced its commitments to develop NGN networks. FTTx projects are happening faster than expected in Portugal, where a high level of competition, government broadband goals, and an effective duct-sharing policy have helped set off a wave of deployments. Increasing CATV competition has become an important catalyst:

- Sonaecom, a leading alternative carrier, began deploying FTTH networks early this year saying that it will pass more than 1 million homes over the next three years and invest **EUR 240 million** by 2010 in a new FTTH network, over which it plans to deliver its IPTV service as well as other services. [143]
- DSTelecom has announced plans to invest **EUR 400 million** over five years in the construction of an open access fibre-optic network. The network, which will cover more than 50 municipalities, is being deployed in partnership with the state, as part of the government's commitment to the development of next generation networks. Portugal Telecom, Zon, Sonaecom and Oni-Communications are also deploying networks as part of the same initiative.[144]
- Another strong player is ZON. Two cable companies recently acquired by ZON have passed more than 100 000 homes with FTTH.[145] The number of wireline and wireless broadband subscribers is increasing. There are 1.5 million fixed broadband subscribers

in Portugal and 1.7 million mobile broadband subscribers. ZON alone has 2.8 million homes passed with a hybrid fibre/coax (HFC) network and 1 million cable TV subscribers in Portugal's major cities. These networks have been upgraded to deliver broadband services.

It is also known that TV Cabo, Portugal's largest pay-TV operator, started to upgrade its national network in 2006 to offer ultra-high-speed broadband, VoIP and HDTV.[146] TV Cabo has strongly invested in the improvement of the network (fibre optics and coaxial cable). According to the Executive Chairman of PT Multimedia, since 2002, TV Cabo has made investments of over **EUR 450 million**. These investments allowed for the improvement of client services, the increase of Internet traffic limits, the introduction of new contents and functions in the television service, and allows to offer a triple play service including telephony. Approximately 80 – 90 percent of the TV Cabo network is capable to offering voice service.[147]

Regulatory development

The following actions taken by ANACOM (NRA of Portugal) can be listed:

- A study on the implementation conditions of the NGN in Portugal[148]
- A public consultation on Next-Generation Access Networks[149]
- The regulatory approach to VoIP was approves in February 2006. It includes a chapter dedicated to interconnection, including IP.[150]

However, probably the most important and interesting initiative took place in Portugal in January 2009, when a protocol on NGNs was signed between the Government and four main telecoms operators, Portugal Telecom, Sonaecom, Zon and Oni Communications.[151] This is an agreement that shows the commitment of all parties to investing in NGNs. In the scope of this agreement, "the Government is committed to opening ducts for NGNs, to regulating networks, to maintaining a centralized information system and to providing a line of credit with a minimum of **800 million Euro**".[152] Prime Minister Jose Socrates announced the funding, saying he hoped the country's main telecoms operators would invest **EUR 1 billion** to build NGNs during 2009. This is the first step in a **EUR 2.18 billion** plan announced in December 2008 to boost the country's economy.[153] The protocol signed is open to every telecoms operator wishing to invest in these networks and aims to take NGNs to around 1.5 million homes by the end of 2009.

However, some operators are still holding back on their plans to invest in fibre networks. Vodafone Portugal considers that, in its particular case, all the required conditions to invest in NGNs in Portugal are not yet met and therefore is not yet willing to sign the protocol. Vodafone Portugal will continue to monitor the evolution of NGNs' regulatory and competitive context. Furthermore, Vodafone Portugal will continue to explore the possibility of creating a shared NGN investment with other operators, namely with those that have signed the protocol, not excluding the possibility of later signing it.[154]

4.15. Romania

Background information

Population	21.34 million
Fixed penetration	19.9
Mobile penetration	106.7
Fixed broadband penetration	9.1
Mobile broadband penetration	4.9
Internet users	24
ICT Development Index (Rank 2007)	**46**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In Romania, competitive pressure from cable television operators has led the incumbent (Romtelecom) to move towards NGN.[155] Romtelecom follows in the footsteps of other major European incumbents and has initiated the deployment of NGN. In this respect, Romtelecom promised to invest **EUR 500 million** in a NGN, if the evolution of the regulatory framework will allow a reasonable return on investment.[156] According to Romiania's contribution to the GSR consultation on NGN migration, Romtelecom in 2005, made public its investment plans to migrate to NGN, but did not disclose detailed information on the migration. According to incumbent's public statements, it might invest **half a billion EUR** over a three year period for the migration to NGN (no details on the investment allocation between NGN core and access networks).[157]

Initial steps have already been taken with approximately **EUR 300 million** invested in the infrastructure during the last three years.[158] Romtelecom launched its ADSL service for residential customers in May 2005. With regards to the telephony infrastructure, in 2007 Romtelecom managed to achieve countrywide digitalization of its network.

Vodafone Romania (mobile operator) announced in October 2007 that it would migrate towards a fully IP-based core network and planned to complete the migration by April 2008. When the process is completed, Vodafone Romania are going to use a common IP-based core network for all its services - 2G, 3G, fixed voice and fixed data.[159]

In 2008, the incumbent operator announced the implementation of an IP NGN core network. The incumbent also started the provision of VoIP origination services to other national and international networks, and bi-directional VoIP services to and from other users of its network, both VoIP and PSTN. The objectives of Romtelecom NGN core implementation include the replacement of analogue and small digital exchanges with access nodes, consolidation and optimization of the switching network, while avoiding making investments in non-upgradeable legacy assets. In the future, Romtelecom will start using the IP-based network to provide voice services, but no IP interconnection is likely to become available in the short term. With regards to the access network, the incumbent plans to reduce the length of local loops to less than 1km, and to increase the number of broadband enabled lines and the number of ADSL lines.[160]

According to a EC report, fibre connections represent 3.9 percent of the Romanian broadband retail market and fibre continues to be rolled out. Although not yet representing a significant market share, the approximate 89 000 FTTH lines is the fifth largest in the EU in absolute terms.[161]

Regulatory developments

In 2006, the National Authority for Comminications ((ANC) the former – ANRCTI) created a working group to analyze local loop unbundling (LLU) issues in Romania. It studied various possibilities for viable access to optical network units (regulated backhaul transmission services, dark fibre and duct sharing) and alternatives (such as regulated bitstream services). The introduction of a regulated bitstream market was found to probably be the best alternative to ensure some level of competition on the (shortened) local loop in the current regulatory framework. However, bitsteam access is still unavailable.

In 2006, considering the fact that some of the Reference Unbundling Offer (RUO) provisions did not comply with the ANRCTI LLU regulation and the slow take-up of the LLU services, ANRCTI revised the general LLU framework.[162] ANRCTI imposed on Romtelecom specific obligations regarding the announcement of planned changes in the access network to:

- notify the alternative operators any modification of its network that might affect the retail services offered by the alternative operators, including the removal of an MDF, not later than 12 months before carrying out that modification;
- publish and update every quarter the plans for modernization of the access network (including deployment of ONUs) at least 12 months before proceeding to modify of the access network.

4.16. Slovak Republic

Background information

Population	5.39 million
Fixed penetration	21.4
Mobile penetration	112.6
Fixed broadband penetration	8.8
Mobile broadband penetration	3.6
Internet users	56
ICT Development Index (Rank 2007)	**38**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In December 2004, Slovak Telecom (incumbent operator) completed the digitalization of its network by deploying the NGN core technology. In principle, the construction of the NGN represents the final stage of gradual development and integration of technologies for voice, data and multimedia services. By the end of 2004, the initial phase (first 150 000 customers) of overall migration of its current platforms (with 1.2 million customers) into NGN was finished.[163]

The Slovak Telecom NGN concept is based on a progressive evolution to end-to-end "all IP". It has been designed in such a way as to be able to provide all types of emerging multimedia services and to keep existing services at the same time. The strategy of partial PSTN replacement and overlay was chosen by Slovak Telecom. In the beginning of 2009, Slovak Telecom covered about 30 percent of households with broadband and was aiming to achieve 40 percent this year, including 300 000 households connected by fibre.[164]

The largest mobile operator, Orange Slovensko, is rolling out FTTH infrastructure as well. It intends to invest approximately **SKK 1 billion (EUR 32 million)** on FTTH network in Slovakia that will cover almost 200 000 households in 10 cities.[165] The coverage achieved by the operator in November 2008 was reported to be 265 000 households (approximately 15 percent of households). Triple-play services are offered over its NGN (broadband, fixed voice and IPTV). Additional areas might be covered using LLU in the future. There has been no agreement concluded on duct sharing for NGN deployment between Orange Slovensko and the fixed incumbent operator.[166]

The number of providers offering bundled services has risen to nine for triple-play services (fixed voice, broadband and TV), and 17 for double-play services. [167] These developments reflect the increasing efforts by local cable operators to offer broadband and fixed voice services.

Mobile broadband services have started to play a role for broadband access. It appears that some customers regard mobile broadband services as a substitute product for fixed broadband access (especially those living outside main urban areas). Mobile operators note intensifying competition between 3G offers with a trend towards increasing speed levels and declining retail prices. However, the development of 3G infrastructure has been limited. The new entrant is testing 3G on a small scale using basic UMTS technology.[168] It should be noted that broadband

access in rural areas is in some instances also available via other technological means, such as mobile broadband and WiMAX services.

In terms of various platforms, DSL has 55.9 percent of total fixed retail lines, wireless local loops (WLL) 13.9 percent, FTTH 11 percent and cable 10.5 percent. DSL is still the technology with the highest net subscriber gain, followed by FTTH and cable.[169]

Regulatory developments

The regulatory approach to NGNs is not yet defined in the country.

However, the project called SANET should be noted. The aim of the SANET project is to build up a gigabit network for the Slovak academic and research community with the connection to a trans-European gigabit network and global Internet. The project is financed by the Slovak government. The value of the project is around **EUR 7 million (SKK 280 million)**.[170]

4.17. Slovenia

Background information

Population	2 million
Fixed penetration	42.8
Mobile penetration	96.4
Fixed broadband penetration	17.2
Mobile broadband penetration	13.8
Internet users	53
ICT Development Index (Rank 2007)	**28**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Slovenia is one of the top European countries in terms of FTTH deployment. It is important to mention that two national wide FTTH networks are being rolled out at the moment, one by Telekom Slovenije and one by largest alternative operator T-2, which is also offering VoIP, IPTV and the Internet. Telekom Slovenia is moving from TDM transport to IP transport in its backbone and access networks, but at the moment still using both (TDM and IP).

However, Telekom Slovenia has embarked upon a fibre build programme ("F2") that aims to achieve coverage of 70 percent of the population by 2015. The programme is a key part of Telekom Slovenia's strategy to compete with new entrants and cable operators. Estimated cost of F2 is **EUR 450 million**, which is being part-funded by a EUR100 million loan from the European Investment Bank – the loan is also being used to fund xDSL and WiMAX roll-out to areas beyond the FTTH coverage.[171] The company planned to spend **EUR 50 million** in 2007, taking fibre to 50,000 homes in Slovenia's main cities, running new cables through its extant ducts for the initial phase of the rollout.[172] An earnings report of the 1st quarter of 2007 from Telecom Slovenia revealed some details about an FTTH roll-out: fixed line and broadband investments in the first three months of 2007 included the construction of a FTTH network; in April the first subscribers were connected, and the operator says it is aiming for 300,000 FTTH customers in 'the medium-term'.[173]

T-2 FTTH speed ranges from 10 Mbps (EUR 14/month), 20 Mbps (EUR 28/month) up to 1 Gbps (EUR 1 000/month). Telekom Slovenije offers FTTH speeds from 20 Mbps (EUR 26/month) upward. Currently FTTH is being built by Gratel as well.

Actually, European countries with little copper legacy are doing their best to bypass the old access technologies and going straight to fibre. This is especially true in the case of smaller nations – like Slovenia. The number of FTTH lines continuously grows in Slovenia, and stands at approximately 45 000 lines, which is one of the best relative performances in the EU.[174]

Regulation

As far as NGN issues are concerned, APEK (NRA of Slovenia) has been among the first NRAs in Europe to include termination of VoIP calls in the definition and analysis of the market for call termination on fixed networks.[175] In 2008, the NRA successfully resolved the issue of discriminatory rates for the termination of IP traffic on the incumbent's network. The incumbent has since been charging the same amount for traditional TDM-based and IP-based termination.

Currently, APEK is preparing the analysis of the markets for physical access infrastructure and wholesale broadband access, whereby it will also analyze the impact of FTTH and other modern access technologies on the relevant competition conditions.[176] In the absence of dark fibre backhaul regulation, for a majority of the market players, access to many locations, due to the high level of fibre wholesale prices, is off-limits.

According to APEK's October 2007 decision on the wholesale broadband access market, the SMP operator has an obligation to provide access to alternative operators in a manner that will allow functional IP telephony, IPTV and video on demand (VoD), in view of the fact that the same services have been provided to the customers by its retail unit. Furthermore, based on a complaint by an alternative operator, APEK mandated the incumbent, *inter alia*, to replicate its upper frequency-band bitstream product, which was offered to its retail unit. Naked DSL offered at a price of retail minus up to 66 percent plus a surcharge for the lower frequency band of the local loop thus became a part of the reference bitstream offer as of November 2008.

In July 2008, the Slovenian government adopted a new broadband strategy, setting out broad political goals to be achieved as soon as 2010. One aim of the strategy is to ensure broadband for all by 2010, and access speeds of at least 2 Mbps to 98 percent of the population by 2012, and at least 20 Mbps to 90 percent of the population by 2015.[177] The strategy also specifies that competition is the key to achieving these goals, coupled with measures such as openness of networks and participation of the local municipalities.

4.18. Spain

Background information

Population	44.59 million
Fixed penetration	45.9
Mobile penetration	109.4
Fixed broadband penetration	18.2
Mobile broadband penetration	22.7
Internet users	52.0
ICT Development Index (Rank 2007)	**27**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Telefonica (Spanish incumbent operator) has made several public announcements regarding the deployment of NGN. This concerns both the core network and the access network. The objectives of the operator, presented in May 2006, included bandwidth of at least 25 Mbps for more than 40 percent of the population by 2009.[178] It also carried out a limited FTTH trial based on PON in the outskirts of Madrid in 2005 and announced a **EUR 1 billion** investment in FTTH.[179]

PTV Telecom, a triple-play provider in Spain, is replacing its existing infrastructure to offer enhanced services in five major cities across the country.[180] It's moving to IP from its existing infrastructure and is expected to facilitate future subscriber base growth, deliver multi-play services to consumers and also give it a lever into the enterprise market with IP trunks and data services. [181] Following the upgrading of their networks, cable operators launched the first broadband offers of 50 Mbps and 100 Mbps. The incumbent launched a pre-commercial offer based on VDSL with speeds up to 30 Mbps.

In Spain the trend towards bundled services is significant and continues to grow, with broadband as the main driver: 12.01 percent of the population had subscribed to a double-play offer and 2.91 percent to a triple-play offer as of July 2008. Moreover, IPTV has experienced significant growth, reaching 668 520 subscribers by July 2008.[182]

Regulatory developments

In 2008, CMT (Spanish NRA) focused on establishing a regulatory framework for NGN access networks with a view to fostering infrastructure competition, although some of the principles still need to be adopted or further defined[183]:

- Following a public consultation, in January 2008 the CMT published its regulatory position on NGN access in the form of a guidelines document.
- In May 2008 CMT, took provisional measures for NGN access, requiring Telefonica to provide access to ducts, supply information on planned civil works and fibre coverage, and deliver an FTTH wholesale service (FTTH bitstream) to unbundling operators. This followed the French model, but in a revision in the following July, the CMT removed the

obligation on Telefonica to provide a wholesale service on the grounds that the company's civil infrastructure access removed the need to adopt provisional FTTH bitstream. Telefonica would, however, have wholesale obligations on its VDSL network. In effect, this decision gave Telefonica a regulatory holiday from FTTH network access, similar to that secured by Deutsche Telekom in 2007.[184]

- In November 2008, following verification of the implementation of that obligation, the CMT authorized the incumbent to launch the first commercial offers based on FTTH. The incumbent is also required to provide a bitstream service to collocated operators at a discounted price. This is a compensatory measure for those operators affected by reduced availability of unbundling due to the instalment of remote nodes between the local exchange and end-users.

However, after publishing its latest EU Broadband Scorecard, ECTA has cited Spain as an example of why regulation is needed to ensure investments and take-up in NGNs, as well as to guarantee competition and consumer choice. According to the research, Telefonica continues to increase its control of the broadband market, with more than 57 percent of all retail broadband connections. However, the market in Spain has stagnated with the result that Spain is languishing below OECD and EU averages with a broadband penetration rate of 20 percent and growth rates are low.[185] Financial results from Telefonica show that it is primarily focused on increasing profitability at the expense of vital infrastructure investments. Increasingly, operators are threatening governments and European politics that they will not invest in NGN access networks, unless there is a relaxation of competition rules that allow rivals to offer services over these networks. ECTA emphases, that growth and investment in high-speed networks depend on competition. Innocenzo Genna, Chairman of ECTA said: "*Light touch regulation has not worked in the banking sector and there is no reason to assume it will work to consumers' benefit in telecoms*".[186]

Spain is slowly edging towards an open-access fibre environment, but in the short term at least, there will be little effective competition to Telefonica except from cable operators, which only market about half of the population.[187] Consequently, Spanish consumers will be punished with some of Europe's highest access charges for some time yet.

There are a few governmental initiatives in the area of NGN that are worth noting. For instance, in October 2008 the Minister for Science and Innovation announced a planned investment of **EUR 130 million** for the launch of a new dark fibre network as part of a project called RedIris Nova. RedIris is the Spanish academic and scientific communities' advanced communications network, to which over 300 institutions belong, including all of Spain's universities and public research entities.[188] Also the Ministry of Industry, Tourism and Commerce has established an Advisory Committee, which should identify possible barriers to the deployment of high speed access networks and propose recommendations to the Ministry.

4.19. Sweden

Background information

Population	9.16 million
Fixed penetration	60.4
Mobile penetration	113.7
Fixed broadband penetration	36
Mobile broadband penetration	24.8
Internet users	80
ICT Development Index (Rank 2007)	**1**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

As in many European countries, a number of Swedish operators are moving to NGN core networks as well. Some public announcements illustrate this trend:

- Telenor announces that it is upgrading its network with the main focus on a fixed and mobile converged IP Centrex application targeting enterprise customers in the first phase. In subsequent phases, Telenor intends to develop the Swedish market up to a leading position in the area of converged services based on IMS, for both enterprises and consumers.[189]
- A new mobile core network is being developed for Hi3G Access Sweden based on IP NGN technology. According to the press release, in the second quarter of 2007, the operator had 44 percent market share in the Swedish mobile broadband market.[190]
- At the end of 2004, TeliaSonera (the incumbent operator) announced that it was going to build Sweden's largest IP network, which would link all 3 650 representatives for the gaming company Svenska Spel in Sweden. The estimated value of the order was **SEK 200 million (EUR 19 million)**.[191]

Besides the move to NGN core networks, Sweden is well advanced in its development of NGN access networks. Sweden has the highest fibre take-up of any non-Asian country, with fibre comprising nearly 19 percent of residential broadband connections. There are now 152 city networks in Sweden, reflecting an investment of more than **EUR 2 billion.** The networks pass three million homes (around two thirds of all households), and 95 percent of those networks offer dark fibre. Sweden also boasts the fastest in Europe broadband speeds used by consumers with more than 30 percent having speeds over 2 Mbps and 10 percent having speeds higher than 10 Mbps.[192] A number of different projects were and are implemented in Sweden in order to reach its current take-up.

At the end of June 2008, TeleGeography estimated that TeliaSonera had 55 000 direct fibre users on its network, with the rest of the country's FTTx connections provided by alternative access providers over their own infrastructure.[193] This shows that, both the incumbent and alternative network operators have been investing in its NGN access network during the last few years.

Akelius Fastigheter, one of Sweden's largest private owners of residential property, signed an agreement with TeliaSonera in 2008 for the build-out of a fibre optic network that will deliver triple-play services to all its apartment buildings in Sweden. The agreement is for a nine-year period and is estimated to be worth **SEK 700 million (EUR 67 million)**. Akelius residents will gain access to telephony, broadband and digital television services over a fibre optic network that will connect 27 000 apartments in 37 municipalities in Sweden.[194]

Sweden's Bredbandsbolaget, Telenor-owned broadband communication provider, is also rolling out FTTH network. In 2006, it announced the delivery of triple-play services, bidirectional broadband access, IPTV and IP telephony services to new FTTH customers.[195] In 2007, Bredbandsbolaget was testing 1Gbps broadband services in Stockholm as part of a wider plan to extend and upgrade its existing FTTH network by 2010. In 2007, the provider had 460 000 residential users in Sweden, of which 180 000 were fibre customers, and was the second-largest broadband provider with a 17 percent market share overall.[196] In 2008, Bredbandsbolaget started offering broadband services at up to 60 Mbps to some 800 000 households.[197]

One of the earliest public initiatives in Sweden was in the city of Vasteras, located 100km west of Stockholm. The municipal authority engaged the utility Malarenergi (also owned by the municipal authority) to build an open access Gigabit Ethernet metropolitan network. Construction commenced in 2000 and was completed in 2007, covering around 83 percent of households.[198] There are more than 25 service providers, including national as well as local companies, and prices are claimed to be among the lowest in Sweden (100Mbps symmetric service costs from SEK299 per month).

As noted by the EC, ownership of broadband networks by municipalities doubled between 2003 and 2007 in Sweden. Some 150 municipality-owned companies are also key investors in fibre. This increasing pace of investment, fuelled by considerable public financing, is in contrast to a slowdown in the growth of the rest of the economy.[199]

Regulation

On 15 Feb 2007, the Swedish regulatory authority (PTS) issued proposals for a new national broadband strategy. The stated aim of PTS was to achieve an increase in the accessibility of broadband infrastructure with the short-term objective of offering broadband to all households, businesses and public entities no later than 2010, and to promote and protect sustainable retail market competition for broadband services. Broadband is defined in the context of this 2010 target as connections that can be upgraded to a downstream transmission speed of at least 2 Mbps.

Three simultaneous policy lines are put forward by PTS to achieve the stated 2010 goals. The first involves financial and regulatory requirements for government funded infrastructures, the second addresses regulation of the fixed incumbent operator's infrastructure and wholesale activities (including proposals for functional as well as legal separation), and the third line focuses on openness and neutrality of (often government-owned or funded) fibre infrastructures.

In terms of government-funded infrastructures PTS suggested the following[200]:

- Continued government support of initiatives representing a global investment of SEK 1135 million (EUR 864 million) for the rollout of broadband infrastructure (of which SEK 567.5 million (EUR 432 million) financed by EU structural funds).
- Imposition of minimum requirements on infrastructure established with public funds (e.g. minimum transmission rate).

- Any broadband networks financed with ‘central government support’ should be open to service providers other than the network owner during the (entire) lifetime of the networks.

In short, the aim, to ensure broadband is available to all households by 2010, is based on open access principles, including equal access to the last mile copper network of the incumbent operator, funding open public fibre broadband networks where private investment is unlikely, and giving municipalities social planning responsibility to ensure local access to broadband infrastructure.

In February 2007, PTS proposed that Sweden's largest telecom operator TeliaSonera be forced to separate its wholesale organization from its retail operation. The regulator suggested a model for separating TeliaSonera's network from its other operations based on BT Group PLC's Openreach structure in the UK.[201] In April 2007, the Swedish government asked PTS to present proposals on operational separation, a lighter form of regulation. Subsequently, in the spirit of the voluntary separation, the incumbent set up a new entity responsible for the management of a full set of passive products (i.e. copper products in particular and ducts). According to the operator this should ensure equal treatment of all market players. Furthermore, in the summer of 2008, the incumbent established the ‘Equality of Access Board’, which initially aimed at increasing market certainty and transparency through the planned publication of regular reports on key performance indexes, also covering the activities of another wholesale unit of the incumbent, responsible for sales of active network elements (e.g. WLR and bitstream, but not fibre). However, later in 2008, the incumbent decided not to publish these reports.

In July 2008, the new provisions empowering the NRA to impose functional separation on the incumbent entered into force. Under the national law, fibre access networks will not fall under the scope of functional separation.[202] At the end of 2008, PTS announced a proposal to force incumbent TeliaSonera to unbundle its fibre-optic broadband access network. PTS wants it to offer a full range of wholesale fibre access services to its competitors, including fibre and ducts. Earlier obligation decisions regulated only access to the copper network.

As for some time now, PTS has received indications that there are problems in the dark fibre market that need to be attended to. In light of this, it has conducted a study of the dark fibre market in 2008, with the aim of describing this market, the problems that exist and how these may be resolved.[203] Even though the outcome of the analysis falls short of the expectations of the alternative operators, the study, which was one of the first of its kind in the EU, analyzed the current market situation, and concluded that, in the light of positive market trends such as the number of stakeholders providing dark fibre at the wholesale level, it was not justifiable to define a specific market for dark fibre. Nevertheless the market would require continuous monitoring.

As reported by the EC, state-financed networks, which have a 12 percent retail market share, may represent another important challenge for the further development of the broadband market. Alternative operators are concerned that wholesale access is not always available to competitors. PTS has reinforced the dialogue with the Swedish Urban Network Association, pressing for conditions that would facilitate wholesale access to both ducts and municipality-owned dark fibre. In addition, some municipalities provide active, lit-fibre products that compete directly with market players at the retail level.[204]

4.20. Switzerland

Background information

Population	7.5 million
Fixed penetration	65.9
Mobile penetration	109.7
Fixed broadband penetration	31.8
Mobile broadband penetration	19.3
Internet users	77
ICT Development Index (Rank 2007)	**8**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Swisscom's (Swiss incumbent operators) intentions to move to a full NGN network first surfaced in 2005.[205] This was also confirmed by Swisscom's annual report of 2005, which stated that Swisscom was in the process of upgrading its networks to NGN.[206] By the end of 2006, Swisscom had its legacy PSTN transit network replaced with an IP/MPLS core. In 2007, Swisscom stated construction of a NGN overlay, intending to completely shut down the PSTN by 2015. [207]

Swisscom, in common with many of the large European operators, is now looking to broadband next-generation FTTH networks to fuel growth.[208] Since October 2008, Swisscom has been expanding its fibre-optic network to cover residential customers and SMEs, with a view to retaining its leading position in broadband communications.[209] The incumbent is actually upgrading its access network very quickly to offer VDSL in urban centres, then in rural areas. At the end of 2008, Swisscom announced that, over the next six years it is planning to invest some **CHF 8 billion (EUR 5.3 billion)** in infrastructure, with 35 percent of this sum earmarked for fibre-optic expansion. Swisscom invited potential cooperation partners from the telecommunications, cable, and utilities industries to work with it on building the fibre-optic network, with the aim of implementing the network more quickly and cost-effectively. [210] To enable potential partners to expand their own fibre-optic infrastructure after the construction work has started, Swisscom is laying several fibres per household in all areas. One fibre will be used by Swisscom, while the others will be made available to partners. In May 2009, the operator announced it will launch a VoIP service that month, as part of its strategy of migrating to an all-IP network — a move that should cut costs through a simplification of its diverse service offerings. [211]

Other actors are playing an active role in the development of fibre access networks as well. For instance, Swiss network operator Swiss Fibre Communications started construction of a dark fibre network from North to South Switzerland in July of 2009.[212]

In many European markets, the development and growth of national and local fibre infrastructure is increasingly being stimulated by the involvement of electricity utilities. This is the case of Switzerland as well, which is fast emerging as one of Europe's significant fibre markets. The major operators, including the incumbent Swisscom, TDC Sunrise and Orange Switzerland, are building their fibre networks in partnership with electricity providers[213]:

- In March 2009 Swisscom announced a joint venture with the Canton of Fribourg and the electricity provider Groupe E to construct an open access FTTH network in Fribourg. The Canton of Fribourg has provided **CHF 5 million (EUR 3.3 million)** as an investment fund in addition to a **CHF 15 million (EUR 10 million)** interest-free loan.
- Other utilities which have invested in fibre include the Zurich municipal electricity provider EWZ, which in May 2006 applied to the district council for a **CHF 200 million (EUR 132 million)** loan to build an open access FTTH network. The network was opened in April 2009, in conjunction with operator Sunrise. Orange Switzerland has also offered a triple-play package over EWZ's fibre network. EWZ also has service deals with the ISPs Netstream, Green.ch and Init Seven as well as the cable operators GGA Maur and Transluminia.[214]

Regulatory developments

At the time of writing this report, no specific regulatory developments were taking place in Switzerland. The Swiss NRA (OFCOM) organized a NGN workshop in September 2007. The participants expressed the view that they did not expect any regulatory holidays with regard to NGN, but are in favour of an approach of market self-regulation.[215]

Wholesale VDSL offers will not be offered in the short term as regular LLU only came into force in April 2007.

4.21. United Kingdom

Background information

Population	61 million
Fixed penetration	55.4
Mobile penetration	118.5
Fixed broadband penetration	25.7
Mobile broadband penetration	20.6
Internet users	72
ICT Development Index (Rank 2007)	**10**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2004, the incumbent operator, British Telecom (BT), announced its plans to replace its core network infrastructure with NGN, called 21CN. BT's plans for 21CN were for a new single multi-service network to replace all of its existing networks. BT's stated aims for the project were to reduce costs (by GBP 1 billion per annum by 2008/09), and improve speed to market for new services. BT also set out several key milestones for its plans[216]:

- Trials of the new technology were to be initiated during 2004, with next generation voice services being delivered to 1 000 customers by January 2005.
- Broadband services were to be available to 99.6 percent of UK homes and businesses by summer 2005, with growth in broadband services being met by a new 'Multi-Service Access Node' platform.
- The mass migration of PSTN customers was expected to start in 2006, and reach more than 50 percent by 2008.
- Broadband dial tone is expected to be available to most customers by the end of 2009.

According to more recent announcements, BT expects to complete its 21CN migration process at the end of 2011. The group initially said the network would be finished by the end of 2010. The value of 21CN is around **GBP 10 billion (EUR 11 billion)**.[217] At the time of project's announcement this was considered as a unique project, however, currently other operators are known to be developing similar deployment plans, including most of the operators that compete with BT in the UK market.

In 2005, Cable & Wireless announced the Group's intention to commit **GBP 190 million (EUR 210 million)** over the next three years to the transformation of its UK core network, and associated IT systems and processes. It expected NGN architecture to be completed by the end of the 2007/08 financial year, and to have the following key elements:[218]

- Convergence of Cable & Wireless' existing five separate service platforms to a single integrated IP service platform;
- Reduction of backbone nodes by 50 percent and rationalisation of metro-edge and metro-access nodes;

- Installation of ten new soft switches to replace the existing 70 legacy voice switches (subject to the timing of traffic switching away from legacy products).

With an investment of over **GBP 200 million (EUR 221 million)**, Opal (UK operator) is migrating its network to NGN. With over 1 650 exchanges fully unbundled to cover 80 percent of the UK population, the NGN provides access to over 21 million business and residential premises.[219]

However, these developments take care of the "backbone" of the UK's broadband infrastructure, but NGN access is another matter entirely. The latest ranking of countries with the most widespread roll-out of FTTH shows the UK without enough coverage to be included in the league table. It was reported in early 2009, that the annual FTTH conference in Copenhagen expressed fears for the UK's global economic competitiveness after statistics showed the UK was still not among the group of economies where FTTH penetration has reached one per cent.[220]

BT is reluctant to spend billions of pounds installing FTTH or FTTC while regulations state it would have to give competitors an equivalent access to those connections. Although estimates vary, a full FTTH roll-out could cost in the region of **GBP 15 billion (EUR 16.5 billion)**.[221] FTTC would be significantly cheaper, but still cost well into the billions.[222] Only in the middle of 2008, did BT announce a **GBP 1.5 billion (EUR 1.65 billion)** investment into a super-fast broadband plan that aims to reach 10 million homes by 2012.[223] However, the deployment of fibre-optic infrastructure is dependant on 'a supportive and enduring regulatory environment', according to the company.[224] BT stated that it would discuss the market conditions with the regulator, Ofcom, to enable the investment to take place. The fibre optic network would allow download speeds between 40 Mbps and 100 Mbps.

Regulatory developments

After BT's announcement to migrate its core network to NGN, the NGNuk industry forum was formed. NGNuk is independent, created by the regulator but funded by the industry. It is open and transparent. The overall goals of this forum are:

- to develop an agreed industry-led vision of NGN developments on the country,
- to act as a co-ordination forum in which key investors in NGN infrastructure and services will discuss, research, consider and, where possible,
- to agree the direction for NGNs in the UK, and
- to communicate such direction to other players in the telecommunications industry and the general public.[225]

From the point of view of the institutional architecture, NGNuk is an interesting solution, as it tries to find a balance between an 'incumbent-led' solution (CN21 programme) and a 'regulatory-led' solution, where the regulator simply dictates the rules after a traditional consultation process.[226]

From the regulatory point of view, it enables the regulator to understand and capture the industry point of view to NGNs without having to conduct costly studies or having to learn through a dispute resolution process. Essentially, it enables the regulator to 'learn' about NGNs and to 'gain time' before making decisions.[227]

From an incumbent perspective, again it has the advantage of learning about NGNs and different stakeholders' positions without having to face them directly in the market through costly and lengthy confrontations with the regulator.

From the alternative operator's point of view, they have different incentives depending on the role that they wish to play in the market. It provides a chance for negotiations with the incumbent and to be protected by the presence of the regulator as an active listener.

Most probably this "dialog-based" decision making mechanism was adopted in the UK because it was one of the first countries worldwide facing NGN-led challenges. Ofcom (NRA for the UK) has been in the forefront in dealing with NGN migration challenges. However, Ofcom concluded that the migration to an NGN would not eliminate BT's market power on the local loop any time soon. As a result, Ocfom has reached understandings with BT to establish a subsidiary to provide those wholesale services, where it has market power. The subsidiary (called OpenReach) is obliged to provide access products at wholesale to competitors on the same basis on which it provides them to BT itself, a principle referred to as Equivalence of Inputs.

Regarding the NGN access situation in the UK, the Digital Britain report, published in 2009, encouraged the rollout of high-speed broadband in the country, but gave no commitments on public-sector investment to support UK optical fibre network infrastructure. [228] To date, no specific actions have been taken by Ofcom.

5. ASIA AND PACIFIC

The FTTH Council consolidated ranking of the economies having greater than 1 percent household penetration of FTTH/FTTB showed that the top four positions are held by Asia-Pacific countries: South Korea, Hong Kong, Japan and Taiwan. The Asia-Pacific region alone accounts for more than 80 percent of the world's 32 million connected homes. Even Europe has been slow (compared to Asia-Pacific and North America) to adopt FTTH technology. South Korea now has more FTTH/FTTB connections than DSL connections, and Japan is close behind.[229] FTTB has been deployed in Japan since 2002 with over 2 million lines and in Korea with over a million lines since 2003. Taiwan is the third most advanced country in Asia with almost a million lines.

5.1. Australia

Background information

Population	20.95 million
Fixed penetration	47.1
Mobile penetration	102.5
Fixed broadband penetration	23.3
Mobile broadband penetration	32.8
Internet users	69
ICT Development Index (Rank 2007)	**14**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In November 2005 Telstra (the incumbent operator) announced its plans to move to NGN. More specifically, these plans were to:[230]

- Introduce a NGN core network, with an investment of more than **AUD 10 billion** over five years of which 2-3 billion AUD added incrementally to existing plans, with an IP core in place by the end of 2007;
- Replace the CDMA mobile network with a national 3G GSM network which will offer the same or better coverage than currently available;
- Connect the approximately one third of users located within 1.5 km from exchange by ADSL2+, by FTTN for the remaining two thirds, and FTTP in “Green-field” areas (without current service);
- Cut the number of business and operational support systems, reduce the number of Telstra's 52 000 full time equivalent (FTE) positions by between 6 000 and 8 000 over three years and 10 000 over five years.

In short, Telstra's announced plans covered all aspects of its networks: core network (planned as common to all services), mobile network, fixed access arrangements, and operation and support arrangements.

In 2006, Telstra decided to abandon a **AUD 3.5 billion** broadband project because of a regulatory dispute. The company changed plans to build a fibre optic network in Australia's five largest cities, after failing to agree with the competition regulator over what it could charge rivals for access to its network. [231]

Whilst Telstra's roll-out of next generation services was being much delayed because of the arguments between the incumbent and the ACCC (Australian Competition Consumer Commission), a group of Australia's largest alternative operators (called Terria) came up with a plan to upgrade the country's PSTN with fibre-optic technology as an alternative to the NGN strategy of Telstra. In December 2006, the group announced their intention to invest in a FTTN network. It was expected to cost around **AUD 3 billion**.[232] The group lodged a special access undertaking regarding pricing policy with the ACCC in June 2007. In December 2007, the ACCC rejected the plan, due to a lack of incentives for providers of the service to compete.

Regulatory developments

Besides commissioning reports and initiating discussions on different NGN related issues, ACCC was always actively involved in determination of price levels for wholesale telecommunication services. ACCC and Telsra had long discussions about how and for how much rivals will access the new Telsra's network. As a result, Telsta decided to abandon its fibre roll-out plan. ACCC also rejected Terria's (consortium of alternative operators) plan, due to a lack of incentives for providers of the service to compete. This obviously was slowing down the process of NGN developments in the country. After a while the Australian government started to think that the current regulatory system of limited operational separation of Telstra's wholesale network operations had failed to encourage competition and wanted to act fast to break apart Telstra's wholesale and retail businesses. Telstra on its side started to consider a voluntary separation of its wholesale and retail divisions, as well as the sale of some assets to the Australian government's NGN project.[233]

Finally, at the beginning of 2009, the Australian government abandoned its earlier plan to fund a privately built FTTN broadband network. Instead, it will directly build an open-access, 100 Mbps+, FTTH network that will reach 90 percent of Australian homes within eight years. The **AUD 43 billion** "National Broadband Network" project was referred to by the Australian government as the "single largest national-building infrastructure project in Australian history." This fibre network will not only reach to 90 percent of homes in Australia, it will also be open access and available for use by any ISP. The government intends to create a private/public company to build the new network, with the government owning at least a 51 percent stake. Deployment of the new network is set to begin in 2010 with an initial investment of **AUD 4.7 billion** from the government.[234] The network, which will operate under a wholesale-only model, should take 7 to 8 years to complete.

5.2. China

Background information

Population	1 336.3 million
Fixed penetration	27.5
Mobile penetration	41.2
Fixed broadband penetration	7.9
Mobile broadband penetration	0.4
Internet users	31
ICT Development Index (Rank 2007)	**73**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

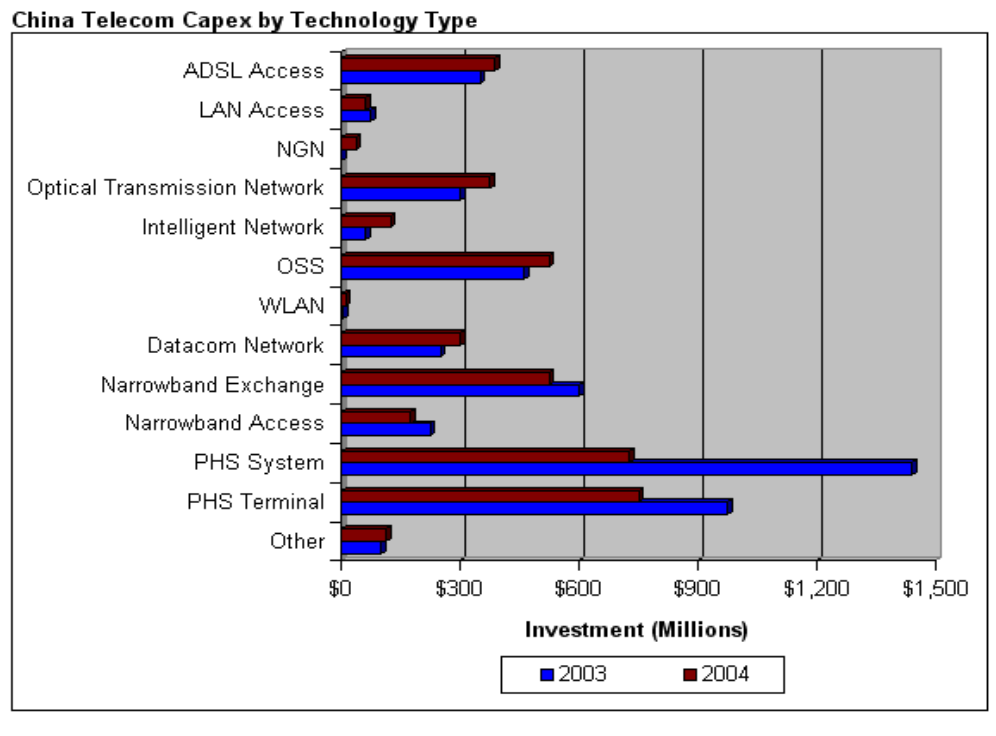
Market developments

In fact, China is one of the most enthusiastic countries to develop NGN. An NGN Forum was created and started its activities relatively early compared to other countries. One of the objectives of this Forum was to study the growth trends and the latest technologies of NGN and to promote NGN developments in China.[235] The 1st China NGN Forum conference took place in 2000. Initially it focused on NGN core technologies and developments. It is worth mentioning that China itself is a huge producer of NGN technology for the rest of the world. Companies, like Huawei or ZTE Corporation are now world-leading telecom solution providers. Consequently, developments of NGN have a double effect on China's economy.

China Telecom first rolled out NGN services in Shenzhen and Zhaoqing in 2002. In Shenzhen, it provides a capacity of 600 000 lines and serves over 150 000 subscribers.[236] The success in this region proved that NGN could replace PSTN switches on a large scale. Based on the success in regional commercial trials, China Telecom launched its technological transformation in 2005, with plans to migrate the entire network to NGN in 5 to 15 years. The first phase of the project were expected to cost **1 billion yuan** with almost **800 million yuan** to be spent on equipment. By the end of 2005, the upgrade of China Telecom's long distance backbone network was completed.[237] At the same time, the other five operators participating in the CNGI (China Next Generation Internet) project backed by the Chinese Government also accelerated the pace in building their own networks.

China Telecom investment in different technologies in 2003, and 2004, are provided in the following figure.

Figure 8: China Telecom investment by technology type in 2003 and 2004



Source: http://www.dri.co.jp/auto/report/hr/hrtic05.htm

CERNET, another NGN in China, with an investment of **700 million yuan** from the Chinese Government and more than **120 million yuan** from 25 leading Chinese universities, was officially launched in December 2004, connecting 25 universities at a speed of one to 10 Gbps.[238] After a year, it started a further expansion of the network and it was expected to cover 100 universities in 2005 and to expand to another 180 universities during a later stage.

In 2008, Yangquan Coal Industry (Group) Co. Ltd, a large state-owned coal enterprise in China, selected a supplier to migrate its traditional fixed network to a NGN that will provide the company with new, converged voice and data applications and multi-media services.[239]

At the end of 2008, China announced that it will build its first nationwide high-capacity optic fibre network.[240] The backbone network will have a bandwidth of 1 000 Gbps. It will allow every user in the network to have a 100 Mbps access to the Internet. The amount of planned investment, unfortunately, has not been revealed. However, it is known that China's government is planning to allocate **2 billion yuan** to develop next-generation broadband ***wireless*** networks over the next two years. Combined with corporate and local investment, initial investment in the technology should be approximately **10 billion yuan**.[241] The focus will be on the development of next-generation cellular broadband communications systems, including but not limited to 3G and concentrating more on LTE, 4G, and other long-term technological developments. State investment will ultimately total as much as **20 billion yuan**. This combined with local and corporate investments could total **100 billion yuan** by 2020.[242]

5.3. Hong Kong, China

Background information

Population	7.3 million
Fixed penetration	57.2
Mobile penetration	149.2
Fixed broadband penetration	26.3
Mobile broadband penetration	30.5
Internet users	64.8
ICT Development Index (Rank 2007)	**11**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

A number of NGN developments are taking place in Hong Kong, China.

Hong Kong Broadband Network Limited (HKBN), a fixed telecommunications network services carrier operating in Hong Kong, is the largest alternative residential provider of voice and broadband services in Hong Kong. HKBN's "*Everything over IP*" network is the basis for its multiplay strategy of offering 10, 100, and 1000 Mbps broadband Internet access, telephony, and digital/IPTV services to high-density, high-population areas in Hong Kong.[243] As early as 2002, HKBN already foresaw the future need for bandwidth, and initially invested more than **HKD 2 billion** in network infrastructure.[244] In 2005, HKBN launched two new Ethernet-based symmetrical broadband services: 100 Mbps and 1 Gbps. Over the last seven years, taking advantage of Hong Kong's high residential density – 200 times higher than the US – it began building out a fibre network that in 2009 passed 1.4 million homes, ***at a cost of only about USD 135 per home***. Currently, they are offering a basic 100 Mbps symmetrical broadband package, which costs USD 33-40 per month. Premium services, at 200 Mbps and 1 Gbps symmetrical can cost up to USD 225 per month. During the next few years, HKBN plans to extend its network to pass 2.0 million out of the 2.5 million homes in the territory. [245] It is also bidding on the NGN in Singapore, in partnership with Mobile One.

In 2004, China Motion Telecom (a telecommunications company with strong networks in Hong Kong) announced that it will develop a NGN to provide cross-border multi-media telecommunications services across networks to customers in Hong Kong and Mainland China with an initial investment of **USD 5 million.** [246]

In 2007, PCCW announced its plans to invest **HKD 3 billion** to upgrade its fibre-optic network to meet the increasing demand for bandwidth applications.[247]

In the beginning of 2009, two telecommunications providers - ZTE and CSL New World Mobility (CSLNWM) - announced a collaboration to build, as it is noted in the press release, "the world's first SDR (Software Defined Radio) based HSPA+ (Evolved High-Speed Packet Access) network". According tho them, the dual-mode SDR CSLNWM network will be a large-scale all-IP network, delivering superior services and user experience, while providing a smooth transition from the existing network to HSPA+.[248] ZTE is the China-based provider of telecommunications

equipment and network solutions, while CSLNWM is the Hong Kong-based mobile operator, a subsidiary of Australia's Telstra Corporation. [249]

Regulation

In Hong Kong, China, the pace of NGN is driven by the market. The responsibility of the Government is to create an enabling environment to help operators make the transition to NGN as and when they see fit. [250] The government is closely monitoring the development of NGNs and their impact on the future regulatory framework. The Office of the Telecommunications Authority (OFTA) initiated a discussion paper at the beginning of 2009, which aims to stimulate discussion on various policy and regulatory issues on NGN.[251] Given the government's efforts in pursuing deregulation, it is being cautious with any further regulatory intervention.

It might be interesting to note, that in Hong Kong, China, there have been suggestions that the cost of Universal Access/ Service (UAS) provision should be calculated by combining the cost of the existing network and the cost of the NGN. However, the regulator has rejected these suggestions and will consider the cost of the NGN only where the change to the NGN stops the existing network from providing UAS.

5.4. Japan

Background information

Population	127.9 million
Fixed penetration	40.0
Mobile penetration	83.9
Fixed broadband penetration	22.1
Mobile broadband penetration	56.8
Internet users	68.9
ICT Development Index (Rank 2007)	**12**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Japan has been deploying FTTH into new buildings since 2005. December 2006 saw the launch of the NGN field trials by the Nippon Telegraph and Telephone Corporation Corp. (NTT), Japan's incumbent operator. These field trials were started in line with the company's Medium-term Management Strategy of 9 November, 2005, which outlined its NGN development plans. The Strategy aims to build a full-IP NGN with optical access, aiming to serve 30 million users by 2010, and invest **2 trillion yen annually** in its construction. [252] Plans involve a radical change of its entire national network through the use of end-to-end fibre optics. NTT East already has fibre reaching at least 75 percent of homes in its service area.[253] Around 100 000 people each month are taking FTTH services from NTT. It had 6.08 million subscribers to its fibre network at the end of March, 2007 and in September of 2008 reached the 10 million mark (Japan has about 50 million households in total).[254] NTT's plans and rapid growth of fibre-based connections suggest that all homes in Japan might be connected to fibre networks by 2010.

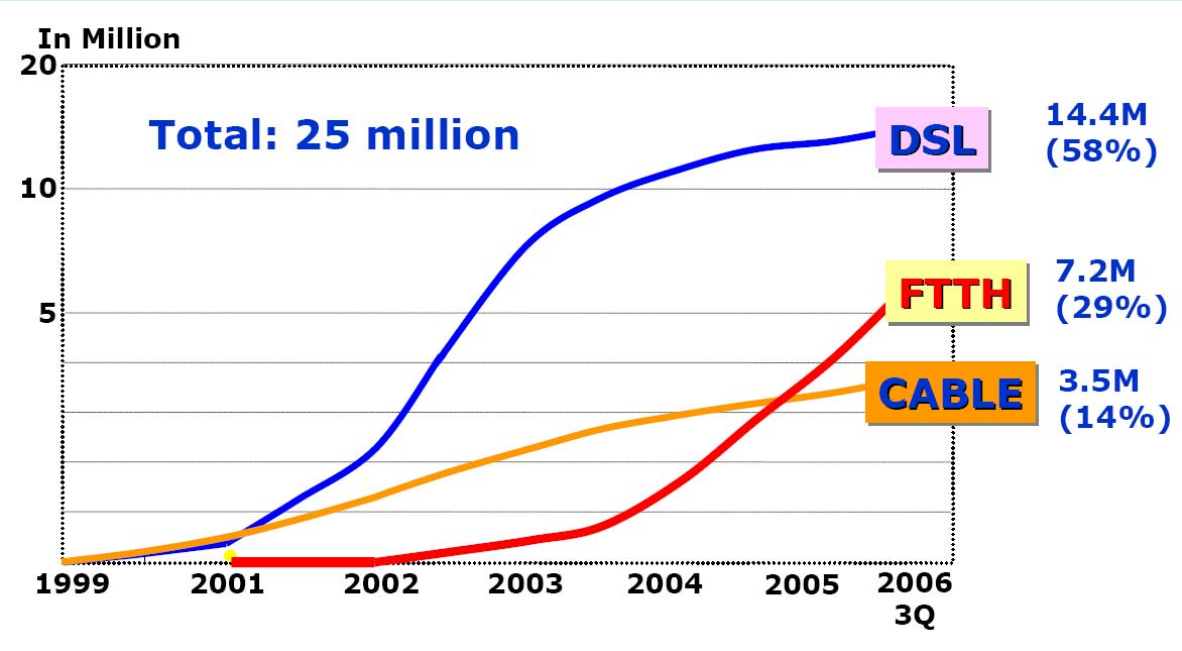
Meanwhile, competitive access providers from power utilities pursue fibre builds at least in the major metropolitan areas. In Japan, many players are active in the field of providing FTTH access services to end users. This does not necessarily mean that all of the players mentioned actually deploy and own fibre. Rather, some of them build their business model on fibre purchased from third parties. The main market players active in Japan include:[255]

- *Telecommunications operators:* NTT-East and West; also KDDI.
- *Regional Utilities:* K-Opticom (Subsidiary of Kansai Electric Power Co.); TEPCO (Tokyo Electric Power Co.)
- *CATV providers:* For example, J:COM.
- *Content providers*: For example, usen Corp. (producing music content).
- *ISPs*: Notably Yahoo! BB.
- *Municipal and regional governments*: they are involved in FTTH deployment in rural and in densely populated regions.

Figure 9 presents technology changes in Japan's broadband market. It shows that FTTH had already overtaken cable broadband in 2005 and is getting closer to the number of DSL

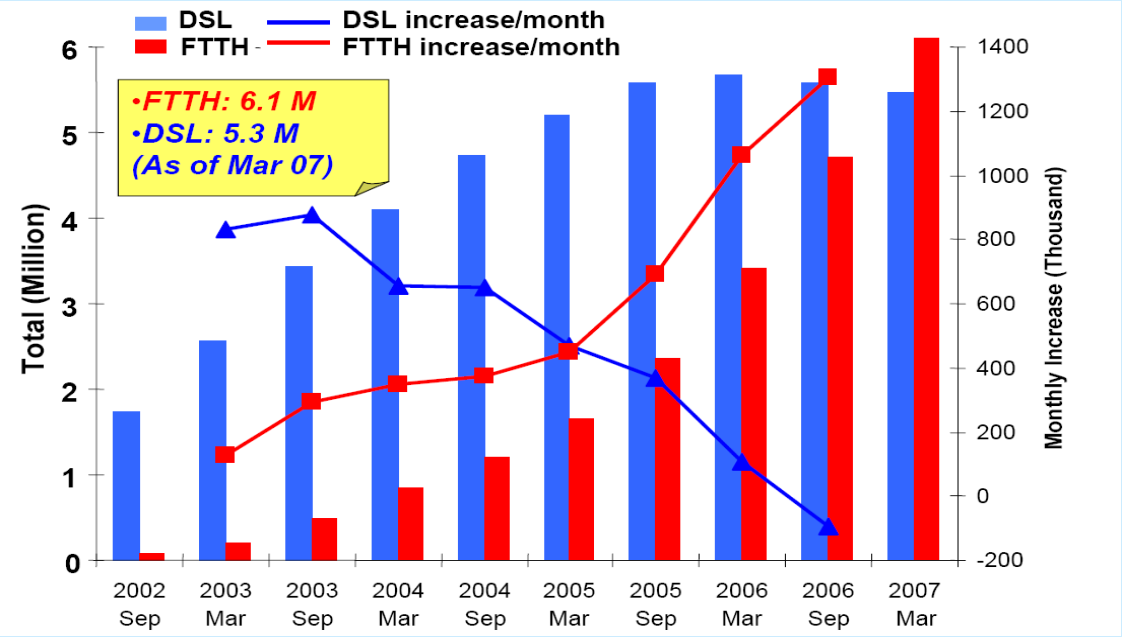
connections in the country. NTT already had more broadband subscribers connected through FTTH than DSL subscribers in 2007 (See figure 10).

Figure 9: Broadband market changes in Japan



Source: Ministry of Internal affairs and Communications (MIC), Dec 2006

Figure 10: Broadband subscribers of NTT



Source: NTT East and NTT West, April 2007

Regulation

The two most important factors accounting for the expansion of fibre networks in Japan probably are very low interest rates and institutional policy commitment to provide ubiquitous fibre network. Since the mid-1990s, the Japanese central bank discount rate has been below 1 percent (0.1 percent at the end of 2008). In addition to this, ubiquitous fibre network has been a broad policy goal for the Japanese government.[256] NTT's national NGN project is largely encouraged by **e-Japan**, which is a national plan to create a wired, broadband nation by 2010, and **u-Japan**, a supplementary plan that mandates the creation of business applications to meet its social and economic needs.

Since 2005, the Japanese Ministry of Internal Affairs and Communications (MIC) has initiated two studies relevant to regulatory responses to the emergence of NGN, one dealing with competition rules, and the other dealing with technical architecture:[257]

- "Study Group on a Framework for Competition Rules to Address the Transition to IP-Based Networks" was launched in October 2005. The group developed a framework for an interconnection and tariff policy and compiled a final report in September 2006.
- In January, 2007, the first meeting of the "Study Group on Network Architecture" was held. The purpose of this study group was gathering information on future architecture of networks, and on issues to be tackled from a variety of viewpoints.

NTT is also subject to comprehensive unbundling regulations. NTT is required to unbundle copper loops and to allow line sharing (competitive DSL service over the primary copper loop to provide plain old telephone service (POTS)). NTT is also required to unbundle fibre loops and interoffice fibre.[258]

5.5. Malaysia

Background information

Population	27 million
Fixed penetration	16.4
Mobile penetration	87.9
Fixed broadband penetration	3.8
Mobile broadband penetration	5.9
Internet users	55.7
ICT Development Index (Rank 2007)	**52**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

In Malaysia, the Government is in public-private partnership with Telekom Malaysia (TM) to deploy a high-speed broadband network that is capable of offering 10 to 100 Mbps.[259] Telecom Malaysia has been appointed by the government to participate in its public-private partnership to roll out infrastructure and services. The first phase of the project is for a ten-year period. The first part of phase one is to connect 1.3 million premises with FTTH or FTTB by the end of 2010. The total investment is to be **MR 11.3 billion**, with the Malaysian government investing **MR 2.4 billion** and TM investing **MR 8.9 billion**. Malaysia is divided into three zones and this first rollout is targeted for zone 1, which has a high population density as well as being economically well off. This network will be open access and with fair access pricing and competition among all service providers. All subscribers will receive a minimum of 20 Mbps. After phase one it would begin "Broadband for the General Public (BBGP)", which will deliver 2 Mbps and will consist of both wired and wireless networks.[260]

At the beginning of 2009, it was announced that Packet One Networks (P1) (Malaysia) Sdn. Bhd., Malaysia's first and leading WiMAX provider, was going to expand its nationwide WiMAX network throughout the country. This is part of P1's continuous growth strategy to ramping up its WiMAX coverage of its WiMAX network in Malaysia aimed at achieving a target of 30 to 35 percent population coverage by the end of 2009. The company has allocated a CAPEX of **MR 1 billion** to support its network rollout plan over the next five years.[261]

It should also be mentioned that in 2005, the NGN Working Group, which consisted of five market players, in the Malaysian Technical Standards Forum Bhd (MTSFB) was already set up to address issues and concerns with regard to standards and regulatory policies with the onset of IP services. This resulted in guidelines on NGN realization. [262]

The licensing framework in Malaysia was modified from a system of 31 different types of licences to four technology-neutral licences, which lessens the burden to NGN development in the country.

5.6. Nepal

Background information

Population	28.76 million
Fixed penetration	2.5
Mobile penetration	11.6
Fixed broadband penetration	-
Mobile broadband penetration	-
Internet users	1.4
ICT Development Index (Rank 2007)	**139**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Nepal Telecom (NT), (former government monopoly, converted to a Public Limited Company in 2004) is to upgrade its fixed (PSTN) line system into a next generation network, which will enable customers to enjoy high-speed internet connection, watch internet television and use other multimedia services. NT has already conducted a feasibility study for the project. The public bidding process to procure the necessary equipment will start soon.

NT is currently relying on its PSTN network to provide voice service, which can also be used to send or received small amounts of packet data through this network using the dial-up system. Recently, NT also launched an ADSL service using the same platform. With this, data can be transferred at speeds of 128 kbps and 256 kbps. The next generation network will bring all these services under one umbrella and provide high quality voice, data and multimedia services from one point. To begin with, NT will lay optical fibres wherever fixed phone lines are operating. These additional lines will widen the paths through which data and voice travel and reduce the burden on existing copper wires. NT, however, has not fixed a deadline to complete this work, not has it fixed the tariff rates for the new service.[263]

In 2008, Nepal Telecommunications Authority formed Study Groups to:[264]

- Conduct a study on fully opening up of VoIP services.
- Conduct a study on various issues of "IP Based Network Services and Network Security".
- Conduct a study on various issues of NGN and IMS.

5.7. New Zealand

Background information

Population	4.2 million
Fixed penetration	48.1
Mobile penetration	101.7
Fixed broadband penetration	20.4
Mobile broadband penetration	28.0
Internet users	70
ICT Development Index (Rank 2007)	**16**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2005, Telecom New Zealand announced its project to build the IP platform for its core NGN. Telecom planned to invest **USD 220 million (~NZD 350 million)** in new network and system capabilities. All of New Zealand's 2.2 million customer lines will have migrated to the new platform by 2012. Telecom has initiated some FTTH deployment in Greenfield areas. The cost of transition of the whole network to NGN is estimated to be about **USD 1.4 billion (~NZD 2.2 billion)**.[265]

Vodafone launched its 3G package in August 2005 and has begun to upgrade its HSDPA mobile broadband network. In July 2008, Vodafone announced that it would continue building out its 3G mobile network, after announcing a year previously that it had to suspend network construction due to regulatory uncertainty. Vodafone plans to extend its 3G broadband network to reach 97 percent of the population by April 2010. To this effect Vodafone has shown its commitment to this project by investing **NZD 500 million** in its 3G infrastructure.[266] It is improving the downlink speed to 7.2 Mbps and in future, peak downlink speeds up to 28.8 Mbps and uplink speeds up to 11.5 Mbps using HSDPA will be available.

In October 2008, TNZ announced that it would invest **NZD 574 million** in a nationwide rollout of its new mobile network within the next two years.[267] Customers will have access to the nationwide 3G services. The technology choices would also extend 3G services and fast mobile broadband to 97 percent of the population, but by about a year in advance of TNZ's main competitor. With the WCDMA technology, TNZ's handsets would work on more than 430 networks in more than 170 destinations worldwide for voice and texting, and over 110 destinations for Internet data.

There are a growing number of FTTH providers and projects in New Zealand. Vector Communications, operating in Auckland and Wellington, has introduced FTTH services over its own fibre network, which it also wholesales to companies such as Ihug, ICONZ and Orcon. In February 2007, it concluded a contract with Auckland's North Shore City Council, which involved building a 38 km extension to its network. The project was funded by the New Zealand government's Broadband Challenge Fund, costing an estimated **NZD 4.6 million**. Another ISP with fibre optic networks, Wired Country, has networks in Pukekohe and Papakura, South Auckland. ISP Citylink offers services to more than 350 buildings in the central business districts of Wellington with more than 100 km of fibre. In Auckland, CityLink is currently building a fibre-based network. [268]

Regulation

Introduction of ULL in New Zealand through an amendment to the Telecommunications Act of 2006, is regarded as a significant factor in stimulating broadband uptake in the country. In addition, operational separation of Telecom New Zealand is intended to facilitate NGN access network developments. In August 2006, Telecom New Zealand announced plans to separate its wholesale and retail businesses. However, the government did not wholly accept the suggestion and so, in September 2007, it ordered Telecom New Zealand to split into three operating divisions (wholesale, retail and network). It now has an infrastructure operator, Chorus, responsible for its underlying network. A wholesale division buys network capacity from Chorus and on-sells it to retailers, including the Telecom New Zealand retail operation.

If 2006 and 2007 were the years when the important regulatory reforms were drafted, 2008 was the year in which they were enacted. One of the first was naked DSL, designed to create a more competitive environment by allowing competing market players to provide services over the incumbents' copper network. It is anticipated that this will drive down prices and further stimulate investment in the telecommunication sector. The result of these changes will profoundly change the telecommunication market in New Zealand over the next five years. [269] On 20 June 2008, the New Zealand Commerce Commission issued a draft paper on the financial information that Telecom New Zealand must provide and the guidelines it must follow regarding the accounting separation of fixed network services, including its retail and wholesale operations, and Chorus (fixed network access). The regulator said that July 2008-June 2009 would be a transitional year, with the first financial information released in the second half of 2009.[270] On 27 June 2008, the Commission released its final determinations on the price and non-price terms for Telecom's provision of backhaul services for ULL and unbundled bitstream (UBA) broadband services. [271] The Commission noted that Telecom New Zealand faces competition in most North Island primary and secondary links of the ULL Backhaul Service, but limited competition in relation to the South Island primary and secondary links. For new access seekers, the connection fee for the ULL Backhaul Service and the UBA Backhaul Service is NZD 4 030 at one end and NZD 8 059 for a new connection at two ends.[272]

Finally on 31 March 2009, the New Zealand government called for submissions on a proposal to build an FTTH network in New Zealand reaching 75 percent of the population and taking at least six years to roll out. The New Zealand government will invest up to **NZD 1.5 billion** in the network, and seek additional private sector investment to create a national market in dark fibre and wholesale broadband access.[273] The funding will be invested in a government-owned enterprise, which will jointly invest with the private sector in local fibre companies (LFCs) in the 25 cities and towns.

In May 2009, Vodafone submitted a proposal to the Ministry of Economic Development (MED) for the government's plan to install a national NGN. Vodafone's white paper suggests a co-investment model, combining public and private investment to fund a new network business, dubbed FibreCo. Vodafone said, it would not be acceptable to move from a copper access monopoly to a fibre access monopoly. According to the plan, Chorus - Telecom New Zealand's network arm, and TelstraClear (New Zealand's second-largest operator, wholly-owned by Telstra (Australia)) to put their network assets into the new business that would be jointly owned by the trio and the government, which would invest through its **NZD 1.5 billion** broadband fund. FibreCo would then provide wholesale services to its shareholders, and its shareholders would compete in retail markets.[274] In April 2009 Telecom New Zealand handed the government its own proposal for the use of the government's broadband fund, suggesting that investment should be channeled into Telecom's existing infrastructure, rather than spent on deploying a new network.[275]

5.8. Singapore

Background information

Population	4.5 million
Fixed penetration	42
Mobile penetration	133.5
Fixed broadband penetration	20.2
Mobile broadband penetration	43.3
Internet users	68
ICT Development Index (Rank 2007)	**15**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Singapore started the Next Generation National Infocomm Infrastructure (Next Gen NII) project in 2006, which consists of two components namely, (i) National Broadband Network (NBN) and (ii) Wireless Broadband Network (WBN). The Singapor government has adopted a public-private partnership (PPP) approach to set up the NGN. The government is to provide some funding to kick-start the project and the private sector is expected to build, own and operate the network.

WBN was launched in December 2006 by three wireless operators (iCELL, QMAX and SingTel) and it will continue to offer free wireless connectivity at speeds of up to 512 Kbps in public areas for three years until 31 December 2009. The three wireless operators have committed to investing **SGD 100 million** in the project while IDA (Infocomm Development Authority of Singapore) will add up to **SGD 30 million** toward deployment costs.[276] It was reported in December 2008 that there were some 7 500 hotspots installed in high-traffic public areas.

In December 2007, IDA issued Requests for Proposals for the Next Generation NBN, where it has embedded the structural separation of new national broadband network infrastructure from the operating company that will operate its switches and routers. Requirements for two different parts of the network (passive and active infrastructure) were separated:

- NetCo. The NetCo will be responsible for designing, building and operating the "passive infrastructure layer". IDA specifies this passive layer to include wirelines and ducts. The NetCo entity will be subject to universal service obligations (USO) and it will be obliged to deploy fibre access ubiquitously by 2015. The government will support the deployment with a grant of up to **SGD 750 million**. The NGN must initially be capable of providing 100Mbps downstream and 50 Mbps upstream bandwidth for each user. Eventually the speed shall be increased to 1 Gbps and beyond.
- OpCo. The OpCo is responsible for the design, build and operation of the "active infrastructure layer" of the Next generation NBN. IDA specifies this active layer to include switches and routers. OpCo shall provide services to 330 000 residential and 80 000 non-residential customers by 2015. Besides managing the flow of traffic on the passive infrastructure, the OpCo will also be the operator that provides wholesale services to the

Retail Service Providers (RSPs). The government will support OpCo with a grant of up to **SGD 250 million.**[277]

The tender for NetCo closed in May 2008 with submissions from two consortia (OpenNet and Infinity). IDA had selected the OpenNet Consortium. It has committed to achieve 60 percent rollout of all households and businesses by 2010 and 95 percent by 2012. USO will be imposed on OpenNet from 2013.

The OpCo tender was launched on 7 April 2008. A StarHub-led consortium was announced as the winner of its OpCo tender for the national FTTH switching infrastructure. This was the culmination of a tender process launched by the Singapore government back in 2006.[278]

Singapore also has an Intelligent Nation 2015 (iN2015) project. This will link businesses, schools, hospitals and homes. Under this project, copper access network will be replaced with fibre by 2015. Singapore already has fibre to the curb but it is currently replacing the last-mile copper with fibre. A key decision in the iN2015 project was to build an open access network even though the country already has two high-speed broadband networks.[279]

5.9. The Republic of Korea

Background information

Population	48.4 million
Fixed penetration	46.4
Mobile penetration	90.2
Fixed broadband penetration	30.6
Mobile broadband penetration	48.6
Internet users	76.3
ICT Development Index (Rank 2007)	**2**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The Republic of Korea, which has the highest number of broadband connections per capita in the world, is also quickly moving to provide next generation broadband through its **uKorea** (ubiquitous Korea) initiative and its **Broadband convergence Network (BcN)**.

The Republic of Korea has been leading the development of BcN since the early 2000's. In BcN, various types of convergence take place such as convergence of wired and wireless networks, and convergence of telecommunications and broadcasting. For broadband end-to-end mobile networking, the broadband wired networks are interconnected with wireless networks (such as Wireless LAN, Wibro, WiMax and 3G/4G wireless cellular networks). The government launched the BcN project in February 2004 with the vision of providing the core infrastructure for broadband. The BcN target is to provide broadband service to 20 million subscribers (10 million wired, 10 million wireless) by 2010. It is estimated that the investment would require **40.3 trillion won** from 2006 to 2010.[280]

The BcN plan was divided into three phases:[281]

- The first phase (2004~2005) was the BcN construction stage. The objective of this phase is to build an IP-based voice and data integration network for wired and wireless networks, to provide IP-based wired and wireless internetworking services.
- The second phase (2006~2007) was to integrate individual wired or wireless networks, and integrate with the broadcasting network.
- The last phase (2008~2010) is to integrate the wired, wireless and broadcasting network as an IP-based network, to build an IP-based integration transport network, to complete infrastructure for quality-assured services, with the help of FTTH, 4G etc., and to implement intelligent integrated terminals.

A full, commercial BcN deployment is scheduled for 2010, providing high quality services at speeds of 50 to 100 Mbps for 20 million subscribers.

KT (formerly, Korea Telecom) is planning to invest another **USD 1.3 billion** to reach 92 percent FTTH coverage by 2010.[282] South Korea has traditionally been deploying FTTB, with over 80 percent of deployments falling into this category, and most future investment plans will be towards FTTH.

5.10. Taiwan, China

Background information

Population	23 million
Fixed penetration	62.3
Mobile penetration	106.1
Fixed broadband penetration	20.9
Mobile broadband penetration	28.5
Internet users	64.5
ICT Development Index (Rank 2007)	**25**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2006, Taiwan's leading operator Chunghwa Telecom revealed its plan to upgrade its infrastructure by replacing the existing circuit-switched PSTN with a completely digital packet-switched NGN based on IP technologies. It is estimated that the total investment would be **NTD 130 billion**.[283] The project commenced in 2007 and it is expected that 80 percent of the migration would be completed by 2010, while the whole project would be completed in 2013. After completion, the NGN will integrate fixed, wireless, mobile and Internet-based networks, to provide voice and data communications, as well as multimedia services. As part of the NGN program, Chunghwa Telecom will focus on building up FTTH and FTTB access infrastructure from 2007 to 2011 so as to reach 75 percent of the island's population by the end of 2011.

In 2008, Taiwan Mobile planned to invest in the nationwide optical fibre NGN to offer convergent telecommunication services. Such a move would make Taiwan Mobile the second local telecom service carrier to make the jump to a NGN after state-run Chunghwa Telecom. As the company will focus on its core network, switches, servers and end-user terminal equipment, high-speed network companies along with other leading network communications companies are expected to benefit from the investment. To keep costs and construction time minimal, Taiwan Mobile signed an exclusive rental contract with Taiwan High Speed Rail Corporation to use its nationwide optical fibre network.[284] In addition, Taiwan Mobile will take advantage of the government-funded national optical fibre network.

6. THE AMERICAS

6.1. The United States

Background information

Population	308.8 million
Fixed penetration	53.4
Mobile penetration	83.5
Fixed broadband penetration	24.0
Mobile broadband penetration	17.4
Internet users	72.5
ICT Development Index (Rank 2007)	**17**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

About one quarter of US households had access to next-generation broadband service by year-end 2008.[285]

AT&T, the largest US operator, began to roll out a FTTN network in 2004. In January of 2008, AT&T's so-called "U-verse" network passed approximately 7.9 million households and had 231 000 subscribers. The investment required to roll out the U-verse network was projected to be as much as **USD 6.5 billion** through 2008.[286] In March 2009, AT&T said it would invest nearly **USD 18 billion** to expand its wireless and wire-line broadband networks.[287] That will create 3 000 jobs in 2009 and create demand for products.

In 2004, Verizon also announced that it would begin deploying a FTTH network, called "FIOS".[288] In the next four years, it spent billions of dollars to pass 11 million homes.[289] Its initial plan included investment of **USD 23 billion** nationwide between 2004 and 2010 to pass 18 million homes.

Verizon and AT&T are not alone among communications companies in the US investing in NGNs. Cable companies have made massive investments in their broadband infrastructures as well. While the combined annual capital expenditures of AT&T and Verizon increased from **USD 17.1 billion** to **USD 24.6 billion** from 2004 to 2008, the aggregate annual capital expenditures of the three largest publicly held cable providers, Comcast, Cablevision, and Time Warner Cable, nearly doubled, from **USD 5.6 billion** to **USD 10.1 billion** during the same period.[290] Cable companies began to deploy DOCSIS 3.0 technology, with 10 million homes having access to this service at the end of 2008. Comcast (a cable operator) expects to reach approximately 30 million homes with DOCSIS 3.0 service by the end of 2009.[291]

Mobile operators in the US are planning to turn to NGN wireless access technologies to keep pace with the demand for data service. Among the wireless access technologies, mobile WiMax and long-term evolution (LTE) are expected to gain prevalence. The leading edge of 4G roll-outs has begun with WiMax deployments and will accelerate with Verizon LTE deployments

in 2010, with mainstream technology roll-outs and market adoption picking-up in 2011 and 2012.[292]

However, as the Information Technology and Innovation Foundation reports, the main shortage in the US is the connection speed of broadband services.[293] According to its report (2009), nearly all-Japanese citizens have access to next-generation broadband, with median connection speeds over 15 times faster than the United States. South Korea, a country with 1/6th the population of the United States, has almost as much Internet traffic as all of North America. And South Korea is not satisfied with its current speeds; the Korean Communications Commission announced on February 2, 2009 an initiative to widely deploy 1 Gbps broadband — both upstream and downstream, that is, "symmetrically" — by 2012. Even China has announced plans to build its first nationwide high-capacity fibre optic network, which would allow most users 100 Mbps access. [294]

Regulatory developments

The US is one of the few countries that has committed to non-mandatory unbundling of new, broadband facilities.[295] This policy has evolved slowly as the FCC implemented the local competition provisions of the 1996 Telecommunications Act. Lengthy regulatory proceedings resulted in an extremely complicated wholesale network unbundling regime that diminished the incumbents' incentives to invest in network facilities after 2001. However, after repeated reprisals by US courts, including the Supreme Court, the FCC began to reverse course. The FCC decided to abolish line sharing and to largely forbear from requiring unbundling of new deployments of fibre to the home (FTTH) in its August 2003 "Triennial Review" local competition order.[296] The FCC based its decision on its conclusion that incumbents had no inherent advantage in building new facilities and that any unbundling requirement would discourage their investment in these facilities. In this deregulatory environment, broadband subscriptions in the US were growing significantly.

On 10 March 2004, FCC released a Notice of Proposed Rulemaking (NPRM) seeking to address the issue of the proper regulatory regime for services and applications that rely on Internet-based platforms. The proposed rules reaffirm the FCC's policy of light-touch regulation of the Internet and draws attention to the importance of embracing a minimal regulatory approach to IP-enabled services. The FCC has acted to ensure that VoIP providers comply with important public safety requirements and public policy goals. These include:[297]

- imposing in June 2005, 911 obligations on providers of interconnected VoIP services – VoIP services that allow users generally to make calls to and receive calls from the regular telephone network--following reports that some VoIP subscribers were unable to access 911 emergency services;
- limiting interconnected VoIP providers' use of customer proprietary network information such as telephone calling records, and requiring interconnected VoIP providers to protect them from disclosure;
- requiring interconnected VoIP providers to contribute to the Universal Service Fund, which supports communications services in high-cost areas and for income-eligible telephone subscribers;
- requiring interconnected VoIP providers to comply with the Commission's Telecommunications Relay Services (TRS) requirements, including contributing to the TRS Fund used to support the provision of telecommunications services to those with speech or hearing disabilities, and offering 711 abbreviated dialling for access to relay services;

- requiring interconnected VoIP providers and equipment manufacturers to ensure that, consistent with Section 255 of the Communications Act, their services are available to and usable by individuals with disabilities, if such access is readily achievable;
- requiring interconnected VoIP providers and telephone companies that obtain numbers for them to comply with Local Number Portability (LNP) rules. These rules allow telephone, and now VoIP, subscribers who change providers but remain within the same geographic area to keep their phone numbers. VoIP providers must also contribute to funds established to share LNP and numbering administration costs among all telecommunications providers benefiting from these services.

It should be noted as well, that In the United States, the government has allocated **USD 7.2 billion** to support broadband build-up. Even though the investment for a country as big as the United States is limited, many advocate apportioning the funds to areas that really need the stimulus.[298]

6.2. Canada

Background information

Population	33.2 million
Fixed penetration	55.5
Mobile penetration	61.7
Fixed broadband penetration	27.6
Mobile broadband penetration	1.5
Internet users	73
ICT Development Index (Rank 2007)	**19**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

During the third quarter of 2003, TELUS began the transition from circuit-based switching to IP technology by launching its NGN, which is designed to carry high-quality voice, data and video applications. TELUS began the process of moving customer long distance voice traffic to its NGN network in parts of Alberta. In November 2003, the operator launched its IP-One telephony service for business customers in Ontario and Quebec. The IP service uses the TELUS NGN to provide business customers with IP-based advanced application services and the ability to integrate voice mail, e-mail and data via the TELUS Web portal.[299]

In 2006, TELUS announced investments to enhance its broadband network in British Columbia, Alberta and eastern Quebec by the end of 2009. It has been installing advanced Internet equipment in more than 7 000 sites across its network and running fibre optic cable closer to customer homes. The upgrades began in early 2006, making an investment of approximately **CAD 190 million** in 2006 and **CAD 600 million** from 2007 to 2009.[300]

In April 2009, TELUS earmarked an investment of **CAD 700 million** to expand and upgrade wireless and wireline networks in Alberta province, including the planned roll-out of a 3.5G High Speed Packet Access (HSPA) mobile network.[301] The new budget follows earlier announcement that TELUS would spend **CAD 500 million** in the neighboring province of British Columbia. It previously earmarked over **CAD 2 billion** for nationwide network improvements in 2009.[302] Ahead of its upcoming financial and operational report on the first quarter of 2009, TELUS revealed it added only 48 000 net new wireless subscribers in the first three months of the year, 46 percent less than the 88 000 it gained in the first three months of 2008.

In 2000, Bell Canada announced an investment of **USD 1.5 billion (~ CAD 1.6 billion)** over three years to rapidly expand and enhance high speed Internet availability for its residential and business customers. Its Galileo initiative, which was launched in 2004, set out to migrate 100 percent of data traffic to IP/MPLS by 2007, with an estimated reduction in operating cost of between USD 1 billion to USD 1.5 billion in 2006.[303] A further investment of **CAD 200 million** over three years was announced in 2003.[304] In 2006, Bell Canada announced the availability of a high-speed Internet access (called Sympatico Optimax), built on the latest in fibre optic technology in Toronto. Rolling out progressively across Toronto, Sympatico Optimax offers customers a consistent and reliable high-speed Internet connection, including a certified

maximum speed of 16 Mbps service. Announced prices were CAD 70 for 10 Mbps and CAD 100 for 16 Mbps.[305] In 2008, Bell has been consistently increasing high-speed bandwidth coverage by driving fibre deeper into its network. Bell's FTTN program is deploying fibre to within less than a kilometer of homes throughout the Quebec-Windsor corridor, and by the end of 2008 it was planned to cover 2.4 million households.[306] FTTN is also being deployed in all new suburban housing developments.

At the end of 2008, Rogers Wireless launched a nationwide HSDPA upgrade of its network, offering peak downloads of 7.2 Mbps. The Rogers 3.5G next generation network is available in the top 25 markets in Canada, from Victoria to Halifax and elsewhere.[307]

Regulatory developments

According to Canada's Contribution to Global Symposium for Regulators (GSR) 2007, the regulatory framework in Canada is designed to enable competitive network provision, including competitive infrastructure builds. [308] The CRTC (Canadian Radio-television and Telecommunications Commission) mandates local loop unbundling (LLU) and co-location of competitor equipment in incumbents' switching centers. This provides for competitor and incumbent interconnection of both local and inter-urban traffic and for competitor use of incumbent copper-based loops all at cost-based rates. The CRTC has mandated third-party access to cable networks to provide competitive Internet access.

In 2005, the CRTC decided that VoIP calls by customers of the incumbent operators, Telus and Bell Canada, will be regulated in the same way as other calls the operators offer. However, in 2006, Canada lightened its regulation of certain VoIP services. On appeal to the Minister, it was decided that there must be a distinction for different types of VoIP services for the purpose of economic regulation. Namely, "access dependent" (VoIP services which connect to customers making direct use of the service provider's own network, e.g. a cable company providing VoIP service over its own cable network) and "access independent" services (those which connect to customers using any high-speed internet connection and are therefore not tied to the service provider's network e.g. a phone company providing VoIP service to a customer through the customer's cable internet access). Access independent VoIP is accessible only to consumers who have a high-speed connection and must be accessed through the Internet. Access dependent VoIP is similar to the traditional phone service, generating stronger arguments for applying the same regulatory regime. The appeal changes the CRTC's decision so that it forbears from the economic regulation of "access independent" VoIP services of incumbent telephone companies when offered in their incumbent territories.

When operating outside their incumbent territories, incumbent telephone companies are already deregulated to the same extent as new entrants. This does not however, vary the social and safety obligations imposed on VoIP service providers such as 911 emergency services, which were effectively applied to VoIP services under the CRTC's original decision.[309]

Two relatively recent CRTC decisions regarding speeds of wholesale broadband access resulted in a new dispute between CRTC, incumbents and other market players:

- Telecom Decision CRTC 2008-117, Cybersurf Corp.'s application related to matching service speed requirements for wholesale Internet services, dated 11 December 2008, and
- Telecom Order CRTC 2009-111, Cybersurf's application related to the implementation of Telecom Decision 2008-117 regarding the matching speed requirement, dated 3 March 2009.

Essentially, these decisions direct incumbents in Canada to provide competitors with wholesale broadband access services at speeds which match the speeds that Bell and Telus are currently providing to their own retail Internet service customers.[310] [311] In the case of Bell Canada, this would mean that Bell would be required to offer these services at speeds of 7, 10 and 16 Mbps in addition to the 512 Kbps, 5 Mbps and 6 Mbps speeds that are currently offered. Both Bell Canada and TELUS say it could cutback in NGN investments unless the federal government overturns and rescinds the two recent CRTC decisions on speed matching.

Keeping in mind the fact that once a leader in international broadband standings, Canada is now being passed by many countries in broadband services, some investment plans are being made by the Government itself. For instance, at the beginning of 2009, it was announced that the Government would invest more than **CAD 33 million** over three years towards projects in communities most at risk from the Mountain Pine Beetle infestation. The first one will install a fibre optic network in the community of Grand Forks, British Columbia.[312]

6.3. Brazil

Background information

Population	194 million
Fixed penetration	20.5
Mobile penetration	63.1
Fixed broadband penetration	3.5
Mobile broadband penetration	1.2
Internet users	35.2
ICT Development Index (Rank 2007)	**60**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Service providers (fixed and mobile) in developing countries are also aware of cost saving efficiencies associated with NGNs in core networks. This might be illustrated by the example of Brazil, where a number of providers have also already announced plans to migrate to NGNs for their core networks.

In 2003, Telefonica selected a supplier for its IP backbone network. While initially deployed to support the voice service offer expansion throughout Brazil, Telefonica's NGN ultimately has served to enable the convergence of voice, data and video services in a single network.[313]

In 2006, Transit Telecom announced a **USD 7 million** investment that it considered would build one of the largest NGNs in Latin America to enable the convergence of voice and data for IP service offerings and the Voice over Broadband market. Implementation of the NGN network was scheduled to be completed by the end of 2006.[314] Transit Telecom has a strong presence in the south and southeast of Brazil and is rapidly expanding throughout the rest of the country.

In 2006, Telemar announced that it contracted a technology supplier to upgrade its network in Brazil. The agreement, worth approximately **USD 5.7 million**, included enhanced versions of hardware and software that will enable Telemar to offer new advanced services to its wireline subscribers through the installation of NGN platform. [315]

Brazilian long-distance operator Intelig Telecom completed tests of its NGN in 2006. In the test phase, 20 000 customers migrated to the unified voice and data platform. The network is used to carry traditional local and long-distance voice call services and also handle VoIP and PABX. The operator has also extended its backbone in Minas Gerais state capital Belo Horizonte and Brasilia, with indirect benefits for Brazil's northeastern region, in order to better serve the corporate market.[316]

In 2007, Brazilian fixed line and mobile operator Brasil Telecom selected a provider to supply it with an IP/MPLS solution as the core backbone for its converged, nation-wide network in Brazil. The IP/MPLS platform will enable the operator to deliver a set of fixed and mobile residential broadband services, as well as business VPN services from a single platform. The exact details of the 'multi-million Euro contract' were not disclosed.[317]

Another Brazilian fixed line operator, CTBC announced in 2007 its plans to migrate the existing infrastructure to a full IP platform over the next five years. The switch to a NGN will allow the operator to offer convergent services.[318]

The creation of Brazil's first IP communications network purely for business use was announced in 2008. Empresa de Infovias S.A. aims to provide cost effective, converged IP voice and data services for its corporate users and to influence the growing regional economy.[319]

In April 2009, Brazilian telecoms operator Sercomtel launched an NGN platform to offer fixed telephony services in Rolândia, Paraná state.[320] When launched, the new NGN will have a capacity of 20 000 users. Sercomtel contracted a technology provider to build the new platform in 2008, awarding it a **BRL 4.9 billion (~USD 2.8 billion)** contract for the installation of the NGN, which will eventually replace its TDM infrastructure.[321]

Some operators in Brazil have initiated FTTx projects for NGN access networks. At this stage, however, the high costs and uncertain returns limit such projects to high population, high-income areas. Therefore, other types of technologies, such as WiMax, are gaining their popularity in this country.

By the end of 2008, Brasil Telecom (BrT) had expanded its fibre optic network in five cities in Brazil and intends to offer broadband Internet access to residential users at speeds of up to 100 Mbps. In the first phase, BrT is offering fibre optic connectivity to residential users in Brasilia, Parana state capital Curitiba, Goias state capital Goiania, Rio Grande do Sul state capital Porto Alegre, and Santa Catarina state capital Florianopolis. The operator offers for broadband services include: 14 Mbps download speed at BRL 199.90 per month, 20 Mbps at BRL 225.90, 30 Mbps at BRL 299.90, 50Mbps at BRL 499.90, 70 Mbps at BRL 699.90 and 100 Mbps at BRL 990.90.[322]

In 2009, Brazilian satellite TV operator Sky is launching trials of WiMax technology in the country using the 2.5GHz spectrum band to offer broadband Internet access.[323]

Wireless broadband solutions provider WxBR says it is ready to launch and are fully operational with the complete WiMax portfolio: customer premises equipment (CPE), base stations, gateways and management.[324]

Telefonica Brazil has rolled out WiMax technology trials in Sao Paulo. The pilot project, was taking place in the Pinheiros and dos Jardins areas, and included around 150 customers. The three-month trial in the last quarter of 2008 used the 2.5GHz band and WiMax equipment based on the 802.16e standard, and was looking to provide broadband Internet access with speeds of 2 Mbps (download) and 600 kbps (upload).[325]

COPEL Telecomunicacoes in Brazil deploys broadband over power lines (BPL) technology in the state of Parana, according to Telegeography, September 2008.[326] COPEL plans to offer high speed Internet access over the existing electrical infrastructure to thousands of customers living in the region. The project includes installation, integration and testing, and operation of BPL equipment and power line communications (PLC) systems. Three hundred customers were expected to participate in trials of the new service by the end of 2008. A second citywide deployment is designed to attract 3 000 to 10 000 customers, while a large-scale deployment is expected to provide full coverage of the company's 3.5 million customers.

To give an overall picture of broadband subscription in Brazil, by 30 June 2008, Brazil had 10.04 million broadband lines (48 percent increase since 30 June 2007). At the same date, the total number of mobile broadband connections (excluding 3G devices but including PC access) stood at 1.3 million, up 464 percent compared to 233 000 subscriptions as of 30 June 2007. The number of 3G-based Internet users was estimated at 950 000 at the end of June 2008, and at

that time according to Cisco's calculations, broadband penetration in Brazil reached 4.6 percent.[327]

Regulatory developments

Anatel (Brazilian regulatory body) established guidelines for co-location and line sharing in 2004, setting a price of BRL 15.42 for providing broadband services over the last mile and giving incumbent operators Brasil Telecom, Telesp and Telemar 30 days to publish plans for line sharing and full unbundling.[328] However, local loop unbundling (LLU) was not very popular among operators due to the lack of a framework for the implementation and enforcement of rules.[329] As with many other country examples, characteristics such as the size of Brazil, population density, areas covered by different fixed line operators etc., have led to other broadband technologies being considered as more promising in this country.

In 2007, Anatel approved regulations to allow the country's 5 561 municipalities to offer Wi-Fi Internet access. Under these regulations, municipal governments wishing to set up Wi-Fi networks can do so either through Anatel-approved companies, or by offering the services directly by applying for a licence to offer a private network service. Anatel hoped the ruling would boost Wi-Fi networks in smaller municipalities. It estimated that it would cost BRL 20 000 to set up a Wi-Fi network capable of covering 10 000 people.[330]

The Brazilian authorities believe the development of 3G/WiMax in the country will help to speed up broadband internet penetration, and in February 2009, Anatel announced plans to auction spectrum in the 2.5GHz and 3.5GHz bands for third-generation (3G) and WiMax services before the end of the year.[331] However, in June 2009 Neotec, the organization representing the licensed multichannel multipoint distribution service (MMDS) operators, has accused 3G operators and equipment suppliers of doing all they can to block the award of WiMax licences in the 2.5GHz band. In Neotec's view, 3G licence holders are concerned that MMDS operators will be allowed to use part of the 2.5GHz spectrum for high speed mobile WiMax (802.16e) services, when they were forced to pay up a total of USD 3.4 billion for their licences in December 2007.[332]

In May 2009, Anatel also published a decision which approves the Regulation on the Conditions of Use of Radio Frequency by Broadband over Power Line (BPL) Systems. The new regulation establishes the criteria and technical parameters for using this technology to ensure that BPL systems do not cause harmful interference to other services (e.g., sound services and image broadcasting services).[333]

With regards to VoIP regulation, it has to be said that there is no specific legislation for VoIP services in Brazil. Anatel considers that VoIP is a telecommunications service or simply a value-added service.[334]

6.4. Colombia

Background information

Population	46.7 million
Fixed penetration	17.2
Mobile penetration	73.5
Fixed broadband penetration	2.6
Mobile broadband penetration	-
Internet users	26.2
ICT Development Index (Rank 2007)	**70**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2006, Colombia fixed line operator Empresa de Telecommunicaciones de Bogota (ETB) selected a provider to supply broadband network equipment (at a cost of **USD 1.3 million**) which will allow it to offer ADSL2+ Internet access, IPTV, IP telephony and gaming applications. The first installation has already been successfully carried out, with the network launched commercially in the same year.[335]

Emcali, one of Colombia's four major fixed-line operators, also announced the upgrade of its core network to NGN core network in 2006. The new network provides a range of advanced services, including broadband access, IPTV, and other intelligent services, to customers in Columbia's second largest city Cali.[336]

In 2006 Telefonica announced a plan to launch new broadband products in the Colombian market, with higher speeds, as well as packages combining voice, Internet access, and quality digital television, with attractive offers that are also suitable for lower-income customers. It was going to make an investment of approximately **EUR 170 million**, in order to convert its current network to a NGN with greater transmission capacity.[337]

Colombia's broadband penetration is slightly lower than the regional average, but it is expanding. Colombia is one of the first countries in the world where WiMax has been deployed commercially, achieving a 5 percent share of the broadband market. According to Colombia's telecoms regulator, CRT, the country ended 2007 with 1.2 million broadband Internet subscribers. ADSL technology represented 57.4 percent of total connections, followed by cable modem technology (35.5 percent) and WiMAX (4.4 percent). Operator ETB took 22.1 percent of the broadband market, followed by EPM Telecomunicaciones (Une) with 20 percent and Colombia Telecom with 16.7 percent.[338] During 2008, a 51 percent growth in the number of fixed broadband connections was observed in Colombia. The growth can be attributed to service provider investment in infrastructure and an increase in computer penetration which as of December 2008 reached 11.01 computers per 100 inhabitants compared with an 8.8 percent penetration in 2007. Fixed broadband connections reached 1 812 892, an increase of 20.7 percent during that period. Fixed broadband penetration in Colombia is now 4 percent, compared with 3.4 percent penetration in June 2008. Mobile broadband grew 3.5 times in the last six months of 2008, reaching 246 700 subscriptions.[339]

Colombia Movil, the Colombian wireless network operator planned to launch 3G services in the second half of 2008. It has already attempted to boost take-up of its services by expanding its coverage and rolling out 2.5G and 2.75G data services to more areas, investing **USD 170 million** in 2007 alone.[340] By September 2007, it had 87 percent GSM/GPRS coverage. It began rolling out an EDGE platform in early 2005 and although services remain limited to the metropolitan areas; it eventually plans to build out an EDGE-capable network across most of its GSM coverage area.[341]

Orbitel, owned by municipally run operator EPM, launched WiMax services in July 2006 (the only company at that time offering these services) in the city of Cali and has since expanded to Bogotá, Medellín, Barranquilla, Cartagena and Cucutá. At the end of 2006, it had just over 1 000 WiMAX customers, of which 15 to 20 percent are corporate accounts.[342] In 2007, Colombia's communications ministry, Mincomunicaciones (MinCom), awarded 55 departmental WiMax licences for the 3.5GHz spectrum band.[343]

Several operators offer triple-play solutions, combining telephony, broadband, and television. The pay TV market has experienced a wave of consolidation, with the acquisition of five cable TV firms by Mexico's Telmex, and of two cable TV firms by UNE-EPM. As a result, Telmex controls more than half, and UNE-EPM almost one fourth of the cable TV market.[344]

Regulatory environment

As stated in a study carried out by CRT (the Colombian NRA), one of the main reasons for the implementation of measures geared at unbundling the subscriber loop in incumbent operators is to promote competition, help incumbents see this market as a way to diversify their offer and to find alternative sources of income, and subsequently to promote investment in new infrastructure to satisfy demand for these services by new users.[345]

In another study in 2007, CRT looked at regulatory options for extending broadband Internet penetration. This study shows that broadband Internet access development in Colombia is low compared with other countries in the region.[346] It also analyzes different mechanisms to promote competition and achieve established goals. The mechanisms focus on enhancing competition based on the existing services (DSL, cable modem) and lowering barriers to competition by analyzing the possibility of unbundling the local loop of existing networks. The study indicates that it is necessary to establish regulatory mechanisms for the unbundling of the local loop and to enable resale of existing infrastructure to promote competition in broadband access. The study shows that there are no special regulations for broadband Internet access in Latin America. In some cases like Chile, the country with the highest regional broadband penetration, the influence of cable companies in market competitiveness resulted in a higher penetration of cable modem services and more investment by telecom companies. This did not happen in Colombia where broadband access tariffs are still high compared with other countries of the region (local tariffs in Argentina are around half the price of those in Colombia).[347]

A relatively new measure being implemented in Colombia in order to address the convergence issues is the introduction of a flat interconnection rate representing the cost of the capacity, rather than a per-minute rate. Colombia has implemented a capacity-based interconnection (CBI) regime that allows operators to request a specific interconnection capacity and pay a flat rate charge that reflects the fixed cost nature of that capacity. As interconnection capacity is dimensioned to peak-hour traffic, CBI rates reflect economic costs and do not require artificially spreading such fixed costs over projected traffic minutes to arrive at a per-minute charge. In 2002, the regulator issued a resolution allowing operators the option of choosing time-based interconnection or capacity-based interconnection on a per-city basis. However, there is only a single 2 Mbps capacity unit and reselling is not allowed.[348]

Colombia, however, has a relatively restrictive environment with regards to VoIP services. It allows VoIP and treats it as a voice telephony service, but one that can only be offered by already licensed voice services operators. The high costs of licences in Colombia mean that there is little possibility of new entrants in the sector.[349]

6.5. Chile

Background information

Population	16.8 million
Fixed penetration	20.7
Mobile penetration	83.7
Fixed broadband penetration	7.9
Mobile broadband penetration	0.4
Internet users	31
ICT Development Index (Rank 2007)	**48**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The composition of the Chilean telecommunication market is very specific: 13 administrative areas govern the telecommunications sector with officials representing each area. The fixed market is split between a number of local and long distance operators, while the mobile market now operates on a model similar to that used in the rest of the world, with three major national operators. [350] The Chile telecom market is the most mature in Latin America, with a modern infrastructure.

Entel, Chilean fixed line and mobile operator, operates a nationwide trunk network using a microwave system and an NGN-IP platform (See Figure 11). In 2006, Entel announced plans to invest **USD 150 million** over the coming three years to expand the number of value-added services it offers over its NGN network. The network, which cost **USD 30 million** and took one year to install, enables the operator to supply communications, data and Internet services.[351] Entel also plans to invest up to **USD 500 million** in 2009, with 80 percent going into expanding the company's 3G network and the rest into fixed line infrastructure.[352]

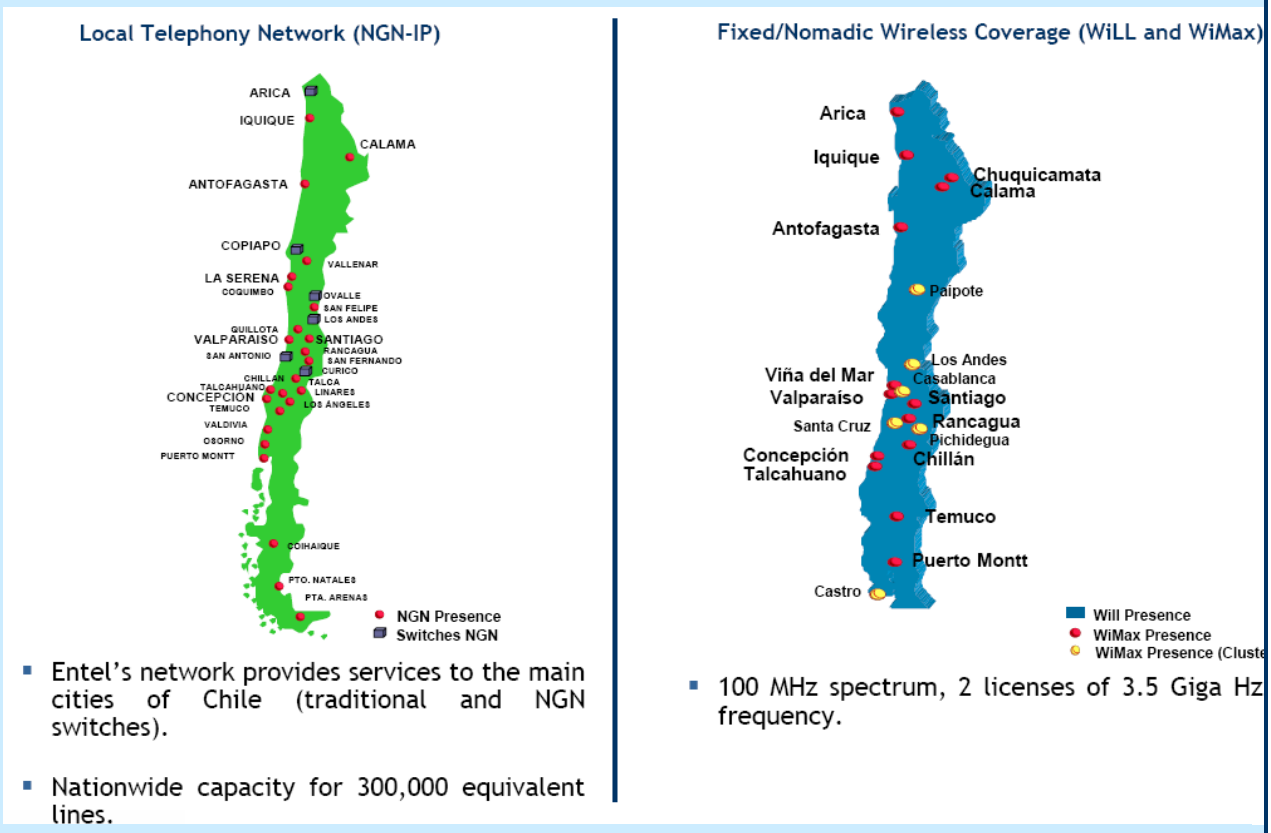
Telmex Chile has upgraded its fibre optic infrastructure with IP/MPLS and NGN technology. In 2005, Telmex announced that it was the first operator in the country to offer a nationwide IP network service, following the deployment of an IP Centrex system, which integrates Telmex's IP/MPLS network and its NGN network.[353] In addition to that, Telmex Chile won the licence to offer WiMax-based services in January 2007 and launched commercial services two months later. In January 2008, it completed coverage of 98 percent of the country's population, equivalent to 92 percent of municipalities including Easter Island.[354] Initial planned investments were **USD 15 million**.[355]

Telefonica Chile operates the largest fibre optic network in the country, with digital satellite and microwave links.[356] Beginning to build its networks in 2003, with initial investments of **USD 230 million** and **USD 150 million** in 2004, Telefonica Chile became the first IPTV service provider in Latin America by 2007.[357] [358] In June of that year, the company launched IPTV in Santiago, with an investment of around **USD 20 million** in network upgrades and equipment purchases. A few months later it was announced that Telefonica del Sur would provide wireless IPTV, using the MediaFlex system, which is a multimedia Wi-Fi solution designed to extend the range and increase the reliability of Wi-Fi signals while automatically avoiding interference as it

occurs. This allows flawless streaming of multimedia, such as IPTV channels, over standard 802.11a/b/g Wi-Fi.[359]

In 2006, telecommunications and cable provider VTR deployed IP NGN architecture, to facilitate the growth of triple-play (data, voice and video) services over residential broadband connections.[360]

Figure 11: Coverage of Entel's networks



Source: Entel, 2007

In March 2009, Inverca Telecom, a Chilean company associated with Malaysia's Packet One (P1), was awarded a **CLP 56 billion (~USD 112 million)** deal to provide wireless broadband services to rural Chile. The company won because in its offer it requested zero government subsidies. The other three bidders - Telefonica Chile, Entel, and Comunicacion y Telefonia Rural (CTR) - asked for subsidies of CLP 28 billion, CLP 22 billion and CLP 31 billion, respectively.[361] The project will involve providing connectivity to 1 470 rural communities that comprise more than 850 000 households and three million individuals. There are also 800 schools. Inverca must establish 30 percent coverage of the rural areas by October this year, 70 percent by July 2010 and 100 percent by March 2011, when the country expects 92 percent of its total population of around 16 million to have access to the internet, compared to the current 70 percent. The cost of the internet service will be approximately CLP15 000 a month per megabyte.[362]

Regulation

Both market players and regulator realized relatively early that the future of the sector lay in wireless technologies, and on this basis, the regulator chose licensees carefully and adopted measures to stimulate competition in the market. For instance, not all current operators are allowed to participate in the upcoming auction for spectrum in the 1700MHz/2100MHz band, because of a Supreme Court ruling on 27 January which stipulated that existing players may not exceed 60 MHz of spectrum per operator. The regulator, Subtel requested this restriction in the hope that this would encourage a fifth mobile operator to enter the market.[363]

In 2008, Subtel published a list of regulations for VoIP services, which guarantee subscribers the same rights as those linked to traditional telephony services.[364] According to the new regulations, VoIP is still a public service, which requires a concession licence. The regulations allow users to make VoIP calls to and from the public telephone network, with the right to complain about poor service, receive an itemized bill, end a contract in a maximum of ten days, as well as call emergency numbers even when the service is suspended due to non-payment. The regulations do not cover internet-to-internet calls or one-directional calls from the Internet to public phone networks. VoIP service providers will receive blocks of numbers that will be assigned to a geographical area, so that callers can be connected to the Internet outside the geographical area, but calls will still be charged as if initiated from the area where the number is registered. Additionally, the concessionary must inform the user about the quality of service being provided. Concessionaries may interconnect with the public telephone network either directly or indirectly via their own means or via third parties, assuming the cost of interconnection. The service is subject to telephone line interception according to the public security regulations established by law. Additionally, the responsibilities of the service provider (concessionary) are separated from those of the broadband service provider and of the ISP.

6.6. Paraguay

Background information

Population	6.2 million
Fixed penetration	6.4
Mobile penetration	76.6
Fixed broadband penetration	0.8
Mobile broadband penetration	-
Internet users	8.7
ICT Development Index (Rank 2007)	**96**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The implementation of a NGN network in Copaco was the result of the need to expand the capacity of both the national and international switching centres.[365] On the basis of competitive bidding Copaco has acquired soft switches capable of handling international and national traffic for 90 000 domestic telephone lines and 45 000 IP lines and started carrying traffic with the new technology for the 90 000 lines at the end of 2007.

With the acquisition of this new technology, although savings in switching costs have been made, the cost of investment and maintenance of the copper access network is still high. Apart from that, with respect to international calls, and keeping the quality level offered by the company, the external fees paid to correspondents are the same for circuit switched or IP technology. The expansion of IP telephony will depend on the growth of Internet services, and the use of computers, given the small penetration in the country.

The company has acquired the NGN network technology to expand the services currently provided, taking into account the cost savings made on switching. It has opened the possibility of IP telephony and other services such as IPTV, which is being studied at the moment.[366]

Although there are no alternative fixed line operators active in Paraguay, it is expected that the country's mobile operators will establish new fibre-optic links to internet gateways. According to TeleGeography, Telecel Paraguay (Tigo) and Nucleo (Telecom Personal) provide fixed-wireless and mobile broadband access services via WiMax technology. Nucleo launched its 3G and 3.5G services in the beginning of 2008.[367] Tigo also operates a fibre-optic backbone network which covers the entire metropolitan area of Asuncion and surrounding cities, whilst Nucleo uses its wireless infrastructure to offer data services to corporate customers in the largest cities, under a separate licence, partly via its own fibre optic network in Asuncion.[368]

Regulatory developments

Following the decision by the Paraguay regulator, Conatel, in March 2009, to end Copaco's monopoly on wholesale internet access, the incumbent operator has announced in May that it will reduce retail and wholesale internet access tariffs for the second time this year. From the beginning of March, Copaco cut certain tariffs by an average of around 23 percent. The

monopolistic market and high prices have inhibited growth in the sector; Copaco reportedly finished 2008 with fewer than 15 000 broadband customers, up from an estimated 10 000 at end-2007[369]

Alongside the wholesale resolution, Conatel reassured Copaco that its exclusivity on the provision of VoIP telephony in Paraguay would continue. The operator launched VoIP services on a commercial basis early 2008.

At the beginning of 2009 the government of Paraguay announced that it is investing **USD 235 million** in the national fixed line operator Copaco.[370] The funds will be used to expand Copaco's wireline and fixed-wireless user base and improve the availability of broadband internet services. The government wants to raise the number of fixed line users from the current level of around 400 000 to one million.

7. AFRICA

7.1. Angola

Background information

Population	17.5 million
Fixed penetration	0.55
Mobile penetration	29.1
Fixed broadband penetration	-
Mobile broadband penetration	-
Internet users	2.9
ICT Development Index (Rank 2007)	**NA**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The priority in Angola, as with the majority of African countries, is to develop and upgrade its backbone networks.

In 2008, Angola Telecom stated that it planed to complete the digitization of its fixed line network over the next few years as part of a wider plan to modernize its services. Angola's incumbent operator plans to expand its fixed communications network and install both a wireless access telephony system and fibre-optic cables. [371] In 2009, state-run Angola Telecom announced that it has budgeted **USD 2.4 billion** to expand and upgrade its domestic fixed line network by 2013. The first phase of the planned project will involve deploying a 7 000 km fibre-optic backbone and installing 500 000 fixed local access connections, at a cost of **USD 1.2 billion**, with a second phase of roughly the same value to further develop the network by 2013.[372]

In April 2009, only a few days after Angola Telecom announced its investment plan of USD 2.4 billion, the alternative operator Mundo Startel, which is partly owned by Telecom Namibia, revealed its own **USD 55 million** expansion plan to build 100 000 new access lines through wireless local loop connected to a NGN backbone.[373] Mundo is building out a fixed-wireless network based on CDMA2000 access technology and NGN backbone infrastructure. [374]

It is interesting that joint activities in building national backbone networks are becoming quite popular in African countries. In June 2009, Angola Telecom agreed to form a joint venture with four private operators under the name Angola Cable to build and manage fibre-optic infrastructure. The new company will be 51 percent owned by Angola Telecom with the remainder split between Mundo Startel, Unitel, Mercury and Movicel, and the partners have committed to a **USD 90 million** investments between them. The fibre project will involve building new links to other African countries as well as Europe, with operations scheduled to commence in 2011.[375]

7.2. Namibia

Background information

Population	2.1 million
Fixed penetration	6.7
Mobile penetration	38.6
Fixed broadband penetration	-
Mobile broadband penetration	-
Internet users	4.9
ICT Development Index (Rank 2007)	**112**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In its annual report of 2005/2006, Telecom Namibia indicated that a transition to an IP based network would provide an ICT product and service portfolio to customers via access technologies such as ADSL, CDMA, WiMax and Metro Ethernet. During the period, the Multi Protocol Label Switching (MPLS) technology was implemented with investments of **NAD 120 million**, and the development of ADSL technology has made good progress.[376] [377] The migration of the company's PSTN to an all IP network is scheduled to be completed by 2010 at a cost of **NAD 1 billion**.[378] To fund the investment, Telecom Namibia intended to raise **NAD 400 million** on the financial markets, with the remainder provided by its own resources.

In 2007, Telecom Namibia started to upgrade its wireless in the local loop (WLL) systems to WiMax standard, in order to expand voice telephony, broadband internet and data services throughout the country. In 2008, the company launched a WLL pre-paid 3G mobile data card service over the company's CDMA2000 1xEV-DO Rev A network. The operator says it has upgraded its networks from EV-DO Rev 0 to Rev A in many towns around the country.[379]

In December of 2006, Namibian mobile operator, MTC, officially launched its W-CDMA/HSDPA mobile network function in the capital Windhoek. The 3G network, with an estimated cost of **NAD 40 million**, initially offered data transfer speeds of up to 900 Kbps. During the next phase of network development, the operator planned to cover the majority of the country's commercial centers.[380] By the middle of 2008, MTC had invested nearly **NAD 300 million** in its network infrastructure, in projects including raising SMS capacity, the deployment of a transmission backbone across several areas of the country, and the replacement of central switching equipment with next generation architecture elements. The company's fibre optic transmission network was extended in areas including the capital Windhoek, coastal regions and in the north, ending MTC's long-standing reliance on renting backbone capacity from Telecom Namibia. MTC also upgraded its radio access network and wireless broadband service. MTC investments over the last 13 years total **NAD 1.6 billion**.[381]

In March of 2008, MTC and broadcaster MultiChoice Namibia have jointly announced that they will offer broadcast TV services to MTC mobile subscribers over the operator's 3G network. MultiChoice Namibia switched on its mobile television network in 2009, based on the Digital Video Broadcast - Handheld (DVB-H) technology standard. DVB-H configured mobile phones will be made available to consumers through MTC.[382]

A new pay television station, GTV Namibia, launched in October 2007, as part of a Pan-African television service already available in Kenya, Uganda, Tanzania, Botswana, Rwanda, Mauritius, Zambia and Ghana, and after investing over **USD 250 million (~ NAD 1.8 billion)** in Africa and a further announcement to invest over **USD 35 million (~ NAD 260 million)** in expanding its NGN in West Africa, has recently collapsed citing the current financial crisis for its demise.[383]

In February 2009, ISP MWEB Namibia launched a new range of business subscriber packages for premises owners wishing to offer Wi-Fi wireless Internet hotspot facilities. MWEB's Wi-Fi hotspot solutions are aimed at businesses such as hotels, lodges, restaurants and shopping malls.[384] The company is planning an extensive roll-out of the service throughout Africa.

Regulatory developments

In September 2008, Namibian Communications Commission (NCC) published a draft of the new licensing framework in Namibia. The current licences issued by NCC are service specific as operators are licensed to provide either mobile or fixed telephony. In the new licensing framework, it is foreseen that integrated network platforms will carry all forms of communication, including fixed and mobile voice, data and video, originating from many different providers. A service and technology neutral approach is employed in the new framework, under which NCC will issue only two types of licence: for Electronic Communications Services (Telecommunications and Broadcasting) and for Electronic Communications Network Services (Networks and Facilities). The aim of this new licensing framework is to remove policy and regulatory barriers in order to facilitate and promote effective competition, to reflect the reality of technological convergence and to liberalize the ICT sector.

As NCC stated in the draft document, this new licensing regime enables the following: "*a. Recognition of Next Generation Networks (NGN) as a key driver of technological convergence. Due to the uncertainty of its evolution path, the new licensing structure aims to avoid reliance on any one view of future market structure, whilst also avoiding unnecessary complexity in licensing structures. The implementation of this process will however happen in stages b. Transfer of spectrum from the broadcast to the telecommunications sectors (as in the case with digital TV migration) or visa versa.*"[385]

In Namibia, VoIP services are provided only by licensed operators.[386] Under the old framework, ISPs were required to obtain separate licences to offer VoIP. This is due to change when a new Communications Bill (presented in the Parliament of Namibia in June 2009[387]), together with the new licensing framework, come into force.

It is also important to note, that the Namibia government has guaranteed funding of **NAD 240 million** to Telecom Namibia to connect the country to a new undersea cable that will provide greater broadband capacity for high speed internet, data and voice transmission between Africa and Europe. Namibia will also participate in the African West Coast Cable (AWCC) project, led by South Africa's Broadband InfraCo, which aims to operate the new submarine fibre route by May 2010.[388] In the new era of NGN, guaranteed and high quality international connectivity becomes very important.

7.3. South Africa

Background information

Population	48.8 million
Fixed penetration	9.6
Mobile penetration	87.1
Fixed broadband penetration	0.8
Mobile broadband penetration	2.7
Internet users	8.2
ICT Development Index (Rank 2007)	**87**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The State Information Technology Agency (Sita), provider of communications services to government, was one of the first (in 2007) to move to NGN in South Africa. The NGN had to replace the government common core network (GCCN), because, in the years since its deployment, core capacity requirements on the GCCN have grown by 150 percent year-on-year, although there have been no major bandwidth upgrades since 2007. The project's total investment was **ZAR 454 million** over a five-year period, and at that time it was the largest deployment of NGN services in the public sector in Sub-Saharan Africa.[389]

Telkom South Africa is planning to make substantial investments into its NGN over upcoming years. As indicated in the company annual report, over the next two years it is going to invest in:[390]

- **NGN**: Approximately **ZAR 2.9 billion** is expected to be invested to accelerate deployment of the NGN;
- **Wireless access network**: Approximately **ZAR 3.8 billion** is expected to be invested;
- **Data centre**: Approximately **ZAR 1.5 billion** is expected to be invested in building local data centre capacity over the next two years; and
- **MWEB Africa and Multi-Links**: An amount of **ZAR 1.9 billion** has been earmarked to settle the bridging finance relating to the acquisition of MWEB Africa and for the buy-out of minority shareholders in Multi-Links.

Wireless operator MTN South Africa announced plans to spend **ZAR 4.6 billion** upgrading its network in 2009. The company aims to improve network coverage and data transmission speeds, whilst reducing operating expenses. MTN is planning to build 305 new base station sites and it is also investing in a fibre-optic network.[391] The network upgrade project began in 2008. One of the key objectives for 2008 was to extend 2G and 3G/HSPA network coverage and major milestones were achieved last year, with 2G coverage extended to reach 97.9 percent of the country, while 3G coverage increased its footprint to 38.2 percent. The complete migration to MTN's NGN is scheduled for 2011.[392]

South Africa is to host the 2010 Football World Cup. In preparation, it is capitalizing on advances in 3G and digital migration to ensure that every mobile phone in the country can

receive mobile television, while visitors from around the world will be able to use mobile multimedia services to send images and video footage of the action at South African stadiums.

At the beginning of 2009, mobile operators Vodacom, MTN and Neotel decided to build co-operatively a 5 000 km national long-distance fibre-optic network that could cost about **ZAR 2 billion**.[393] The telecom companies agreed to share the costs of trenching and project-managing the 5,000km network. However, they are expected to provide their own fibre and transmission equipment.

Regulatory developments

There is no specific regulation with regards to NGN in South Africa so far. But from the speeches of ICASA (Independent Communications Authority of SA) officials, it is clear that the regulator is keeping an eye on NGN that they would be held accountable for service delivery.[394] "National Broadband Forum" is drafting a framework for a national broadband strategy for South Africa, which no doubt will take into consideration current NGN developments in the country.

One of the issues to simulate NGN developments in South Africa is relatively recent deregulation of VoIP services in the country. In February 2005 several statutory restrictions have been lifted on the use VoIP in South Africa. Previously, VoIP could only be utilized by the incumbent telecommunications operator, the second national operator and under serviced area licensees. An announcement by the Minister of Communications revoked this ban so that as of 1 February 2005, VoIP could be provided by Value Added Networks (VANS) as well.[395]

However the pending decision on mobile TV licence/ licences might be interpreted as obstacle to the further spread of NGN services, especially the ones provided through mobile networks. In February 2009 ICASA has withdrawn an invitation calling for firms to apply for mobile TV licences, saying it is keen to finalize its digital migration policy before offering concessions. ICASA favors the deployment of a single national mobile TV system, which will be shared by all cellular operators, while the operators themselves have called for spectrum to be awarded to individual players.[396]

7.4. Tanzania

Background information

Population	45.5 million
Fixed penetration	0.4
Mobile penetration	20.6
Fixed broadband penetration	0.2
Mobile broadband penetration	-
Internet users	1.0
ICT Development Index (Rank 2007)	**145**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Tanzania launched an IP-based NGN network in 2005 after the expiry of the four year Exclusivity Period (February 2001- February 2005) on basic telecommunications and leased line services given to the Tanzania Telecommunications Company Limited (TTCL), the incumbent fixed telecommunications network operator.[397] At the end of 2006 TTCL announced that it would begin work on installing a NGN in Zanzibar in 2007 to improve the island's telecoms system.[398]

In February 2007 Vodacom Tanzania launched 3.5G services in the capital Dar es Salaam, offering broadband speed on the move via an HSDPA data card.[399] The service has since been rolled out in Dodoma, the third biggest city in the country and capital of the Dodoma region. In June 2008 Vodacom Tanzania launched 3G services in the northern city of Arusha, offering subscribers access to high-speed Internet connectivity, as part of a **USD 126 million** broadband upgrade for Vodacom.[400]

In 2007 Redline Communications has won a contract to supply Tanzania-based telecoms provider Hotspot Business Solutions with the country's first national WiMax network. Financial details were not disclosed, but it is understood Redline will supply the operator with products, enabling Hotspot to deliver high-quality voice, video and data internet services across the country, via its six-city WiMAX network. The first phase of the project launched in 2007 in Dar es Salaam and Mwanza. The second phase deployment will begin in January 2008 and will bring WiMAX services to Dodoma, Morogoro and Zanzibar.[401]

Regulatory developments

On 23 February 2005, the Tanzania Communications Regulatory Authority (TCRA) introduced the Converged Licensing Framework (CLF). The CLF was introduced after the end of the exclusivity of the incumbent fixed line operator. The new framework is designed to encompass technology and service neutrality and crafted to match with the dynamism of the communications sector. The converged licences currently available are:[402]

- **Network Facility Licence** entitles the holder to construct, maintain, own and make available electronic communication infrastructure, e.g. earth stations; fixed links and cables, payphones; radio transmitters.

- **Network Service Licence** entitles operation of electronic communications networks in order to deliver services e.g. bandwidth services, broadcasting, access to applications.
- **Application Service Licence** authorises reselling or procurement of services from Network Service Operators e.g. Internet providers, VoIP, virtual mobile provider.
- **Content Service Licence** entitles provision of public content e.g. satellite broadcasting, free to air TV, radio broadcasting.

During 2006 most service providers obtained their new licences. The new licensing framework has had two types of effects. First, it has led to an increased variety of implemented (wireless) technologies, and second, it has led to new market entry. New technologies including CDMA and WiMax have been introduced.[403] After the introduction of the new Converged Licensing Framework, by May 2006 already four new service providers were licensed that are rolling out wireless/mobile services.[404]

According to Balancing Act, Tanzania, Kenya and Uganda have the most liberalized environments, clearly defining who has access to international gateways and VoIP services and how international VoIP providers can interconnect with local operators to offer truly "legal" VoIP.[405]

As reported by TeleGeography in June of 2008, the government of Tanzania also intends to spend **TZS 204 billion (~ USD 150 million)** to build a national ICT infrastructure backbone designed to link all regional and district headquarters by 2010. The ICT backbone will be built using fibre-optic technology and financed through a soft loan by China.[406] The new system would have capacity to cater for all Tanzania's data transmission requirements and will link up with the Indian Ocean submarine cable systems - EASSy, Seacom and Uhurunet - where Dar es Salaam will the landing site. Upon completion the new ICT backbone will be government-owned while its operational management will be handled by TTCL. Alongside the construction of the new fibre-optic backbone, the government was also finalizing plans on the introduction of a new universal communication access fund. The fund was established under the Universal Communication Access Act of 2006 and aims to enhance telecoms services in the country, particularly in rural areas. The minister said the new fund would be up and running by December 2008 thanks in part to a **USD 30 million** contribution from Sweden via the World Bank.[407]

7.5. Uganda

Background information

Population	31.9 million
Fixed penetration	0.5
Mobile penetration	13.6
Fixed broadband penetration	-
Mobile broadband penetration	-
Internet users	3.6
ICT Development Index (Rank 2007)	**140**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

Uganda Telecom, the incumbent operator, has completed the first phase of the rollout of a **USD 5 million** IP-based NGN in June 2006.[408] In September 2007 the company has announced that it has selected a provider to design and deploy an 802.16e WiMax network. Initial deployment was due for completion by the end of 2007, enabling residential and enterprise voice and data connectivity services such as VoIP and virtual private networks (VPN).[409] A few months later Uganda Telecom announced that it successfully deployed an UMTS/HSPA network. The new network is seamlessly integrated with a GSM/EDGE-based network.[410]

In October 2008 Uganda Telecom signed an agreement with a provider to expand its existing NGN, with an investment of more than **USD 10 million**.[411] It is planned to replace 33 analog RLUs (remote line units) spread across Uganda with new state-of-the-art soft switches, also to deploy seven new CDMA (Code Division Multiple Access) landline sites and transfer existing sites from a wireless loop to the NGN. The NGN expansion is scheduled for completion by the end of September 2009.

MTN Uganda was also deploying an IP/MPLS network in 2006 already. It was meant to serve as overall backbone for MTN, provide IP-VPN services to enterprises and allow the implementation of NGN architecture and services delivery solutions.[412] It began deploying a fibre optic network in 2000 in capital city Kampala. According to AllAfrica.com, MTN Uganda has extended its fibre optic network to the Mbarara and Bugiri districts of the country in 2006 and was planning to expand the network to the northern part of the country.[413] In June 2007 MTN Uganda has announced the launch MTN Broadband, a WiMax-based broadband service, available in three different packages: 200 Mb bundle at UGS 115 000 per month (~ USD 69.7), 500Mb bundle for UGS 220 000, and 1 Gb bundle for UGS395 000. A one off installation charge was set up to UGS295 000.[414]

In September 2007 wireless licensee Warid has selected a supplier to deploy an IMS system in Uganda. By constructing the IMS core network and integrating it with a WiMax access network, Warid was seeking to offer VoIP and IP-based multimedia services.[415]

Late 2007 Reliance Communications (RCom) announced that it would invest **USD 200 million** to launch a telecom network - both fixed and mobile – in Uganda by the third quarter in

2008. The company has gained a licence to be the Uganda's sixth telecoms operator. RCom has two licences - Public Infrastructure Provider (PIP) and Public Service Provider (PSP) - which will allow the company to offer mobile, fixed, Internet, national and international long distance services, in addition to WiMax and Wi-Fi services in Uganda. RCom planned to launch mobile services on the GSM platform in the first phase and then expand to the services to other communication related services. Since the Ugandan licence also provides for international long distance services, RCom will look to link its network with its Flag Telecom's upcoming NGN African undersea cable. Flag Telecom is a 100 percent subsidiary of Reliance Communications.[416]

Regulation

In January 2007 the Uganda Communications Commission (UCC) has confirmed that a new licensing regime has finally ended MTN and Uganda Telecom's (UTL) five-year duopoly on fixed line telephony. Under new licensing regime three categories of service licences are available: public service provider licence, infrastructure provider licence and general licence permits.[417] The licences available are no longer hinged to a type of technology (cellular, Public Switched Telephony Network - PSTN or Internet Protocol). The licensee is given a licence to provide for example Voice and it is the licensee that chooses what technology he/she will use to provide this voice to his/her customers.

According to UCC, VoIP in Uganda is considered simply as another form of voice service and is therefore an acceptable service in Uganda for personal and public use.[418] However, licences are still in order to provide VoIP services:

- Voice and Data licence - if what a customer receives is a voice service similar to the conventional personal/organizational telephone service (fixed or mobile phone);
- Capacity Resale licence - if a calling card or pre-paid pay phone system is offered;
- If a provider wants to offer public payphone kiosk services using VoIP or have customers using VoIP applications available on the Internet as they surf, then it is eligible for General Authorization licensing.

8. ARAB STATES

8.1. Bahrain

Background information

Population	766 thousands
Fixed penetration	25.9
Mobile penetration	148.3
Fixed broadband penetration	9.1
Mobile broadband penetration	10.2
Internet users	33.2
ICT Development Index (Rank 2007)	**42**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In January 2009 Batelco, Bahrain's incumbent operator, has announced that the final migration from the legacy network to the new NGN was completed. Batelco has invested **USD 52 million** in its new NGN to deliver countrywide MPLS services in the Kingdom of Bahrain.[419] The migration was divided into several phases, while the nationwide project was scheduled to be completed by the end of 2008 (2011 initially).

With regards to NGN access network, Batelco started its Fibre-to-the-Home-and-Business (FTTH&B) Pilot Network for up to 100 homes and 20 businesses in Bahrain in 2002.[420] Though, no further information about the outcome of this Pilot project is publicly available. However, just after the complete migration to core NGN, Batelco has announced in May 2009 the upgrade of its HSDPA-based mobile broadband services to a maximum theoretical speed of 14.4 Mbps (download). To access Batelco's mobile broadband services from a laptop or PC, customers may purchase one of its "O-net" plug and play devices; "O-net" pre-paid packages are also available.[421] In June 2009 the company has launched a new range of ADSL broadband internet packages including a new 10 Mbps (download) package; consumer DSL access speeds were previously capped at 2 Mbps. Existing customers will have their maximum speeds automatically upgraded, for instance subscribers to Batelco's 2 Mbps package will be upgraded to a 4 Mbps service.[422]

ZAIN Bahrain, one of the leading telecommunication operators in the Kingdom of Bahrain, was deploying its WiMax network in 2007. The project was evaluated at **USD 10.2 million**.[423]

In January of 2007, Bahraini wireless and satellite broadband operator, Mena Telecom announced, that has successfully implemented a Fixed Wireless Access (FWA) which will allow the company to provide customers with the full range of fixed and nomadic telecommunications services. It has rollout its FWA network nationwide, deploying a technology solution based on state-of-the-art WiMax technology.[424]

Market players such as 2Connect and Neutel are also offering ICT services through their NGN networks.[425]

Regulation

With 3 mobile operators (3rd mobile licence was handed over in March 2009), several WiMax players and a liberal policy towards VoIP, Bahrain is widely viewed as one of the region's most dynamic telecom markets. [426]

Since 2003, after the end of fixed-line monopoly, the Bahrain's telecoms regulator TRA has issued 140 licences across 12 segments since and eight other companies have been issued licences for national fixed-line services.[427] However, the unbundling regulation has not been in place all these years. In March 2009 TRA has launched a consultation on draft access regulations, which order the incumbent Batelco to add local loop unbundling (LLU) to its Reference Access Offer. Under the draft order, it must "*make all appropriate actions so that LLU field test experimentations can start no later than 15 July 2009*".[428] TRA thinks that in Bahrain, unbundling would mainly be used by operators to offer broadband services, rather than fixed voice.

The former monopoly operator already offers IP bitstream and wholesale DSL products. However, bitstream offer, which allows other operators to offer services using Batelco's infrastructure, has a limited success. According to Batelco, there has only been one customer for the last four years. [429]

In May 2009 TRA also has published for a public consultation a draft Position Paper, which aims to provide guidance for the deployment of telecommunications networks in new property developments. The main elements of the proposed regulatory strategy are: (1) contribution of developers towards deployment of telecommunications infrastructure together with (2) an open access policy, ensuring competition and choice for consumers in new developments, as well as (3) continued application of the existing regulatory framework.[430]

8.2. Egypt

Background information

Population	76.8 million
Fixed penetration	14.9
Mobile penetration	39.8
Fixed broadband penetration	0.6
Mobile broadband penetration	0.2
Internet users	14.0
ICT Development Index (Rank 2007)	**94**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2005, Telecom Egypt (TE) chose suppliers to upgrade its fixed network to an IP- based core network.[431] Initially, the NGN deployment strategy was based on the targeting of small areas in Egypt that offered strong potential as business and tourism centers. In June 2006, TE contracted technology suppliers to enable the launch of VoIP and advanced data services across various parts of the network. Under the deal, TE integrated Broadband Loop Carrier Technology and ATM network technology, allowing circuit switched voice to move onto a pure packet network. Suppliers also provided a roadmap for the delivery of new voice, video and data services such as ADSL2+, VDSL2, Passive Optical Network (PON), Ethernet and IP Video.[432] At the end of 2006, Telecom Egypt launched its first IPTV services via its ISP subsidiary TE Data, providing streaming and video-on-demand content to TE Data's ADSL subscribers.

In 2007, Telecom Egypt started the expansion of its transport network in the Nile Delta area. Capacity extensions in the backbone network were necessary to meet the rapidly growing demand for broadband capacity required for high-speed data, storage, video, and voice services.[433]

Etisalat Misr (Etisalat Egypt) was established in July 2006, when a consortium led by the UAE-based Etisalat won the third GSM licence to operate 3G and 2G services in Egypt, for EGP 16.7 billion. The company launched its services in May 2007. It planned to invest up to **EGP 8 billion** over the next three years on its network to boost its coverage area.[434] Etisalat now offers 3.75G services, thus enabling its mobile users to benefit from data transfer speeds of up to 7.2 Mbps. Among the features that Etisalat offers via its 3.75G network, are video calling, mobile TV and a mobile portal, especially created by the operator so that its customers can have access to a wide range of content made for their handsets.[435]

In 2007, Egyptian ISP EgyNet chose WiMax products to build a broadband wireless network in Sharm el-Sheikh. The project forms part of an initiative by the Ministry of Communication and Information Technology (MCIT). EgyNet was licensed to provide wireless Internet services to the region through the WIESC (While In Egypt Stay Connected) programme.

April 2008, Tata Communications, formerly VSNL, announced the expansion of its Global VPN service to Egypt through a partnership agreement with Telecom Egypt's TE Data arm. The

pair has interconnected their respective multi-protocol label switching (MPLS) infrastructures, setting up multiple redundant network-to-network interconnection points between the two companies. The agreement allows Tata to extend its end-to-end service capabilities by incorporating TE Data's IP MPLS network footprint in Egypt, reportedly using more than 800 access points of presence.[436] At the end 2007, Egypt's Ministry of Interior selected a supplier to provide equipment for the WiMax network. The network is expected to be used to connect Egyptian police stations and offices nationwide.

In June 2008, Vodafone Egypt announced the launch of ADSL services. The service, which is available to both residential and business customers, comes with a free Wi-Fi router and no installation charges. Customers have the choice of two packages: a 2 Mbps options with 100 on-net minutes and a 10Gb download limit for EGP 222 per month or an 8 Mbps package with 200 on-net minutes and a 30 Gb download limit for EGP 555 per month.[437]

In May 2009, Egypt's Mobinil announced the beginning of its IP-NGN. The new IP-based infrastructure will help to reduce network complexity and management costs and enhance network reliability.[438]

Also in May 2009, Palm Hills Developments (PHD), a leading Egyptian real estate development company, selected a supplier for its first FTTH network deployment.[439]

Regulation

In early 2006, the National Telecommunications Regulatory Authority (NTRA) announced that it would amend licences to enable Internet service providers to obtain international bandwidth. The licence amendment was a bid to restructure the broadband system. The NTRA will offer two international licences in March for international call services to expand incoming and outgoing telecommunication traffic. During the first phase (2006 to mid-2008), the two licences were to allow the new companies to operate international gateways based on the infrastructure provided by Telecom Egypt. Companies will be permitted to build their own infrastructure during the second phase.[440]

In April 2005, the NTRA released the regulations governing the VoIP market in Egypt. PC-to-PC IP telephony calls are not regulated, whereas services to end-users are monitored for quality of service. Infrastructure-owning ISPs can, along with Telecom Egypt, resell IP connectivity to companies wishing to offer VoIP services, or sub-contract the networks' rollout to other firms. In June 2005, LINKdotNET, a major privately owned ISP and solutions provider has become the first company to provide VoIP services in Egypt. An agreement has been signed with the NTRA, expanding the class 'A' ISP licence granted to LINKdotNET to include providing VoIP services to agencies and corporations using VPN networks. [441] [442]

To support its continuous liberalization of telecom market and promote competition, Egypt introduced an unbundling of local loops for ADSL services as part of the broadband initiative launched in May 2004.[443]

8.3. Libya

Background information

Population	6.28 million
Fixed penetration	15.7
Mobile penetration	73.1
Fixed broadband penetration	0.2
Mobile broadband penetration	0.2
Internet users	4.7
ICT Development Index (Rank 2007)	**81**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

In 2008, Libya's national incumbent Libyan Post Telecommunications and Information Technology Company (LPTIC) announced its plans to put in place a fibre Next Generation Backbone Network (NGBN) and that pilot projects will extend IP delivery at a local level. Its implementation of the NGBN is split into two phases and between the eastern and western part of the country at a total cost of **EUR 160 million**.[444]The first phase of the project is to roll out 8 000 kms of fibre to link all of the cities of Libya. Most of the cable has to be laid across rocky ground. The second phase involves putting in the transmission equipment. This work will be carried out at two levels: the first level concerns the transmission equipment for the backbone infrastructure and the second level concerns the routers to link the small and medium-sized towns.

Libya Telecom & Technology (LTT), Libyan Internet service provider, plans to launch its first commercial WiMax wireless network, hopes to start with WiMax coverage, including mobile WiMax, in 18 cities. The operator's new system, which has initial capacity for 300 000 subscribers, will begin signing up business and residential customers in the beginning of 2009.[445] The project is worth almost **USD 60 million**, and follows a **EUR 90 million's** project, initiated in July 2007 to build a national fibre-optic network.[446] In May 2009, the company awarded a contract to an equipment vendor to provide it with a FTTH network. Under the deal, a provider will roll out an FTTH network, covering 800 apartment buildings on the Airport Road in Alzohor District, Tripoli, in the first phase, and expanding the network coverage to other districts in the second phase. The deployment will enable LTT to offer more stable and more advanced broadband services for end users. The network will be the first commercial FTTH project in Libya.[447]

Regulation

The General Telecommunication Authority (GTA) announced, in February 2009, the launch of an international tender for a fixed and mobile licence covering Libyan territory. The GTA will grant one combined licence to one service provider. The winner was expected to be announced in June 2009. There are currently no private telecoms operators in Libya. The state-owned General Posts and Telecommunications Company (GPTC) is the only fixed line service provider. GPTC has 100 percent ownership of the two mobile operators Libyana and Al-Madar.[448]

8.4. United Arab Emirates (UAE)

Background information

Population	4.5 million
Fixed penetration	31.6
Mobile penetration	176.5
Fixed broadband penetration	8.7
Mobile broadband penetration	46.6
Internet users	51.6
ICT Development Index (Rank 2007)	**32**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The UAE telecommunications market was officially closed to all but Etisalat, which has been the telecommunications service provider in the UAE since 1976. In 2003, the situation changed with the announcement of a Federal Government Decree, which declared the end of the Etisalat monopoly status and paved the way for the partial liberalization of the UAE telecom sector.[449] The second telecom operator "du" was licensed on February 12, 2006.

Currently, Etisalat offers fixed line services over a NGN, which enables it to offer voice, video and data. It successfully launched UMTS services on December 24, 2003, and became the first organization in the Middle East and the Arab World to introduce a 3G network.[450] In 2006, Etisalat announced the migration of is core network to NGN. It predicted that 50 percent of its network would be NGN by the end of 2007, and 90 percent by the end of 2009.

Etisalat is also in the process of completing the roll-out of a nationwide fibre optic network (access NGN network), and aims to connect every home in the UAE by the end of 2011. One of the key project milestones for its implementation will be achieved by mid 2009, when Abu Dhabi becomes fully connected with FTTH.[451] In April 2009, Etisalat announced that it has nearly completed its FTTH network covering the whole of the country's capital Abu Dhabi. The project, known as eLite, is set for completion at the start of the third quarter of 2009 and will be expanded to Dubai and Sharjah in the near future. The network will provide high definition IPTV services, broadcast and on-demand, online gaming and other new services such as e-education, online health check-ups, video conferencing and remote infrastructure management. The company has reported that it has already connected over 300 000 homes to the eLite network since 2008, and aims to connect the entire country by the end of 2011, including 1.4 million homes and offices.[452] Etisalat will migrate 712 000 customers in 2009 to its FTTH network with plans to connect the entire country by the end of 2011.[453]

du, the main Etisalat's competitor, has an IP based, fibre network with FTTH and FTTB. It also offers triple-play services (voice, IPTV, data) to residential and business consumers over its fibre network in select areas of the UAE. Broadband services currently rely on copper and coaxial cabling for last-mile delivery, although management stated that sizeable investment in NGN infrastructure will deliver converged services at higher speeds.[454] In June 2009, du announced the launch of broadband speeds of up to 24 Mbps download, claiming it to be not only the fastest speed achievable in the country but in the Middle East as a whole. The operator

also stated that customers subscribed to its broadband services offering theoretical speeds of 4 Mbps, 8 Mbps and 12 Mbps will see their speeds doubled, free of charge.[455]

It is also interesting to note that, in June 2009, operators started to negotiate possible infrastructure sharing. Osman Sultan, CEO of du, said his company planned to spend **USD 545 million** on mobile and fixed line network upgrades this year, and is hoping to forge an agreement with its rival to offset some of the associated costs in light of the current economic downturn.[456] The operator recently revealed plans to launch advanced IPTV-based services in Dubai in the coming months, including HDTV and Video-on-Demand (VoD) applications, following the completion of its core IP network upgrade to 40 Gbps. Until recently, du enjoyed an unofficial monopoly of fixed-line services in most of the areas known as 'New Dubai.' Within most New Dubai areas, Etisalat's Internet, voice telephony, and TV services are delivered via du's infrastructure. At the same time, du relies heavily on Etisalat's wireline infrastructure for outgoing voice and data traffic from New Dubai.[457]

Regulation

VoIP is allowed on private telecommunication networks in UAE, for instance corporate networks, but not to make international calls or calls to other networks. This means use of VoIP services like Skype, Net2Phone and Vonage are banned in the UAE. Under their licence terms, both Etisalat and du can provide VoIP services to the public, but neither operator provides such service nor has indicated that they will do so in the future.[458] The United Arab Emirates Telecommunications Regulatory Authority (TRA) has reiterated that the provision of VoIP services will remain the exclusive domain of Etisalat and du.[459]

In line with TRA directives, in June 2008 du started blocking VoIP calls from residents living in Emaar and Nakheel properties in the Dubai free zones that the company services, where VoIP services were previously accessible. Whilst this obviously punishes customers, it should enhance du's international call revenues from these locations, given a majority of the people living in the areas affected are expatriates. du has tried to soften the blow by offering cheaper international calls to its customers - for each second of an international call, they will receive 1 fil of free credit.[460]

In May 2008, TRA set out rules for mandatory mobile site sharing between operators.[461]

In April 2009, Etisalat was fined AED 400 000 (~ USD 108 thousands) by TRA for non-compliance with fair-competition rules. Etisalat, along with its sole competitor du, were required to introduce carrier pre-selection (CPS) by June 2008. While du complied, Etisalat failed to adopt the service by the deadline given by the TRA. A month before, TRA fined Etisalat AED 200 000 and issued a new deadline of 16 April, which was also ignored. The fine has since doubled and a new deadline of 16 May was set with the fine doubling for each month of non-compliance. Etisalat said it had upgraded 70 percent of its network to enable CPS, while the remaining 30 percent allows the service to be used with special dialing codes or devices.[462]

8.5. Saudi Arabia

Background information

Population	25.3 million
Fixed penetration	16.2
Mobile penetration	114.7
Fixed broadband penetration	2.5
Mobile broadband penetration	2.4
Internet users	25.8
ICT Development Index (Rank 2007)	**55**

Sources: ITU World Telecommunication/ICT indicators database, The ICT Development Index.

Market developments

The Saudi Arabia telecom market has experienced rapid changes in recent years. In 2006, two data licences were issued, and in 2007, three fixed network licences were issued. In 2007, more and more competitors began entering the telecom market in Saudi Arabia, and they began introducing new technologies such as WiMax, FTTx and IMS, in an attempt to target different market segments.

Before the competition came in to force *de jure* and *de facto*, STC (Saudi Telecommunications Company) started to prepare for it. In 2005, STC started to replace some existing nodes in its network, followed by transforming the whole STC's fixed-line network into an all-IP NGN core network, which allowed STC to reduce costs and quickly implement new services in response to the competition.[463] In the same year, the operator made a **USD 23.46 million (~ SAR 88 million)** deal with a technology provider to roll out 180 000 ports for advanced IP DSLAM technology to enable the operator to meet the demand for high speed internet access services and broadband applications such as IPTV.[464] In 2006, the company also started to upgrade its 3G networks with HSDPA equipment.[465] In 2007, it announced investments of **SAR 4 billion** in broadband services and has selected a technology provider to build a WiMAX 802.16e network to provide wireless broadband coverage of major Saudi cities including Jeddah, Riyadh and Dammam.[466] [467]

In July 2006, Mobily, the second largest mobile operator by subscriber in Saudi Arabia, launched its W-CDMA/HSDPA services and signed up 1.8 million 3G/3.5G users by the end of June 2007.[468] It also claimed 70 percent population coverage and 300 000 3G subscribers at the end of 2008. In 2007, it selected a provider to construct a nationwide IP backbone network for voice and data services, aimed at enabling Mobily to provide users with faster and more reliable 3G mobile services and move towards an all-IP network.[469]

In September 2008, Mobily launched a new WiMax service for residential users in four major cities: Riyadh, Jeddah, Dammam, and Khobar, after it had taken over ISP and WiMax licensee Bayanat al-Oula in 2007. Mobily said subscribers can expect download speeds of up to 2 Mbps on the service. The service costs **SAR 250** a month. Mobily said WiMAX coverage will eventually be expanded across the whole Kingdom.[470] In March 2009, the company announced the launch of a high-speed uplink packet access (HSUPA) upgrade to its 3G/3.5G network. In a

SAR 1 billion roll-out, the 3.5G technology will boost mobile upload speeds in the main cities of Saudi Arabia, with further expansion expected.

Zain Saudi Arabia, a subsidiary of Kuwait's Zain telecoms group, won a licence from the Saudi Telecommunications and Information Technology Commission to operate a mobile service in the country in April 2008. Zain paid **USD 6.1 billion** for the third mobile licence and is intending to invest **USD 335 million** to deploy its new network.[471]

The Saudi Arabian fixed line licensee Optical Communications Co, which is led by US operator Verizon Communications, is expecting to spend **USD 3 billion** on deploying infrastructure. The company has set a USD 3 billion budget for the optical wire infrastructure alone and hopes to launch its operations for 2010.[472]

In June 2009, Etihad Atheeb launched broadband services in two of Saudi Arabia's largest cities. The company deployed networks in the Saudi capital Riyadh and the city of Jeddah. Etihad Atheeb has also launched a nationwide WiMax network. Etihad Atheeb plans to invest **USD 1 billion** over five years in its fixed line operations, targeting government and industrial hubs as well as regions not covered by STC.[473]

Regulation

According to the VoIP regulation framework, set by CITC (Communications and Information Technology Commission), all Facility-Based Providers (FBT) can offer IP telephony services in Saudi Arabia. ISP licences do not include VoIP services. VoIP services are subject to the same security monitoring and emergency services as for the PSTN. CITC doesn't set the requirement for QoS or prices for VoIP, leaving market forces to determine acceptable levels of QoS and prices.[474]

CITC has briefly considered IP-based interconnection as part of their review of the Reference Interconnection Offer of the Saudi Telecommunications Company (STC).[475] They note that "…*IP traffic does not lend itself easily to per minute charging, and it is technically complex to separate one kind of traffic (e.g. voice) from another (e.g. http traffic) where many different types of traffic may be carried simultaneously across the same interconnection link. This raises issues about how service providers should charge for interconnection, and the issues are particularly complex when traffic has to be passed from a circuit-switched to an IP environment, or vice versa. The CITC believes that interconnection to NGNs will be an important issue in the Kingdom in future, and intends to begin a process of analysis and consultation to arrive at an optimal set of regulations for NGN interconnection within the Kingdom*."

9. CONCLUSIONS

The analysis of the NGN expansion in different regions of the world shows significant differences across regions in terms of both market and regulatory developments.

In Europe, the majority of operators have already migrated to NGN core networks, hoping to make some savings in the future. As many operators have extensive infrastructure already in place, for migrating to NGN many of them have chosen an overlay strategy. NGN access developments in this region are mainly based on fibre optics. However, compared to Asia, the roll-out of FTTx in Europe has been much slower. In Europe, the main incentives to invest in fibre infrastructure have originated from the competitive pressure of alternative operators, but with relatively small, limited developments, rather than nationwide roll-outs. FTTx in many European countries has also been strongly driven by municipalities and utility companies, usually limited to focusing their investment in specific areas.

Incumbent operators in Europe are announcing their plans to move to NGN access, but are carefully observing not only demand for high-speed broadband services, but also the regulatory environment. The regulatory environment has often been cited as a reason for the slow roll-out. Regulators across Europe have different approaches to regulation (e.g. structural separation in the UK, access regulation in the Netherlands), and that has slowed down incumbent operators who state that they will not invest without a clear regulatory environment. This has particularly slowed down investment in the UK and in Spain. The European Commission is seeking to harmonize the regulatory framework across EU Member States, however, its draft Recommendation on this matter results in extensive debate.

On June 12, 2009 the Commission published for public consultation a second draft of its Recommendation on regulated access to NGA. The draft Recommendation aims to promote a consistent approach to regulated access to NGA networks and to provide legal certainty to investors. In the light of comments from stakeholders, the revised draft Recommendation includes mechanisms to allocate the investment risk between investors and operators seeking access to NGA networks. The Commission is seeking to encourage investment in FTTH networks based on multiple fibre lines into end-user premises. To provide an incentive, it says that no cost orientation obligation should be imposed on the price of unbundled fibre loops or WBA in multiple fibre FTTH deployments provided certain conditions are met.

However, just after the draft Recommendation was published for consultation, ETNO (the European Telecommunications Network Operators' Association) announced that the Recommendation would further slow down fibre investments in the EU, as it extends current regulatory obligations to new networks and does not exploit the potential of new mechanisms to promote investment.[476] Market players are mainly financing fibre deployments by themselves and they are particularly sensible, therefore, to any changes in the regulatory environment. Credit lines have been opened by governments in some countries to ease the transition through the recent economic downturn.

Asia appears to be leading the field in the development of both NGN core and NGN access networks. In general, when investments in NGN core networks are financed by the operator, driven by a belief of possible savings, NGN access developments have strong support from governments in the region. The preference for FTTH technology is clear in the majority of Asian countries.

In many Asian countries, governments are committing substantial investment. The level of government investment, thus, is a consequence of the business case for investment in national FTTH networks, which is being undermined by the high capital cost of fibre access and uncertainty over future revenues, especially in dispersed and diverse markets such as Australia and New Zealand. Nevertheless, government investment cannot eliminate the underlying technological and commercial risks. This means that taxpayers are bearing these risks instead of private investors.[477]

The US is of the view that a deregulatory regime has successfully encouraged investment in NGNs. It is one of the few countries that have committed to no mandatory unbundling of new, broadband facilities. Although companies such as AT&T and Verizon have begun to deploy FTTH and FTTC and broadband penetration is high in the country, it might, however, have negative effects on market structure. There is a strong pressure from operators for deregulation in Canada as well. In both countries, governments are contributing to the funding of NGN expansion, but not so significantly as in Asia.

In Latin America, there is a need for innovations in both infrastructure and business models to make deployments in rural regions with low ARPU users. Operators are considering how they can provide services to the consumer segment, offer seamless access to services and also introduce new offerings in a quick and cost effective way. Not surprisingly, operators have begun the transition to NGN core networks. Regarding NGN access developments, wireless NGN access technologies seem more promising in this region. Some operators have also initiated FTTx projects for NGN access networks. At this stage, however, the high costs and uncertain returns limit such projects to high population, high-income areas. Therefore, other types of technologies, such as WiMax, are gaining popularity.

Not only market players, but regulators as well, realized relatively early that the future of this region lies with wireless technologies. Therefore, regulators have been licensing relevant spectrum bands, carefully choosing licensees and stimulating competition in the market.

In the Africa region, the priority had been to develop and upgrade backbone networks. There is a range of different financial sources being made available to build backbone infrastructures in Africa: operators are investing individually to build their own network, joint private activities in building national backbone networks are becoming more popular (e.g. groups of operators are investing jointly in Angola or South Africa), and governments are allocating funds to built essential infrastructure. NGN access in the region is more likely to be developed using wireless technologies than fixed wire lines. It is also more likely to be new build rather than an overlay of legacy networks and which is also more likely to be driven by cost savings, rather than by new services, such as IPTV or HDTV.

Although new licensing regimes with the principles of technological-neutrality and service-neutrality are replacing old frameworks in Africa, more liberal policies with regards to VoIP or International gateways might be needed in some African countries in order to facilitate ICT and NGN investments.

Operators in the Arab region are also following the trend to migrate their core networks to NGN. NGN developments vary across the region, e.g. the Bahraini incumbent operator states that it fully completed the migration from its legacy network to a NGN in January 2009, whereas the Libya incumbent operator, LPTIC, announced its plans to put in place its NGN backbone in the middle of 2008. For NGN access, there is a mixture of different technologies being used in the region.

As the liberalization process in the region is relatively recent, the majority of current regulatory developments are related to adapting to the changing environment, e.g. changes in licensing frameworks, infrastructure sharing obligations etc. However, when creating their new

regulatory frameworks, regulators in the region might directly address the issue of NGN developments, for example, the Communications and Information Technology Commission of Saudi Arabia has considered IP-based interconnection as part of current RIO of Saudi Telecom or the recent position paper from TRA of Bahrain that promotes state-of-the-art telecommunications infrastructure in new property developments. In some cases, quiet strict regulation of VoIP services are still a barrier for further developments in telecommunications markets.

Although NGNs are a reality and that investments are taking place in all regions of the world, the current economic situation has become a challenge for everyone – operators, regulators, and governments alike. In response to the economic crisis, where operators are reducing their investments by postponing the launch of big projects, governments have begun to deploy incremental public infrastructure programs with an ICT focus. Government reaction varies from country to country, for example, with some encouraging greater private-sector involvement via a combination of guaranteed wholesale access, while others give tax breaks and subsidies. It should be noted that the acceleration of broadband access deployment, which some governments regard as an issue of national competitiveness, does not need to be restricted to the roll-out of fibre alone. Fibre has its advantages of almost limitless bandwidth and low operating costs, but this comes at a high price. If the average cost of connecting a household with fibre in a country with a combination of city and rural households is an estimated USD 1 000,[478] then in some cases, the return on investment may not justify the cost. Therefore, in today's situation, the potential of alternative NGN access technologies should be considered as well.

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