White Paper

Get Up to Speed

How Developed Countries Can Benefit from Deploying Ultrafast Broadband Infrastructures

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The Need for Broadband in Developed Countries

The question of whether governments should assist in deploying ultrafast broadband (UBB)[1] in developed countries with solid network infrastructures is almost certain to trigger a hot and often emotional debate. Some claim that UBB is a solution to a problem that does not exist. Others compare the building of UBB infrastructures to the construction of eight-lane freeways in the 1970s: excessive at the time, but enormously beneficial in the future. In recent statements, U.S. President Barack Obama[2] and German Prime Minister Angela Merkel[3] compared the development of data networks to the realization of the national distribution grid for electricity a century ago. Believers in a "new digital renaissance" view the new network infrastructure as the enabler of rapid global economic recovery, improved public services and institutions, and increased cultural enrichment in each country.

The issue over government assistance cries out for rigorous cost and benefit analysis. What happens if you deploy next-generation communication access infrastructures such as fiber to the home (FTTH) that support bandwidth-intensive applications—3D, high-definition, interactive video for gaming, telemedicine, and social interaction—and provide the highest-quality experience for end users? Various economics papers[4] agree on beneficial effects for emerging countries, but what happens if advanced infrastructures are built in countries where solid ones already exist?

The Cisco® Internet Business Solutions Group (IBSG) conducted ample research to estimate the impact of UBB on gross domestic product (GDP) and employment, plus spillover effects on

[1] Ultrafast broadband refers to ultra-high-speed broadband transmission supporting download speeds of 50 Mbps and above (potentially 100 Mbps and higher), providing high-speed symmetrical low-latency capacity, and capable of handling next-generation applications. UBB requires a fiber-optic access network—fiber to the business (FTTB) or FTTH deployment. While cable can be considered UBB, the focus of this white paper is to provide guidance on FTTH/FTTB investments. For further information, see "Broadband Access in the 21st Century: Applications, Services, and Technologies," Cisco IBSG, 2011, http://bit.ly/y4lEZm

[2] http://www.whitehouse.gov/issues/technology

[3] http://www.youtube.com/watch?v=KljB8LIyglQ

[4] "Broadband Dynamic Value Assessment: Understanding Possible Macroeconomic Benefits of Broadband in Developing Countries," Cisco IBSG, December 2009.

society as a whole—taking into account cost of deployment and potential impact of new services—and assessed possible direct and indirect incentives from local governments and the public sector.

This white paper is intended to ignite discussions with relevant stakeholders on how to plan for UBB. Many leaders with whom we spoke believe that investments in information and communications technology (ICT) can boost economic recovery. The challenge is in finding a common denominator for public and private intervention.

UBB Fosters Economic Growth, Employment, and Public Good

Ultrafast broadband offers developed countries a unique opportunity to nurture global economic prosperity; providing ubiquitous UBB Internet access for citizens is key. An economic assessment conducted by Cisco IBSG and the University of Rome II Tor Vergata showed that the benefits of an upgrade from conventional Internet access to UBB are threefold: 1) increase economic prosperity; 2) create jobs; and 3) improve the public's welfare by, for example, providing better access to healthcare and education. Economic and social effects of UBB deployments are shown in Figure 1. Figure 1 assumes that in a country like Italy, for example, 50 percent of subscriber penetration and usage of FTTH/point-to-point (P2P) infrastructure requires a €13.3 billion (roughly US$17 billion) investment.[5]

Figure 1. Ultrafast Broadband's Effect on GDP, Employment, and Public Good.

Type of Effect	Magnitude	Remarks
GDP Growth Direct Indirect	 +1.1% +3.5%	Direct effects are a result of investment in a fiber access network. Indirect effects are the capacity of the economy to promote innovation, offering new services and enabling substantial economic development
Employment Growth	+1.1%	Overall job creation
Public Welfare (as measured by HDI)	+14%	The United Nations Development Program Human Development Index (HDI) takes into consideration network effects on welfare key indicators

Source: Cisco IBSG and University of Rome II Tor Vergata, 2011.

Increase Economic Prosperity

Ultrafast broadband has both direct and indirect effects on economic prosperity, as measured by GDP. We use Italy and Germany to illustrate examples of direct and indirect effects on the economy.

One direct effect is the increase in expenditure due to the network itself. Cisco IBSG estimates that direct effects on Italy's economy are 1.1 percent of GDP (equal to approximately €17 billion,

[5] "Infrastrutture e Servizi a Banda Larga e Ultra Larga" (ISBUL), Telecommunications Regulatory Authority Work Package 2.2, Professor Alessandro Frova; Work Package 2.4, Professor Francesco Sacco.

or $22 billion) based on a Keynesian multiplier[6] equal to 1.31 over 10 years. This multiplier is independent of the technology required to build the infrastructure (FTTH, P2P, FTTB, gigabit passive optical network, and mixed infrastructures). This means that broadband investment is as effective in creating both jobs and direct effects as it is in creating other infrastructure programs.

Indirect or "spillover" effects include the creation of new Internet-based services and increased productivity. In a developed country, the indirect effects of UBB deployment on economic growth depend on how effectively the economy can create new services that allow substantial economic development. Based on Cisco IBSG's study, broadband deployment 1) accelerates innovation resulting from new broadband-enabled applications and services, and 2) impacts the structure and deployment of industry value chains. In information-intensive economies such as Germany, where a majority of the workforce is information-based, infrastructure needed to facilitate the flow of information has an impact on productivity, innovation, and business growth. Multiple studies[7] also point out that national competitiveness and network readiness are directly correlated. The impact of these indirect effects is approximately a 3.5 percent increase in GDP. Even with some discrepancies country by country, this percentage has been confirmed by other recent econometric studies on fiber deployments in Italy[8] and Germany,[9] which show indirect effects worth €55 billion (approximately $72 billion) and €138 billion (approximately $181 billion), respectively, in additional GDP.

Create Jobs

Along with GDP growth, the upgrade to UBB enables the creation of jobs in three main sectors: 1) construction (with a high concentration of labor-intensive jobs), 2) telecom-munications, and 3) electronic equipment manufacturing. Ultrafast broadband's impact on the labor market is further illustrated, again using Italy and Germany as examples. Cisco IBSG estimates that Italy can create 250,000 jobs if the country invested roughly €13.3 billion (approximately $17.5 billion) in an FTTH/P2P network that covers (and is used by) 50 percent of the population, while Germany could create 541,000 jobs if it made a similar investment worth €27.9 billion (approximately $36.7 billion). Reported value is the net global job impact in each country.[10]

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[6] According to Keynesian economic theory, any injection into the economy via investment capital or government spending will result in a proportional increase in overall income at a national level. The basic premise of this theory is that increased spending will have "carry-through" effects that will result in greater aggregate spending over time. The multiplier itself is an attempt to measure the size of those spillover effects.

[7] World Economic Forum Network Readiness Index. http://reports.weforum.org/network-readiness-index/

[8] Indirect effects of €55 billion=3.5 percent in additional GDP, "Infrastrutture e Servizi a Banda Larga e Ultra Larga" (ISBUL), Telecommunications Regulatory Authority Work Package 2.2, Professor Alessandro Frova; Work Package 2.4, Professor Francesco Sacco; and Cisco IBSG analysis, 2011.

[9] Indirect effects of €138 billion=0.6 percent of additional GDP, "The Impact of Broadband on Jobs and the German Economy," Professor Raul Katz, et al., 2009.

[10] NOTE: Cisco IBSG analysis is based on studies published by Professors Francesco Sacco, Allesandro Frova, and Raul Katz, based on the following assumptions: FTTH deployment with 50 percent penetration and 25 percent to 50 percent adoption. The higher adoption case assumes a copper switch-off plan. The assessment relies on input-output tables from both Italian and German statistical offices to evaluate direct-/indirect-induced impact on job creation. The labor market impact on foreign countries is also considered. Foreign effects are a result of industrial value chain decomposition, job transfer, foreign equipment manufacturers, and import-/export-related activities. See also "Benefits of High-Speed Internet for Economic Growth and Job Creation," Speed Matters.org, a project of the Communications Workers of America.

Improve the Public's Welfare

Ensuring the public's welfare requires more than just the creation of jobs and an increase in output per capita: people should be able to fully develop their potential and lead productive lives. A recent study by the Organisation for Economic Co-operation and Development (OECD)[11] identifies the most relevant areas for potential spillovers: e-health and education. The study claims that a cost savings of 0.5 percent to 1.5 percent in both sectors would justify building a national FTTH network. An analysis[12] commissioned by Connected Nation shows enormous benefits, including reduced healthcare costs, as well as a reduction in time spent traveling and related carbon emissions.

Cisco IBSG built on the United Nations Development Program Human Development Index (HDI) toolset and then customized it to quantify UBB's effects on public welfare, taking into account network effects such as health, education, income, gender, and sustainability (see the *Methodology* appendix on page 13 for an explanation of our analysis).

The United Nations reports that the population growth rate for people over 60 in OECD countries is 2.6 percent per year, and is expected to increase through 2020, by which time those over 60 will outnumber children for the first time in history. A significant number of older people will live alone; in more-developed regions, one-quarter of the older population lives alone.[13] Given these demographic developments, developed countries in particular are in need of social innovation to improve elderly care, simplify autonomous living, enable remote diagnosis, and provide home care.

Furthermore, developed countries should favor more doctor-to-patient interactions from home and interactions among doctors at different medical facilities. The World Health Organization suggests that teleconsultations can reduce patient office visits for simple procedures such as checking blood pressure, allowing medical staff to focus on patients who may benefit from in-depth treatment required in-person. Reducing doctor visits, or even hospital stays, decreases costs; some people need to be monitored just once a day from home, and fiber with high-definition video can enable a doctor to provide such services remotely.

Mobility among the workforce is another benefit of UBB to public welfare. UBB-enabled services can help employees create balance between their personal lives and careers. Achieving this creates a more satisfied, productive workforce. Teleworking and telepresence solutions supported by UBB can help reduce commuting and related stress, fuel costs, carbon emissions, and other factors such as extended childcare costs.

Overall, Cisco IBSG's study showed that UBB yields an average increase in public welfare of about 14 percent, with notable differences among various countries (see Figure 2).

Lessons Learned from UBB Implementations Worldwide

Ultrafast broadband deployments have shown that success depends on three key factors: 1) partnerships among local developers and private companies to design and deploy infrastructure, 2) public investment in a broadband stimulus plan for universal UBB access

[11] "Network Developments in Support of Innovation and User Needs," OECD, December 2009.

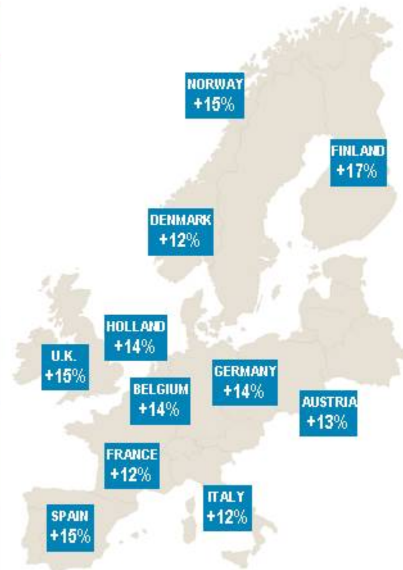
[12] "The Economic Impact of Stimulating Broadband Nationally," Connected Nation, December 2008.

[13] "World Population Ageing, 2009," Department of Economic & Social Affairs, Population Division, United Nations, 2010, http://www.un.org/esa/population/publications/WPA2009/WPA2009-report.pdf

countrywide, and 3) a requirement of 80 percent penetration for GDP impact. Following are examples of notable implementations.

Figure 2. HDI Variation: Public Social Welfare Effects of UBB Deployment in Developed Countries.

Area % Weight	Key Effects
Health 40%	• Strong reduction in health expenses (about 5%) because of telehealthcare for an ageing-well continent
Education 25%	• Less expenditure on education • More Internet users • Increased mean and expected years of schooling
Income 20%	• GNI growth because of GDP growth (1,25% every 10% of UBB increase)
Gender 12%	• Increase of labor force participation rate, female/male ratio
Sustainability 3%	• Smart Grid solutions will reduce CO^2 emissions 15% by 2020



Source: Cisco IBSG and University of Rome II Tor Vergata, 2011

Australia. As part of its national broadband stimulus plan, the Australian government in 2009 formed a public-private company responsible for network design and deployment. The organization's goal is to provide 100-Mbps service to 90 percent of households and businesses by 2017. Government will hold a majority share in the company, with private investment capped at 49 percent. The company will invest up to AUD$43 billion (approximately US$46 billion) in the project, including the AUD$4.7 billion (approximately $5 billion) already allocated by the government. Once the project has been up and running for five years, the government will begin selling its stake in the company.

New Zealand. The New Zealand government announced its UBB initiative[14] in September 2009, committing NZD$1.5 billion (approximately US$1.25 billion) to accelerate the rollout of broadband to 75 percent of urban homes over 10 years. The government indicated that there would be national economic benefits of between NZD$2.7 billion (US$2.2 billion) and NZD$4.4 billion (US$3.6 billion) per year, with additional potential. It is now considering a range of regulatory and non-regulatory measures to facilitate the rollout of broadband infrastructure by reducing deployment costs, speeding up consenting processes, and encouraging the use of existing support infrastructures. For example, schools will receive fully funded fiber connections when fiber is deployed in their regions.

In a second initiative, the New Zealand government plans to deliver broadband to 252,000 rural households at prices and service levels comparable with those of urban residents.

[14] Ministry of Economic Development, Manatu Ohanga, New Zealand. http://bit.ly/wcs9iW

Scotland. In August 2011, the Scottish government received GBP£68.8 million (approximately $108 million) in funding to make next-generation broadband available by 2020. Funding is being provided via Broadband Delivery UK (BDUK), which was created to increase access to broadband in poorly served areas across the United Kingdom. Available funds may not be sufficient, however, to fully achieve the government's broadband ambitions.

South Korea. South Korea is a global leader in fast Internet. More than 94 percent of South Korean households have access to high-speed Internet services, and the country has the highest penetration of broadband subscribers in the world.[15] South Korea pioneered e-learning, e-government, and e-health services—all driven by widespread broadband availability. According to the Korea Communications Commission:

- **E-learning:** 99.6 percent of students use ICT for their studies (globally, South Korea ranks second in ICT skills[16] and fifth in e-learning[17]). Every primary and high school has free Internet access and PCs; through government programs, 96,000 computers have been distributed to low-income students.
- **E-government:** South Korea ranked sixth worldwide in the "United Nations E-Government Readiness Index 2008." Integrated e-government platforms handle 90 percent of public administration documents (for example, home taxes and housing registrations).
- **E-health:** Almost all medical claims are managed electronically. All medical institutions are linked to the government's high-speed fiber network; remote diagnostics and portals display live medical operations.

A number of initiatives were also key to South Korea's success, including a digital literacy campaign called "Cyber Korea 21," which was developed to create an information-based society; and the "Ten Million People Internet Education" project for students, soldiers, the elderly, and farmers. Moreover, a certification process was established to measure the level of broadband readiness and broadband speeds in new apartment buildings. The process includes a rating system that reveals whether a residence has broadband speeds of less or greater than 100 Mbps. Over time, this program had a major impact on increasing consumer awareness of fiber networks.

Building on its success, the South Korean government in 2009 announced a new plan through which high-speed Internet and wireless broadband services will be 10 times faster by the end of 2012.[18] According to the Korea Communications Commission, details of the plan include:

- 1-Gbps high-speed Internet service
- 10-Mbps wireless broadband service
- HD-TV images that are 16 times clearer than those currently available

[15] http://ftthcouncil.eu/documents/Presentations/20110209PRESSCONFMilan.pdf and http://eng.kcc.go.kr/user/ehpMain.do
[16] "Measuring the Information Society," International Telecommunication Union, 2011, http://bit.ly/xD9cBg
[17] "The 2003 E-Learning Readiness Rankings," Economist Intelligent Unit, http://bit.ly/widf5x
[18] "Korean Internet Speeds To Be 10 Times Faster by 2012," Korea Communications Commission, March 28, 2009, http://bit.ly/zLUvyo

The plan calls for total spending of KRW34.1 trillion (approximately $30 billion). Central government will contribute KRW1.3 trillion (approximately $1.2 billion), with the remainder coming from private telecom operators. The project is expected to create 120,000 jobs.

A Compelling Case for UBB: Requirements for Success

Central and local governments are working to increase competitiveness, productivity, and efficiency to support economic and employment growth. Telecommunications networks are the foundation needed for the development and competitiveness of all other networks, whether physical or virtual. Governments are thus looking to develop digital infrastructure and encourage widespread use of technologies, services, and digital processes.

Italy, for example, currently has a broadband (ADSL) penetration rate of 60 percent of households, with 14 million subscribers. The fiber infrastructure reaches 10 percent of households, and there is no cable infrastructure.[19] At a cost of roughly €13 billion ($17 billion), Cisco IBSG estimates that the likely effect of a UBB infrastructure covering 50 percent of Italy's population would increase GDP by more than €70 billion ($92 billion) through direct (€17 billion, or $22 billion) and indirect (€55 billion, or $72 billion) effects, plus create about 250,000 jobs, significantly increasing public welfare.

Service providers, public sector institutions, and OTT players must evaluate opportunities for collaboration in funding and beyond. This paper has shown the impact of their investments on productivity, economic growth, employment levels, and social welfare, satisfying different stakeholders' needs in areas including healthcare, education, and justice.

Given these findings, UBB infrastructures make sense for developed countries. However, the reality of deploying them is more complex. Policymakers must consider the following factors to fully exploit the potential benefits of ultrafast broadband.

Need for Public Intervention and Funding

Economic research[20] shows that countrywide deployment of a next-generation FTTH network serving 50 percent of households has a payback period of about 10 years. These findings may not suffice, however, in attracting private investors, especially in rural regions. When comparing incremental revenue and EBITDA (earnings before interest, taxes, depreciation, and amortization) derived from UBB to related investments and costs in large cities, incumbent telcos need a compelling business case in regard to long-term return on capital to deploy FTTH.[21] It is unlikely that SPs will profit from such deployments in lower-density areas unless projects are co-financed with public parties. It is important to note that the concept of profitability for an SP is quite different from that of a municipality or local/central government; even rural FTTH deployments will be highly profitable on a socioeconomic level.

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[19] http://www.osservatoriobandalarga.it/

[20] "Portare l'Italia Verso la Leadership Europea Nella Banda Larga: Considerazioni sulle Opzioni di Politica Industriale," Franceso Caio," 2009; and "Impatto della Larga Banda Sulla Crescita Economica: Evidenze dalla Letteratura," Dr. Lorenzo Pupillo, Telecom Italia, Columbia University, December 2009.

[21] Arthur D. Little estimates a return on capital employed (ROCE) of 12 percent post-tax by 2021, assuming long-term penetration of 60 percent and 50 percent retail market share. "Superfast Broadband: Catch Up if You Can," 10th Edition, Arthur D. Little and Exane BNP Paribas, March 2011.

To shorten the payback period of countrywide FTTH deployment to four or five years, Cisco IBSG prepared a number of simulations using the Dynamic Model. The simulations suggest that public bodies should contribute up to 30 percent of the total investment, focusing on areas where there is no commercial business case—typically rural or less-dense areas. The simulations also show that neglecting public funding in favor of an exclusive private action translates into financial non-sustainability of the investment because less stability is manifested over time, depending on market dynamics and the bank's performance (expressed by its rate of acceptance on investment). Financial models[22] indicate that SPs' investment in FTTH could be at serious risk and have a lengthy payback period. This is why local government funding is desirable; such funding can result in a win-win situation for both the private and public sector.

Governance Models: Set Up Public-Private Partnerships

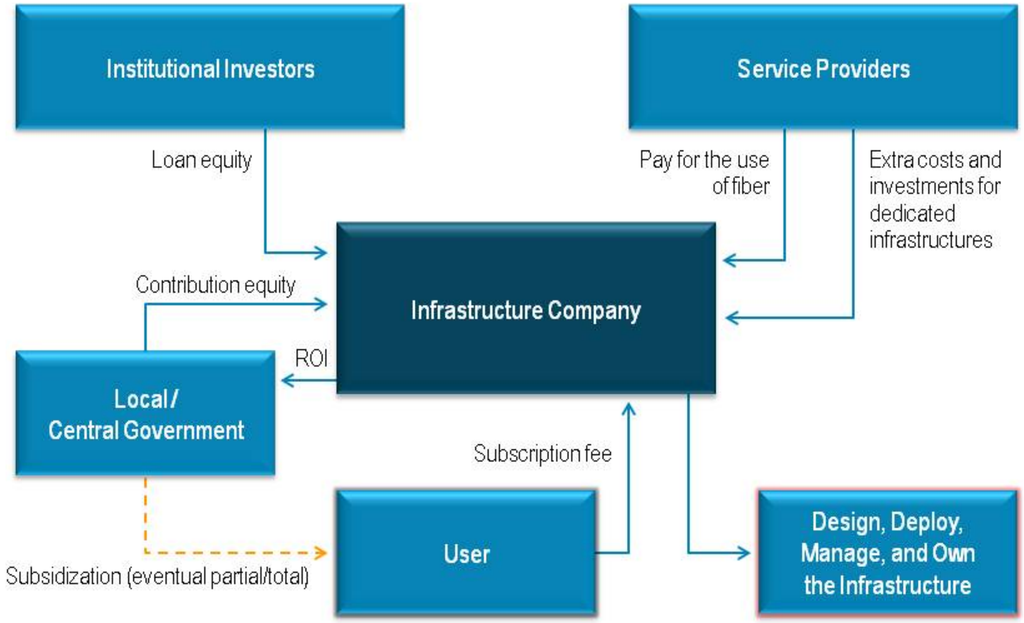
An efficient governance model is required if public-private funding is going to be used to deploy UBB networks. Public and government intervention can improve financial attractiveness, increase stability of the investment, and ensure large and fast fiber adoption through interventions such as copper switch-off plans. Such a model can also ensure that suitable prices for dark fiber are available to SPs, thereby encouraging service-based competition that will increase adoption. This approach is extremely relevant in less densely populated areas.

It is also important that SPs have the ability to enter into new business models—including two-sided ones—with OTT providers, and that a regulatory framework(s) allow for sufficient flexibility within these business models.

Cisco IBSG developed a governance model (see Figure 3) based on a fictional regional infrastructure company that deploys fiber in the territory and then sells dark fiber to SPs. The infrastructure company should be regional because regional government is responsible for civil public works and can coordinate municipalities' project implementations. The company can collect public funds—as well as private investments from banks, manufacturers, and institutional investors—and develop a business plan with a five-year ROI.

[22] "Ultrabroadband Investment Models," Raul Katz, The Columbia Institute for Tele-Information (CITI), *Communication & Strategies Special Issue*, November 2008.

Figure 3. Governance Model for Private-Public Partnership.



Source: Cisco IBSG, 2011

The Lombardia region of Italy has implemented an example of this model; local government's goal is to provide UBB to 50 percent of the region's population within seven to eight years. Lombardia set up an infrastructure company that will coordinate and regulate dark fiber deployment. This approach can:

a) Ensure central coordination of construction works and permission from different municipalities

b) Promote competition among SPs, enabling them to adopt the right topology for dark fiber provided by the infrastructure company

c) Regulate price (in the case of Lombardia, the price of dark fiber to SPs was €9 [$12] a month to enable facilities-based competition)[23]

d) Ensure that copper is switched off in areas served by fiber to avoid extremely slow migration (for example, Lombardia estimated that it would refund the incumbent €500 [$658] for each switched-off line of copper, with a commitment from the incumbent to reinvest that money in fiber deployment projects)

This type of governance model is *not* required in the case of a privately funded model for UBB networks.

Technology Choices: Enable a Hybrid Approach

The type of technology used to build UBB infrastructures may impact economic effects. According to some studies, there can be variations of up to 10 percent in the size of investments required to enable ultrafast broadband capabilities, based on technologies selected and other

[23] Service-based competition is usually associated with wholesale bandwidth rather than with access to passive infrastructure, in which the incumbent owns the technology. The use of dark fiber represents facilities-based competition because it requires multiple operators to deploy their own equipment.

factors such as topography, existing infrastructure, and population distribution.[24] These effects are less relevant than those derived from facilities-based competition. In the public-private partnership model described above, the infrastructure company enables SPs to make architectural choices and implement a hybrid approach among various technologies.

Create Ultrafast Broadband Use Cases and Services

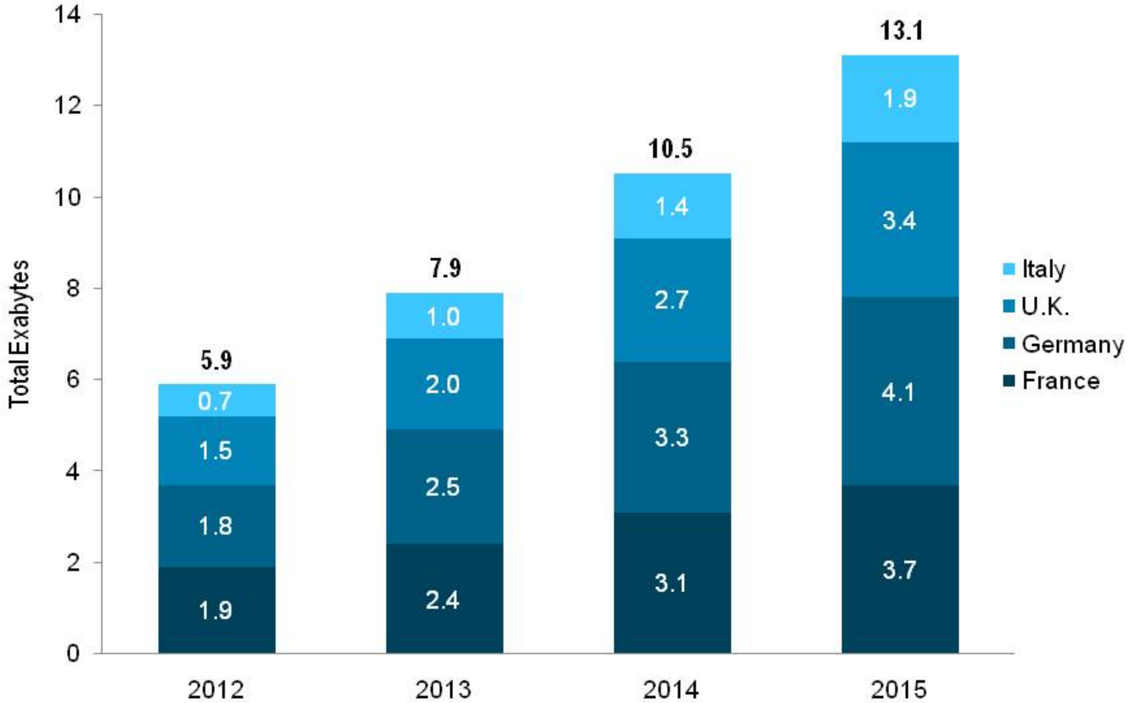
Service providers are uncertain about future demand for UBB and its effects on ROI. They look for concrete use cases and services that not only focus on speed, but also differentiate them from competitors, increase share, and decrease customer churn. Subscriber demand for services like IPTV and broadcast video, over-the-top (OTT) video, online gaming, video conferencing, and other bandwidth-intensive/latency-sensitive applications "in the cloud" keeps growing, and requires vastly improved network performance. Here are several examples of UBB services in use today:[25]

- French startup Link Care Services provides remote video monitoring for patients with Alzheimer's and other cognitive diseases. Today, the company's customers have only DSL, which imposes a number of restrictions. For example, only two low-quality video feeds of a patient's home can be monitored simultaneously via the control center; with FTTH, Link Care Services would have the capacity to monitor all rooms in a patient's home.
- PT Inovação, the R&D arm of Portugal Telecom, developed a system that enables healthcare professionals to consult on a diagnosis, using video conferencing, data sharing, and other online collaboration tools over a fiber connection. High-bandwidth fiber is important for a successful remote consultation. Doctors must be confident, however, in the live images they are viewing; otherwise, they could misdiagnose a patient's condition.
- French company Erdenet supplies web-based courses that students can study at their own pace using interactive video and online collaboration tools. With an ordinary DSL connection, it is difficult to add rich media such as video, audio, and maps. Such applications require fiber connections.
- STRATO, a German web hosting company, launched a remote online storage application called HiDrive that offers ample cloud storage capacity for a low monthly fee. STRATO's similar offering in the United Kingdom is complemented by a DVD send-in service.

Bandwidth increases immensely due to such innovative services. Cisco IBSG expects that by 2015, there will be 13 exabytes of data traffic in at least four Western European countries and that 91 percent of Internet data will be video; one-third of all data will live or pass through the cloud by 2020 (see Figure 4).

[24] "Broadband Access in the 21st Century: Applications, Services, and Technologies," Cisco, 2011, http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/white_paper_c11-690395.html
[25] "What Would You Do with Blindingly Fast Broadband?" Nadia Babaali, Communications Director, FTTH Council Europe, June 7, 2011.

Figure 4. Western European Bandwidth Requirements Estimate, 2012–2015.



Source: Cisco Visual Networking Index, 2011, http://bit.ly/wmPirb

Conclusion

This paper provides a compelling case for UBB deployment in developed countries. New UBB technologies are an extraordinary opportunity for what some call the "new digital renaissance" because they offer the possibility to improve public services and institutions, creating conditions for deep and rapid growth, development, and cultural enrichment. The new network infrastructure enables a cultural renaissance and the potential to support a global economic recovery.

Appendix: Methodology

Cisco IBSG used a Dynamic Model, developed by the University of Rome II Tor Vergata, and the Human Development Index (HDI) tool, developed by the United Nations Development Program (UNDP), to evaluate the benefits of ultrafast broadband infrastructures.

Econometric Model. In the static econometric model, fiber to the home is a substitute for the copper access network. The static model was developed by the University of Milan and adopted in a study, "Infrastrutture e Servizi a Banda Larga e Ultra Larga," for the Italian Communications Authority. To quantify UBB's impact, the study used a linear econometric model with country-specific fixed effects and country clusters.

Dynamic Model. The Dynamic Model is articulated through a network of agents and interactions that can simulate the underlying dynamics of establishing and financing a next-generation network. In the dynamic approach, Cisco IBSG takes into account the investment rollout over time. Using computer-aided modeling, we created a hypothetical country, "Fiberland," that shows the typical characteristics of several developed countries. The model recognizes the intervention of public and private organizations, modeled in a collaborative perspective for both financial and social sustainability of the investment. We identified the indicator for the short-term financial view (ROI) and the indicator that represents the non-financial long-term vision (sub-sustainability). The model focuses on the "Split" lever between indicators and defines the percentage of resources to divide between short-term business and social sustainability objectives. The optimal choice that emerges for funding next-generation network projects suggests a 20 percent to 30 percent concentration of resources allocated to social sustainability objectives, while 70 percent to 80 percent goes toward short-term business objectives.

Human Development Index. HDI is a composite statistic used to rank countries by "human development," taking into account human rights, sustainable development, literacy, health and social services development, equal opportunity, and gross national income (GNI) per capita. We customized the UNDP HDI and considered the parameters of health (weighted at 40 percent), education (25 percent), income (20 percent), gender equality (12 percent), and sustainability (3 percent), as they clearly show the impact of new network deployment. Our study analyzed the new HDI in 1) regard to deployment of a UBB network, and 2) the absence of a network. From there, we compared our findings via a tool from UNDP.

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