Government broadband plan: 5 key policy measures that proved to make a difference

Strategic White Paper

Numerous studies have demonstrated the impact of broadband on a country's economic development. From a research perspective though, going beyond such a broad statement is not as simple as it seems. How does broadband impact development? Most importantly perhaps, what can a policy maker — be it a regulatory authority or a government — do to "make broadband happen?" What works and what doesn't?

To answer these questions and identify which policy measures really have an impact on broadband adoption, Nokia conducted an in-depth market study, analyzing the broadband plans of 35 countries across the world. The results presented in this white paper highlight five key policy measures that are proving to make a difference.

A key to the success of broadband policy initiatives lies in the implementation of such well-thought-out broadband plans.

NOKIA | DIFFRACTION analysis

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Executive summary

While the benefits of broadband plans have been established by research, it appears necessary to take a closer look at the efficiency of the specific measures they incorporate. In this white paper we have categorized the initiatives included in the broadband plans of 35 countries to assess their impact on the availability, affordability and quality of broadband. These three major objectives are linked, and improving them carries benefits for the telecom sector and the economy as a whole.

Lack of public intervention in broadband development bears a cost in terms of missed opportunities, which can lead to limited progress in affordability, availability and quality of broadband nationwide. Furthermore, as new waves of technology (cloud, network virtualization, Internet of Things) required more and better broadband, inaction of policy makers will widen the gap between the countries that choose to act and those that don't. Only the former will reap increasing benefits.

To better understand which initiatives really make a difference and how, the efficiency of five key policy measures was analyzed among the sampled countries:

- **Public investment in backbone and aggregation**: By lowering the cost of operation for market players this measure has a noticeable impact on the price of fixed broadband. Countries that have included such investment in their plans have seen the price of fixed broadband drop by 4 percent of gross national income per capita over 4 years as opposed to a little over 1 percent for countries that have not invested.
- **Public investment in access networks**: By improving the coverage and quality of broadband, this measure increases the growth of fixed broadband subscriptions. Over 4 years post-publication, countries that have invested see a growth 30 percent higher than countries that have not invested.
- **Regulatory framework for infrastructure sharing**: By allowing operators to access existing assets to develop their networks, this measure enables a higher growth of internet adoption for households. Over 3 years, countries that put such a framework in place see the proportion of households with internet increase significantly more.
- **Inclusive/social offers**: By allowing those who can't afford broadband to access some level of connectivity, this measure has a strong impact on the use of the internet within the population. Over 4 years, the growth in Internet usage per 100 inhabitants is 18 percent for countries with inclusive offers versus only 10 percent growth for those without.

- **Regulatory frameworks facilitating FTTx roll-out**: By reducing the costs and hurdles of deploying next generation network, such frameworks greatly improve the quality of broadband access in the countries in question.

Folding some or all of the above measures into a transformational project for broadband development maximizes their impact. In the end, there is no doubt that public involvement in broadband development works and has positive impact, but it requires willingness, drive and funds.

Introduction

Numerous studies have demonstrated the impact of broadband on a country's economic development. From a research perspective though, going beyond such a broad statement is not as simple as it seems. How does broadband impact development? Most importantly perhaps, what can a policy maker — be it a regulatory authority or a government — do to "make broadband happen?" What works and what doesn't?

To answer this question and identify which policy measures really have an impact on broadband adoption, Nokia conducted an in-depth market study, the results of which are presented in this white paper.

A key to the success of broadband policy initiatives lies in the implementation of well thought-out broadband plans.

Broadband plans

Policy measures are often, but not always, implemented as part of a broadband plan: a coherent set of measures designed to produce the desired outcomes in the broadband market for a given country. A UN Broadband Commission and ITU study published in 2013 showed that "the introduction or adoption of a broadband plan is associated with 2.5% higher fixed broadband penetration, and 7.4% higher mobile broadband penetration on average."[1]

This is a very important finding in that it suggests that a structured approach with a clear identification of goals in a coherent package is more effective than disparate individual measures. In other words, the process of putting the plan together itself impacts its chances of success. However, it is a very binary finding and leaves one wishing for more detail on the plans themselves. In particular, it doesn't look into the contents of the plans to try and assess the effectiveness of specific initiatives. In this paper we will try to do that.

1 Planning for Progress: Why National Broadband Plans Matter, UN Broadband Commission, ITU, Cisco, 2013.

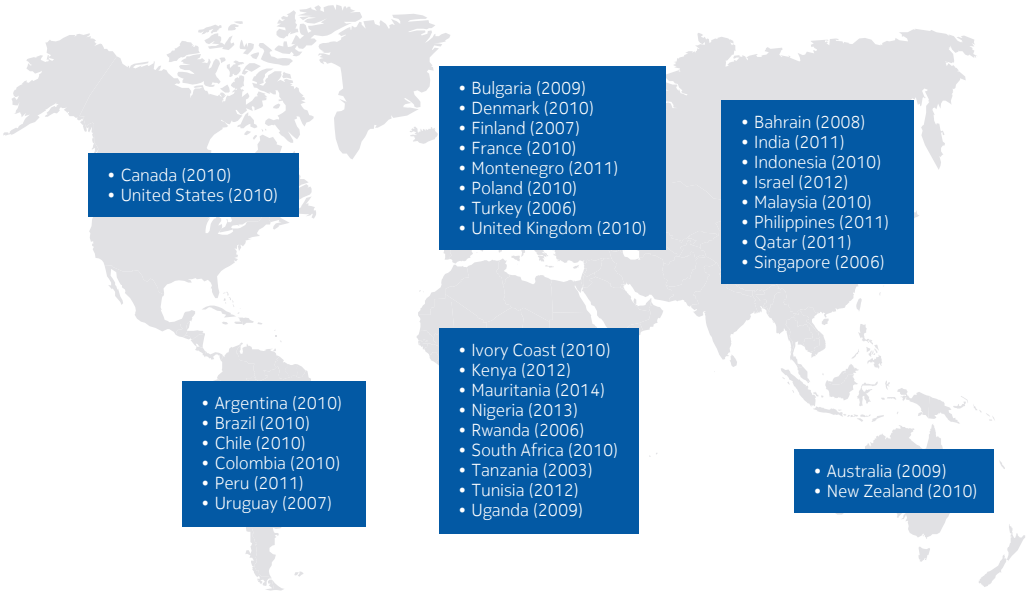
The ways in which policy can affect broadband outcomes are not always clear. While there are no universal solutions, equally applicable in any context with predictable outcomes, there is a wealth of experience in terms of policy, and sometimes enough hindsight to see what worked and what didn't. Our goal in this paper is to identify the measurable impacts of specific initiatives included in broadband plans and look at specific examples of these measures as they have been implemented in various countries. This in turn will show not only which measures are effective but how they should be structured and implemented for maximum effectiveness.

Methodology

Our approach is to compare the impact of measures taken by some countries and not by others. We collected the broadband plans from 35 countries worldwide (see Figure 1), at different stages of broadband development, and we tried to categorize the initiatives included in said plans to measure their possible impact on availability, affordability and quality of broadband, as well as adoption (the ultimate goal).

Every country in the sample has published a broadband plan, but they don't all contain the same initiatives. By comparing indicators likely to be impacted by a given measure, we anticipated that we might be able to see the efficiency of specific initiatives. In order to do that we categorized initiatives with the highest potential impact (see section entitled "Impact of policy" for a detailed description).

Figure 1. Countries with broadband plans included in the sample



For each initiative we decided to analyze, we identified the countries that included said initiative in their plan and those that didn't. Table 1 shows the number of countries that included each initiative in their broadband plans.

Table 1. Number of countries in the sample that included each initiative in their broadband plan

Initiative	Number of countries
1. Public investment in backbone and aggregation	15
2. Public investment in access	13
3. Framework for infrastructure sharing	21
4. Inclusive/social offers	9
5. Framework for fiber-to-the-home (FTTH) deployment	11

We then compared the performance of key indicators likely to be impacted by the initiative considered for the countries that included said initiative and those that didn't. In order to establish a comparable basis, we examined all indicators by taking the publication of the broadband plan as year zero. That way we can compare over time the impact of plans published in 2009 and plans published in 2012 as part of the same analysis.

Data sources and indicators

Having defined the expected outcomes, we gathered data sources to verify them. The main two data sources were ITU's 2015 ICT Indicators Database and 2015 GSMA data. Data was normalized so that the comparison basis was identical for all countries. For example, growth in subscriptions was compared to the untapped market potential so that developed countries and new growth markets could be compared on the same basis.

Why more and better broadband is crucial

Framing the policy goals

No matter what the actual tools put in place, broadband policies aim for a broader adoption of quality broadband. These policies, whether they are defined by regulatory authorities or governments, focus mostly on supply (trying to ensure that what is offered by the market goes in the right direction), although some countries have put in place demand stimulation as well. It is possible to frame each policy initiative as affecting one or more of the following:

- **Availability** of broadband is the basis on which all other policy initiatives are built. If broadband isn't available, it cannot be used by citizens and businesses.

- **Affordability** of broadband aims at broadening the available broadband user base by mitigating or eliminating the cost factor. This is especially important in new growth markets where purchasing power may be very low in relation to the cost of market-priced broadband subscriptions.
- **Quality** of broadband aims at delivering better service to more citizens and businesses, thus enabling more advanced usage of the broadband platform.

Note that these three policy objectives are not independent, and in a sense are tiered: acting on affordability has a limited impact if broadband is not broadly available, and acting on quality has a limited impact if broadband is not broadly available and if citizens and businesses cannot afford to connect to it.

Fixed or mobile broadband?

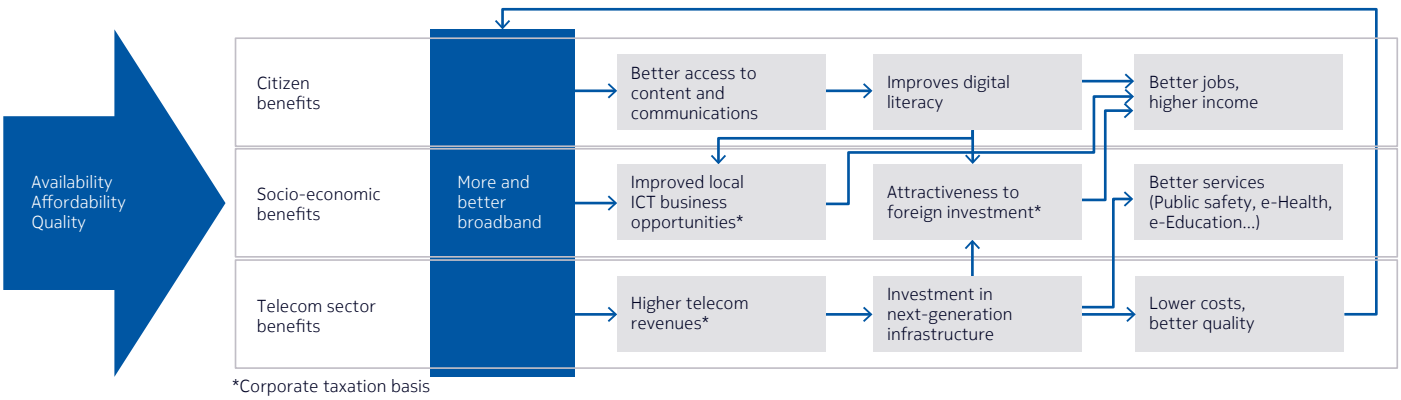
Even in tech policy circles, one often hears questions about the need for fixed broadband if it doesn't already exist. Our position is that both fixed and mobile broadband are necessary, because they serve different end-user needs.

Furthermore, technology paths push for converged fixed and mobile networks as denser mobile antennas require fiber aggregation, as do Fiber to the Premise networks. In the long term, it will not be about one or the other but about both.

Hereafter, and unless otherwise specified, broadband means both fixed and mobile.

This in turn explains why the degree of maturity of the broadband market in a given country usually informs the policy plans: more mature countries tend to implement policies that mitigate the barriers to adoption (affordability) and deliver better broadband (quality) rather than focus solely on availability. In less mature countries, availability is often the central goal.

Figure 2. Positive impacts of more and better broadband as seen from the public sector



*Corporate taxation basis

More broadband subscribers and better quality broadband have significant impacts for citizens, society and the economy as a whole — and (of course) the telecom sector.

Figure 2 summarizes the impacts of more and better broadband.

From a public sector point of view, there are three broad areas of benefits from more and better broadband.

- It benefits citizens who, through better access to content and communications, gain in digital literacy and can hope for better jobs and higher incomes.
- Society and the economy benefit through improved ICT business opportunities bolstered by a more technology-savvy workforce. The availability of ICT skills in the market combined with a better telecom infrastructure attracts international businesses, thus growing the overall market.
- Because the telecom sector itself benefits from broadband adoption, it can invest in next-generation infrastructure, which lowers costs and drives quality up, but also allows for new technology to be deployed in the public space to improve areas such as public safety, energy efficiency, transportation, public health and education.

This is a virtuous circle in that the benefits in turn create an opportunity for further investment in availability, affordability and quality of broadband.

Cost of doing nothing

While broadband connectivity can bring benefits to society as a whole, it is also worth exploring how lack of public intervention in broadband development can prevent countries and local authorities from grasping present day opportunities in terms of economic growth, sustainable development or social and health-related benefits.

To better understand these opportunities, one needs simply to look at the growing impact of digital technologies and broadband connectivity. In countries with developed broadband infrastructure, the digital sector contributes heavily to economic growth, and digital technologies improve the performance of other sectors. The quality of infrastructure has even become a primary concern for businesses: it is now a major criterion for the attractiveness of countries, and of regions within countries.

In most cases, however, the sole action of private telecom players will not result in a fair and even development of territories, and it is unlikely to drive quality up. Pure competition between telecom operators is likely to lead to situations such as the following:

- A number of operators significantly reduced in many markets through consolidation. In Europe for example, the operators Numericable and SFR merged in France in 2014, and Three and O2 are waiting for a green light from the European Commission to do so in the UK. While this leads to economies of scale and drives the creation of international scale players, it doesn't necessarily drive connectivity further inland or drive prices down. Both availability and affordability, therefore, are not automatically served by a post-consolidation competitive market.
- In developed economies, most incumbent operators will look at lengthening the life of the copper network and postpone investment in fiber beyond reason. While such arbitrations can make sense and should be considered in the short term, delaying long-term investment in fiber will harm the country's competitiveness as broadband quality suffers compared to that of other countries that have embraced fiber deployment. Currently, incumbent operators such as BT in the UK and Deutsche Telekom in Germany are investing in fiber-to-the-curb (FTTC) networks. In the US the dominant broadband technologies are FTTC and cable, both reusing existing copper wiring.
- In new growth economies, pure private market investment will focus mostly on mobile. While mobile is a vital part of broadband connectivity, many uses cases are impractical or uneconomical on mobile, and mobile on its own will not allow for the full impact of broadband adoption to be felt (see "Fixed or mobile broadband?" above). As a consequence of this mobile focus, quality will suffer in the short term, and adoption of new generations of mobile technology will suffer — and the dense deployment of fiber for 4G/5G antenna connectivity isn't undertaken.

Countries where nothing significant is done from a policy perspective to make the broadband market more dynamic will see availability, affordability and quality of broadband suffer. In turn, these countries might not benefit from the latest development in network optimization like software defined networking (SDN) and network functions virtualization (NFV). These technologies allow for a better convergence of fixed and mobile network assets, more flexibility in network deployment and operation and a much increased ease in new service development and deployment. With a limited footprint nationwide and below-par quality, countries that don't intervene might miss out on the massive economies of scale and flexibility that these technologies enable.

Ultimately, the risks in an absence of government involvement in the development of broadband can be summarized as follows:

- **A widening accessibility gap**, due to the lack of available broadband solutions in some secluded areas, but also because the lower quality of broadband solutions available in other areas makes it impossible for end users to benefit from all services the broadband connectivity enables. As more innovative services become available to populations living in the cities, where better broadband infrastructure is deployed, populations living in rural areas are more isolated and marginalized.
- **A widening affordability gap**, because the reduced competitive pressure on operators limits the incentives to drive the prices down. This affordability gap, which affects the most fragile populations (for example, poor communities, elderly people), has deeper repercussions in terms of access to public services and education, as broadband connectivity becomes the main means of access to services for everyday life.
- **A lesser attractiveness** for the establishment of companies, because of the lack of proper broadband infrastructure itself, but also because the lack of infrastructure hinders the development of specialized digital skills within the population and of advanced digital services for professional users. This lesser attractiveness brings a gap between countries themselves, but also between regions within a given country.
- **A limited innovation in the digital sector**, as efficient broadband infrastructure is necessary for the provision of innovative services. Therefore, the lack of it prevents global players to provide their services locally, or local players to develop new services that may require efficient connectivity. This downside is furthermore strengthened by the lesser attractiveness mentioned above.

Impact of policy

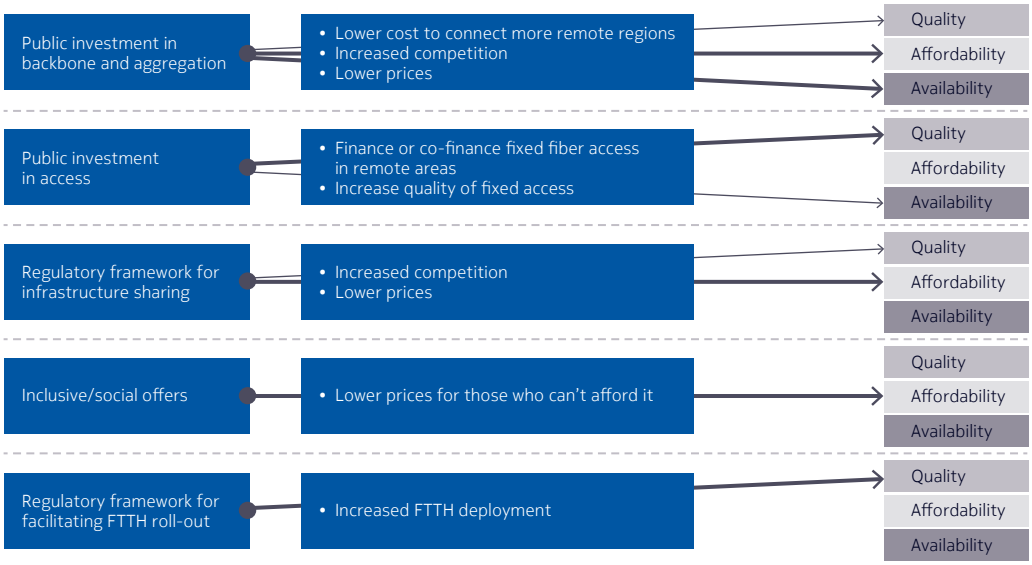
In order to measure the impact of broadband policy, we identified five key policy measures most likely to have a measurable impact.

1. **Public investment in backbone and aggregation**: One of the biggest hurdles for broadband development, especially in new growth markets or rural areas of developed markets is the lack of open backbone capacity. By contributing public money (through investment, subsidies or any other financial mechanism) in an open access aggregation and/or backbone network, governments aim to lower the cost of operation and therefore make broadband more broadly available, increase competition (through equal access to a shared infrastructure) and lower prices for the end user.

2. **Public investment in access**: In some countries where an open aggregation and backbone network already exists but where a fixed access network is either non-existent or obsolete, governments have directed initiatives and public money toward access networks. These public private partnerships are often linked to some form of openness in the network (but not always). The expected impact would be broader coverage of fixed network access (availability), but more importantly an increase in quality of broadband.
3. **Regulatory framework for infrastructure sharing**: In many countries the incumbent operator's fixed infrastructure is forced open, at least to some extent, to create some competition in the access. This can be anything from an obligation to resell bitstream wholesale products to full-fledged structural separation. Infrastructure sharing is supposed to drive competition, and through that both lower prices (affordability) and innovation (quality).
4. **Inclusive/social offers**: Inclusive or social offers aim at enabling those who cannot afford broadband at least some level of connectivity. They are sometimes mandated as part of operators' licenses or financed by government. These are targeted measures that only affect affordability.
5. **Regulatory framework facilitating FTTx roll-out**: These measures aim at accelerating the deployment of next-generation fiber infrastructure. They can be combined with public funding in the access, but also include measures designed to reduce the cost of deployment or eliminate hurdles (rights of ways, building consent, etc.).

To identify the indicators best suited to seeing the impact of these measures, we mapped their expected outcomes on the basis of the analysis framework as shown in Figure 3.

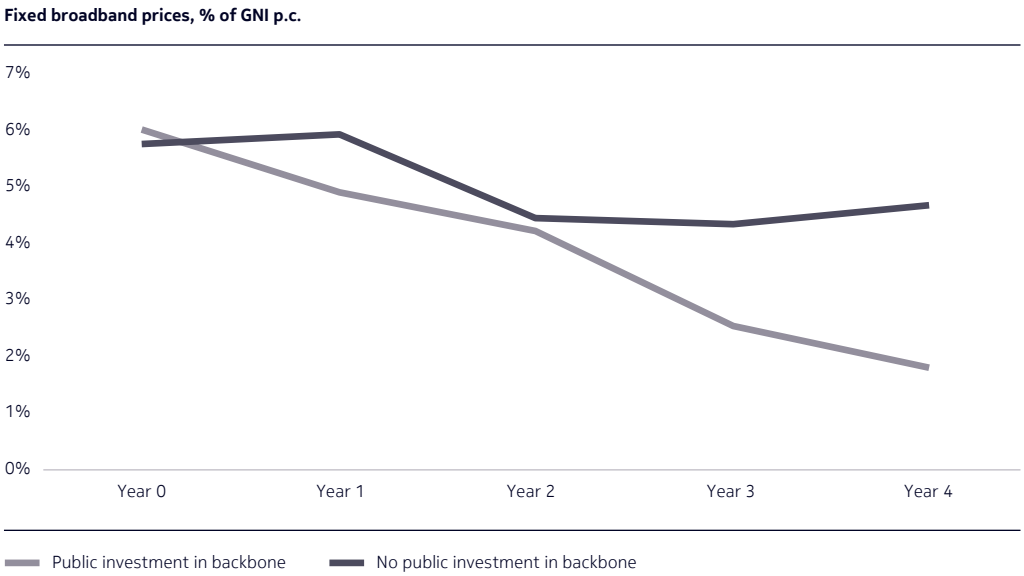
Figure 3. Expected impact of five main policy measures



Public investment in backbone and aggregation

As shown in Figure 4, public investment in backbone and aggregation drives broadband prices down. Countries that have included such investment in their plans have seen prices drop by 4 percent of Gross National Income per Capita (GNI p. c.) over 4 years as opposed to a little over 1 percent for countries that haven't invested. Considering the average GNI p. c. for Year 0 among the countries of the sample (US $18,925), this drop in price would represent US $66 per month on average for the first group, but only US $17 for the second group.

Figure 4. Impact of investment in backbone and aggregation on fixed broadband prices



Case studies

Colombia

The public-private partnership to deploy a backbone project in Colombia is an innovative example of government-funded connectivity. In 2010, out of the 1,122 municipalities[2] that constitute the Colombian territory, only 287 had access to high-speed broadband services. The rest had low-speed services, satellite services or nothing. Newly appointed Telecommunications minister Diego Molina decided that as many municipalities as possible should

2 The term "municipality" does not represent only urban areas in Colombia: some municipalities are centered around small pockets of population but across huge rural territories.

have access to high-speed services. He initiated a plan to achieve that, and launched a number of studies to determine priority targets and cost of deployment of a fiber backbone connecting these targets. The idea was to find ways to incentivize the private market to build the national backbone thus envisaged. Four hundred priority municipalities (mostly Tier 2) were identified, and the estimated cost to connect them with backbone fiber was estimated at 415 billion pesos (roughly US $200 million).

The government then opened up a tender to deploy a national fiber backbone network and connect the target municipalities with at least 24 fiber cables with a capacity of 2 Gb/s per fiber, upgradable to 10 Gb/s. The estimated length of the network to be deployed was 19,000 kilometers. In addition to establishing a single node for interconnection in each municipality, the winning bidder would also have to connect 2,000 schools, hospitals, army and administrative buildings in targeted municipalities. Finally, the bidders had to agree to a ratio of aerial deployment to buried deployment of no more than 75 percent (where 90 percent of Colombian backbone networks were aerial). The unusual notion in the bid was that it was not about how cheaply the network could be deployed: the $200 million were committed as a subsidy. It was about how many more municipalities in addition to the core 400 would be connected.

The tender was won by Mexican company TV Azteca, which committed to connect 353 municipalities in addition to the original 400 through the company Azteca Communications, amounting to 753 municipalities in all. The government later requested an extra 1,500 kilometer deployment from Azteca Communications to cover 788 municipalities, rather than the initial 753, and an additional $10 million was offered to cover the extension.

Azteca Communications reportedly finished rolling out the 20,500 kilometer backbone in March 2015, covering 80 percent of the country's territory. However, the company doesn't own the network: the contract stipulates that the network will have to be managed for 15 years with no extra subsidies before the winning bidder gets full ownership. The network cannot be sold, and if TV Azteca was to go bankrupt, the ownership of the network would automatically revert to the state.

In addition to its obligations to deploy, TV Azteca has two more crucial obligations in this project: everywhere the network is deployed it must offer retail services and also wholesale services. The wholesale services are active (Layer 2), although TV Azteca is not barred from reselling dark fiber should they wish to do so. The wholesale price is capped by the contract at $700 per Mb/s. This has allowed some mobile operators to open new markets, which they could not afford to cover until now.

There hasn't been enough time since the completion of the program to perform relevant measures of socio-economic impact, but in terms of connectivity the results of the backbone program are already visible.

Between 2011 and 2014, the number of Colombian households with internet access more than doubled from 2.3 million to 4.9 million (on a total of 12.8 million in 2014), while the total of fixed-broadband subscriptions -including businesses- rose from 2.6 million to 5.0 million.

The Colombian backbone program has attracted a lot of attention in Latin America, with continental organizations like Unasur trying to assist other countries in replicating the model. Colombia's example shows that by ensuring open access backbone connectivity, the government makes efficient use of public funding as it unlocks private investment in access. This is a particularly effective way to ensure the extension of mobile access coverage.

Key success factors

- Ambition to connect as far and wide as possible rather than minimize spending
- Focus on aggregation and public building connectivity
- Embracing open access from day one

Poland

The National Broadband Plan of Poland aims at providing high-speed internet of at least 30 Mb/s to 100 percent of its population, and 100 Mb/s to 50 percent of its population by 2020, in accordance with the objectives of the Digital Agenda for Europe.

This plan incudes the construction of fiber-optic networks, the vast majority of which are planned as backbone and aggregation networks for supplementing deficiencies in the regions. The networks financed by public funds should improve access to the internet in rural areas, and increase competition by providing operators with cheaper connectivity.

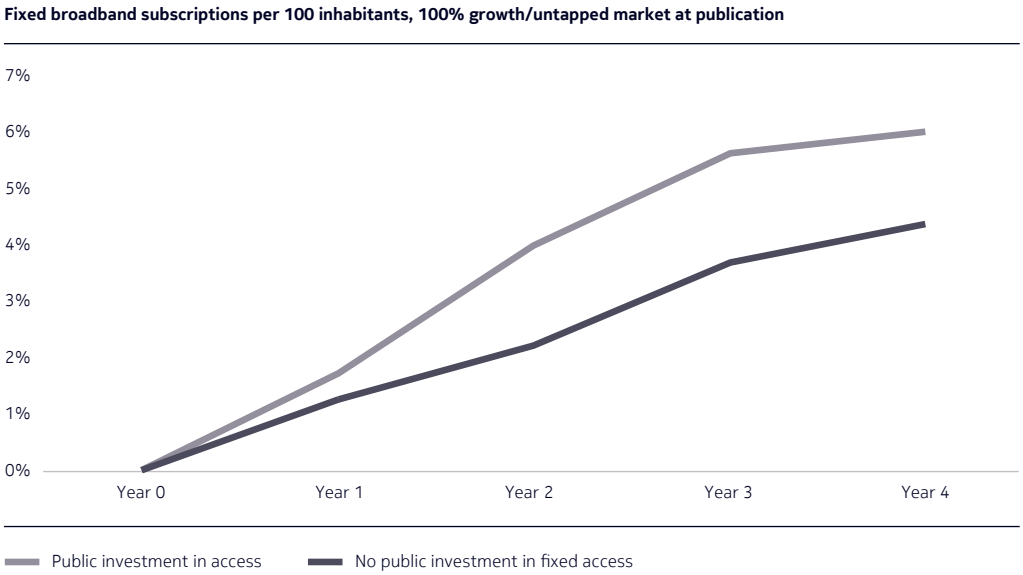
The project encompasses of around 30,000 kilometers of fiber-optic backbone and distribution networks and more than 3,000 backbone and distribution nodes in 11 Polish provinces. The fiber networks will be open for all telecom operators willing to provide NGA services.

In total these projects are worth more than PLN 3 billion (€700 million), of which more than 60 percent are subsidies from the EU. By the end of 2015, nearly 15,000 kilometers of fiber infrastructure had been constructed, and some towns with as few as 500 inhabitants have been connected.

Public investment in access

Countries that invest public money in fixed access see a marked increase in fixed broadband subscriptions as shown in Figure 5. In other words, public investment in access drives fixed broadband subscriptions. Over 4 years post-publication, countries that have invested see a growth 30 percent higher than countries that have not invested. Countries that haven't invested in fixed access also see an increase, but the difference with those that do invest is quite significant. Note that this analysis shows growth in subscriptions based on the proportion of the market that hadn't subscribed to fixed broadband at the plan's publication.

Figure 5. Impact of investment in access on fixed broadband subscriptions



Case studies

New Zealand

New Zealand's Ultra Fast Broadband initiative launched in 2009 aims to cover 80 percent of the population within 10 years (as well as businesses, schools and health services), with services of up to 100 Mb/s downstream and 50 Mb/s upstream. The state is supporting the development of FTTH networks with an investment of NZ $1.56 billion (roughly €950 million), managed by the purposely created entity Crown Fibre Holdings (CFH). The remaining 20 percent of the population will be covered by a specific rural plan involving multiple technologies, financed by an NZ $ 400 million grant (€245 million). An additional NZ $150 million was specifically earmarked for schools.

A condition for access to the government investment was the absence of any financial ties with service providers. In order to participate in the second round of bids, Telecom NZ underwent voluntary separation, with the two resulting spun-off entities being Chorus (infrastructure wholesaler) and Telecom NZ (now Spark, retail services). Chorus and three other Local Fiber Companies (Northpower, Ultrafast Fiber and Enable) cover the whole of the targeted territory. The public and private partners play specific roles in the fiber rollout process:

- A specific entity called a "Local Fiber Company" (LFC) is created to own the infrastructure and receive the invested funds from the public and private entities.
- CFH finances the construction of the shared access and aggregation network (excluding end-user drops), that is, the "communal infrastructure."
- The private partner finances the connection of the end users when they subscribe and buys back the corresponding "communal infrastructure" cost from CFH on a per-user basis.

This financing strategy mimics the economics of a network with 100 percent take-up for the private partner: the private operator only incurs cost when an end user is connected, on a per-user basis. As the take-up occurs, CFH's interest in and control over the LFC gets diluted: the private partner buys back the shares from the state. This releases funds for further investments by CFH, without additional capital required from the state. It also means that ultimately the government will get all of the investment back.

The characteristics of the financing mechanism were chosen to stimulate private investment by redistributing the related risks. In particular, the uptake risk is mostly supported by CFH, while the private partner supports the operational risk.

This ambitious strategy has already started to pay off: as of September 2015, 815,000 premises were open for service with 134,000 users connected to the network.

Key success factors

- Tying public funding and structural separation to ensure long-term infrastructure investment
- Focus on long-term infrastructure buildout through FTTH technology
- Invest rather than subsidize for a more effective use of public funds

Malaysia

Malaysia's High Speed BroadBand project (HSBB) is a very successful example of public investment in an access (and aggregation) network:

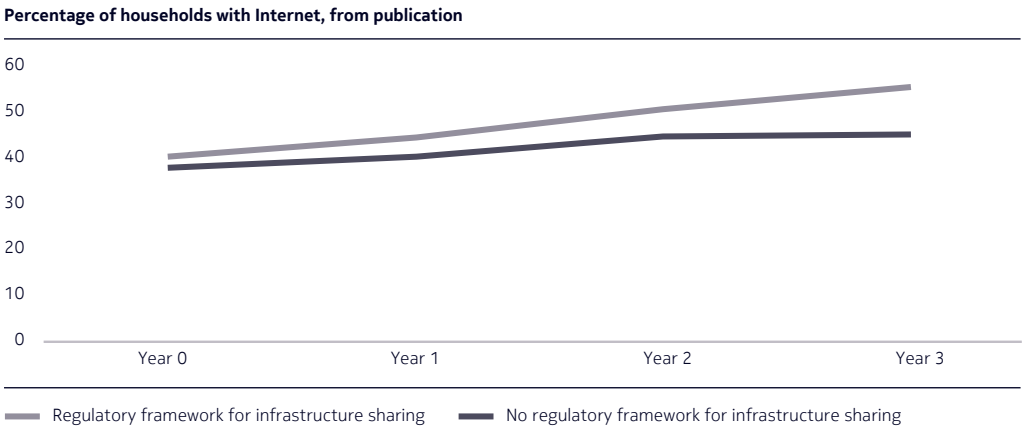
- The government and Telekom Malaysia signed a public–private partnership agreement in September 2008. The total project cost amounted to RM 11.3 billion (€2.52 billion), with government funding of RM 2.4 billion (€535 million), and Telekom Malaysia carrying an investment of RM 8.9 billion (€1.98 billion).
- The rollout started in late 2008 with a mix of technologies including FTTH and very high-speed digital subscriber line (VDSL2).
- In March 2010, HSBB services were launched conjointly to a National Broadband Initiative to drive broadband adoption.
- By October 2012, the targeted 1.3 million premises had been passed with FTTH. By Q3 2014, there were 735,000 subscriptions to the network, accounting for a take-up of 57 percent on premises passed.

Telekom Malaysia agreed to make the network available to other operators: the agreement states that the incumbent shall set a fair and equitable price on a commercially negotiated basis. As of April 2014, five operators had signed up for HSBB access services, and 25 had signed up for HSBB transmission services used to enhance their own backhaul network.

Framework for infrastructure sharing

Infrastructure sharing seems to have a broader impact even than investment in access, as shown in Figure 6. Countries that put in place a framework for infrastructure sharing see the proportion of households with internet increase significantly. Because it impacts both fixed and mobile operators, infrastructure sharing has a much more marked overall effect on broadband usage. While the workable time series here is only 3 years, the gap in households with internet between countries that have published a framework for infrastructure sharing and those that haven't is clearly widening. From an initial gap of 2 percent on year 0, we see a gap of nearly 10 percent on year 3 in households with internet.

Figure 6. Impact of framework for infrastructure sharing on percentage of households with internet access



Case studies

Brazil

In 2012, Brazil's telecommunications agency, Anatel, approved the General Plan for Competition to stimulate competition in relevant telecommunications markets. This plan introduced obligations for companies with significant market power to publish offerings of reference allowing smaller operators to access parts of their networks and infrastructure. In particular, the framework aimed at removing significant entry barriers in markets where the competition was hindered, including local access, local and long-distance transport, and passive infrastructure.

These regulatory measures allowed the development of wholesale offers, which were then made available to all operators through a specific platform, the Brazilian National Wholesale Trading System (SNOA). The platform functions as a virtual trading exchange system for telecom assets, and includes databases of reference offers from all the operators with significant market power (SMP) on their own relevant markets. For operators, it's a one-stop-shop for wholesale assets, with standardized requests and processes as well as a guarantee of non-discrimination; for the regulator, it's an efficient tool to monitor the wholesale market, reduce asymmetry of information and limit the disputes. The system is managed by a board composed of SMP and non SMP companies, with parity of votes between these two groups, and is funded by the dominant companies. The platform was implemented in September 2013, and by April 2015 more than 34,000 requests had been recorded.

Regarding mobile networks, a law published in April 2015 enforced new standards regarding mobile infrastructure deployment and sharing. Named the "Antenna Law," it aims at reducing the duplication of mobile

network antennas in urban areas, by constraining operators to share their infrastructure, all the while encouraging investment in expanding network footprints. Public authorities also expect to improve the availability and quality of mobile voice and broadband services. In addition to ensuring the sharing of newly deployed infrastructure, another important aspect of the Antenna Law is that the operator owning the mobile infrastructure must share its surplus capacity with other operators.

Key success factors

- Focus on real entry barriers: costly infrastructure (ducts, access network) and players with significant market power
- Implementation of processes and platforms to facilitate communication between partners

France

The French government released its national broadband plan — Programme National Très Haut Débit (PNTHD) —in 2010, followed in 2013 by an update — Plan France Très Haut Débit (PFTHD). While local loop unbundling was the cornerstone of the telecom regulation until then, the PNTHD introduced new objectives regarding the deployment of FTTH networks:

- Stimulate the investment of private operators where the deployments are deemed profitable
- Support projects led by public authorities elsewhere.

The launch of the PNTHD was accompanied by regulatory measures introducing mechanisms to reduce the duplication of infrastructure where it was not deemed necessary:

- In dense areas (mainly cities with more than 100,000 inhabitants), the part of the network within buildings has to be shared.
- In less dense areas, the last mile is shared between operators from the optical distribution frame.
- In areas where the low density deters private operators from investing, local authorities invest in open access networks, with some state subsidies.

The regulatory authority also defined rules for duct sharing (of the incumbent) in 2008. By the end of 2013, 13,000 kilometers of ducts of the incumbent operator were used by alternative operators. In addition, infrastructure owners who are about to carry out installation or maintenance projects

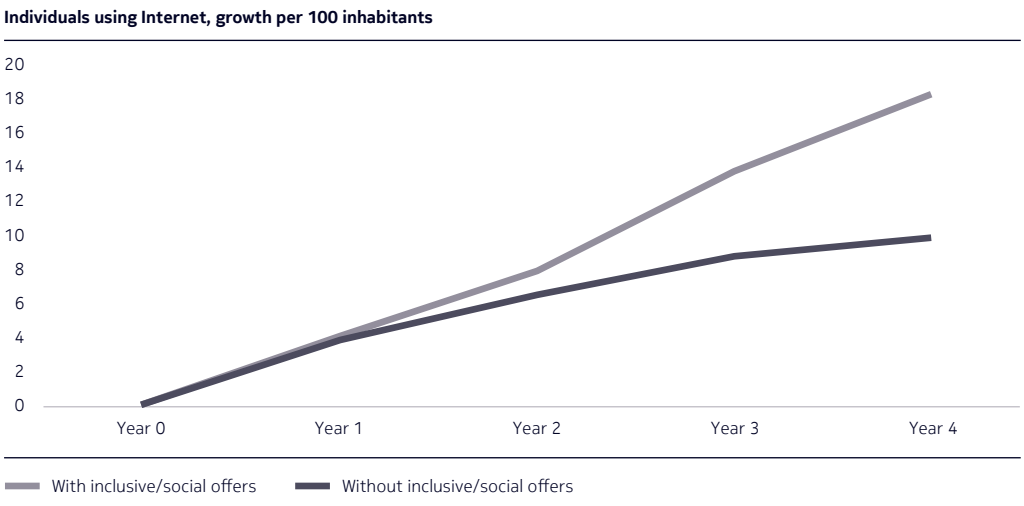
of “significant length” (approximately 150 meters in urban areas and approximately 1 kilometer in rural areas) are obliged to announce to the local authorities their plans for surface works (such as stripping and replacing surfaces), works on overhead lines, and any works that require excavation. These infrastructure owners are obliged to allow operators to install electronic communications equipment in any trenches that are created during the works.

The operators (in particular the incumbent, and to a lesser degree two of its competitors) committed themselves to cover 57 percent of the population despite the fact that only about 20 percent of the population lives in the denser areas, which are the most profitable and where infrastructure-based competition occurs.

Inclusive/social offers

Inclusive offers have a clear impact on broadband adoption. As Figure 7 shows, countries with inclusive or social offers in their broadband plans have seen subscriptions grow significantly faster than those without. From an equivalent starting point, the growth in internet usage per 100 inhabitants is 18 percent on Year 4 for countries with social/inclusive offers versus only 10 percent growth for those without.

Figure 7. Impact of inclusive/social offers on growth of internet subscriptions per 100 inhabitants



Case studies

Uruguay

Uruguay's plan, CEIBAL, was launched in 2007 to bring new technologies to the country's classrooms. The acronym CEIBAL stands for "Conectividad Educativa de Informática Básica para el Aprendizaje en Línea", that is, IT Educational Connectivity for Online Learning. The government thus decided to distribute one laptop to each child and also to the teachers in the primary public school system.

In September 2009, 380,000 computers had been distributed, bringing benefits to the children, but also their families since the children own the computer they receive. Around 70 percent of the laptops were given to children who didn't have access to a computer at home. This initiative reduced the digital gap and addressed the social and economic inequalities in the Uruguayan society. With these devices, the children and their families can access the internet using Wi-Fi® networks in the vast majority of schools and in 250 outdoor public places, as well as other educational private and public institutions.

The total cost of the CEIBAL program on a 4-year period was around €300 per child. This figure includes the devices, replacement of devices after 4 years, maintenance, internet costs, content production and training courses for the teachers.

The "one laptop per child" project was also completed in April 2012 by the initiative "Universal hogares" of ANTEL, the Uruguayan government-owned telecommunications company, to provide internet access to low-income households. These households can benefit from a permanent connection to the internet if a phone line connects their premises, at a cost of UYU 490 (€15). While the offer includes traffic of only 1 gigabyte per month, it is possible to add more data for a fee.

US

In June 2015, the US Federal Communications Commission (FCC) voted to subsidize broadband services for low-income households. The Commission approved the addition of Internet subsidies to the Lifeline program, a government assistance program that already offered discounts on fixed and mobile phone service. The Lifeline program is funded through fees paid by service providers and currently helps around 12 million American households.

In the US, less than half of homes with an income smaller than $25,000 per year have access to the internet, while 92 percent of households with incomes between $100,000 and $150,000 have broadband access. With the FCC's vote, low-income households will be able to benefit from a subsidy of $9.25 per month for internet, phone service or both.

The president's administration also announced in July 2015 a new initiative called "ConnectHome" to bring broadband to over 275,000 low-income households across the US. The pilot program is set to launch in 27 cities including New York, Boston and Seattle.

Launched and managed by the US Secretary of Housing and Urban Development, ConnectHome is funded by private industry, non-profit organizations and local leaders, who have pledged to spend $70 million over the next several years. Among other companies, eight nation-wide internet service providers have announced they will support the program.

Key success factors

- Takes into account both connections and devices
- Involves private players to ensure long-term efficiency
- Sets the priority on the most vulnerable populations

Framework for FTTx development

The quantitative impact of frameworks for FTTH development could not be consistently measured based on the indicators at hand. Two main reasons for this, lack of reliable history depending on the plans considered, and lack of consistent and reliable indicators data. However, there are a number of clear case studies that demonstrate how such frameworks can be implemented and why they have worked. We detail two of these on the following page.

Case studies

South Africa

The South African government identified broadband as a key element in the economic development of their country and sketched in the Electronic Communications Act of 2005 as a set of measures that would allow for the long-term development of digital infrastructure.

Among others, the following measures were specified to enable a suitable framework for investment in high-speed broadband infrastructure:

- Implementation of clear, transparent and efficient processes to grant permits for civil works. These processes are to be shared between all public entities in charge of delivering these permits.

- Facilitation of the access and use of physical network infrastructure, be it public or private infrastructure (including ducts, manholes and cabinets). This measure may have a wider scope and include other civil domains (electricity, water and sewage, transport, etc.) to provide additional support for quick deployment of fiber networks.
- Coordination of civil works to facilitate cooperation between network operators in order to exploit potential synergies in network rollout. This coordination is also expected to reduce accidental damage to existing urban networks.
- Definition of a specific framework for in-building equipment:
  - All newly constructed buildings and buildings undergoing major renovation are to be equipped with facilities for "high-speed-ready physical infrastructure."
  - Every internet provider will have the right to terminate its network at a concentration point located inside or outside a building, and will have the right to access any existing high-speed-ready in-building physical infrastructure on reasonable terms.

Initially identified in 2005 (but lacking a more practical implementation in the legal and regulatory framework), these measures were reiterated under the "Digital readiness - laying the foundations for South Africa's broadband future" chapter of the South African broadband policy published in 2013. As of early 2016, this set of measures is to be implemented under the Strategic Integrated Project 15 (SIP 15), labeled "Expanding access to communication technology," in coordination with the regulatory authority, Independent Communications Authority of South Africa.

While it is not yet possible to observe the impacts of these initiatives in South Africa, it is worth mentioning that the South African government has defined a comprehensive set of actions that have already proved successful in other countries to accelerate the development of FTTx networks.

In particular, the clarification of the framework for in-building equipment is considered in many western countries as a cornerstone for the development of FTTH networks.

Qatar

The Supreme Council of Information & Communication Technology of Qatar announced in March 2011 the launch of the Qatar National Broadband Network (QNBN) to build a nation-wide, open, and cost-effective FTTH network. The QNBN targeted the provision of a broadband service of at least 100 Mb/s effective download and 50 Mb/s effective upload speeds, to 95 percent of the population by 2016, by connecting nearly 250,000 homes and business premises. While there are no publicly available data

on the current coverage of QNBN, the evolution of Qatari FTTH/FTTB subscriptions is impressive: from 1,100 in 2010, the number of subscriptions reached more than 100,000 in 2013.

Retail service providers were nonetheless allowed to deploy their own fiber networks if they chose to do so. Some initiatives were necessary to facilitate the deployment of the QNBN as well as alternative fiber networks:

- Resolve duct ownership issues through an investigation of their historical deployment, and define non-discriminating conditions for access to infrastructure
- Map the existing infrastructure, with information regarding ownership and availability, and maintain the data up to date
- Publish a guideline to standardize in-building wiring between operators
- Consult with industry to define a roadmap for the copper network switch-off, securing investment in fiber infrastructure.

The private operator Ooredoo was thus able to deploy its own FTTH network, covering 80 percent of homes in Qatar as of early 2014. With these initiatives, the coverage enabled by private investment may well be even more important than the coverage of the QNBN.

Key success factors

- Implementation measures reduce costs, in particular for access to infrastructure
- Reduction of administrative complexity and time-consuming processes
- Anticipation of technical and regulatory aspects of in-building wiring

Transforming the broadband ecosystem

The countries examined above provide good examples of initiatives aimed at adjusting specific issues in the broadband landscape. Nevertheless most of them have taken a broader outlook to drive deeper changes, not only addressing a specific pain point, but aiming to transform the digital economy for the long term.

This “sustainable development” strategy to broadband can be achieved through a comprehensive approach, creating a more suitable ground for development on multiple aspects: a widespread network, healthy competition, and the development of demand. The benefits of broadband for citizens, society and the economy are all tied together: by targeting multiple issues, the positive impacts can be multiplied. In addition, positive impacts may often require a transformational project to shake up some broadband ecosystem rules for the long term.

A transformational approach is achieved first and foremost through a willingness to change the policy frame of reference, even at the cost of ruffling a few feathers. A transformational project must be:

- Focused on the long term, understanding that the actions a government undertakes may not yield immediate results, but will eventually yield lasting and important results. This also means that the policy approaches themselves must be thought out for the long term, even if the political circumstances that surround them change.
- Ambitious: In order to transform the ecosystem for the better, a government must want to see these changes happen, and not satisfy itself with minor improvements. For instance, many governments satisfy themselves with mobile broadband coverage, not recognizing the long-term challenges that this raises. An ambitious approach needs to be comprehensive and wide-ranging.
- Willing and accepting to shake the ecosystem: In all markets there are entrenched interests who would either prefer no public intervention or hope to twist whatever measures are undertaken to their benefit. Policy makers need to recognize this market inertia and design policies that may, and in some cases must, go against these entrenched parties.

One important aspect is to clearly establish what the private market can do, and what it won’t do. Measures can then be taken to facilitate private initiatives, and focus public funding on those areas that simply will not happen without it.

Mexico

The Mexican national broadband plan currently being implemented is an example of a government-led initiative targeting several issues in the telecom market: a lack of competition, low market penetration, and low investment in infrastructure. The constitutional reform of telecommunications, approved in 2013, established access to broadband and broadcasting services as public services of general interest. The plan, supported by the Mexican president, includes several complementary initiatives, such as:

- The creation of a network of community centers for digital education
- The connection of public buildings with broadband solutions: schools, hospitals, administrations
- The implementation of a local internet exchange point, to facilitate the exchange of traffic between service providers
- The overhaul of regulatory institutions to enable a more efficient regulatory process
- The promotion of public—private partnerships for the deployment of networks.

But the most impressive move certainly lies in the envisioned investment of close to €50 billion on both terrestrial and wireless infrastructure, from which 75 percent is expected to come from the private sector. This investment will enable the extension of the fiber-optic backbone owned by the Federal Electricity Commission, the installation of a mobile network in the 700 MHz and 2.6 GHz bands, the connection of close to 250,000 public places with broadband services, and the reinforcement of satellite solutions to ensure the availability of connectivity in secluded areas.

While the implementation of the plan is still under way, the national broadband plan makes it clear that the country has identified major impediments in the development of broadband infrastructure and services, and that some bold solutions are being planned to bring broadband connectivity to end users.

Toolbox of remedies

It should be clear that there is no magic recipe to solve broadband issues in a given market. However, based on various successful broadband plans and broadening the scope from the initiatives analyzed in this paper, one can establish what might be called a toolbox: various approaches that policy makers could mix and match to achieve specific objectives as part of projects aiming to transform their broadband ecosystem for the long term.

Figure 8 shows what some of these initiatives may be, which goals they should achieve (availability, affordability or quality of broadband) and whether they require public funding or not.

Figure 8. Toolbox of broadband remedies

This figure showcases the various policy tools that can be put in place, highlighting their primary impact (affordability, availability and quality) but also secondary impact (through the arrows)

A prevailing view in policy circles is that nothing happens without public funding, and that view often leads to inaction due to lack of financial resources. As the toolbox demonstrates, there is much that can be done without funding, which of course doesn't imply that funding doesn't have a multiplying effect on results.

Conclusions

The importance of policy involvement in broadband development cannot be overstated. As we have demonstrated here, it also has a clear and measurable impact, especially when initiatives are undertaken as part of a well thought-out broadband plan. In order to maximize the impact of broadband policy measures, it seems that the following components are necessary as part of the policy outlook:

- A shift in mindset on the role of policy, which can only come from the policy makers themselves, both regulatory authorities and governments. Accepting that policy has a vital role to play, that it can move forward despite opposition of entrenched parties and that it will deliver measurable results.
- A driving force for change, not just in the design of the policy itself. Too often, smart policy fails in its implementation either because policy makers put too much trust in market forces or because they simply don't see their role as one of driving the change, just of initiating it. Effective policy isX driven by constant attention, adjustments and overcoming of hurdles.
- Public funding is an important component of public policy that must be used efficiently to reinforce the impact of a broader political framework. In particular, public funding should address pain points in the market in a fair and open way so that no single player benefits from its use. In this way, the impact of funding is maximized.

These need to be put in play with a focus for the long term, not just in terms of the impacts of policy but in terms of its continuity. It is vital that policy doesn't shift too often and that time is allowed for its impacts to be felt.

Policy makers must involve themselves in the implementation of their policies in three ways:

- The design of policy and regulation is their primary role and responsibility.
- Ensuring that the financing of initiatives that require financing is ensured throughout the life of a project is a second way in which their role is crucial. Too often, publicly financed initiatives are funded in the early years, but financing falters in later years when the initiatives are no longer in the limelight.
- Get involved operationally when public—private partnerships (or other modes of collaboration) are set up: operational follow-up is key to ensuring that the vision and goals of the policy initiatives are carried through. This follow-up must be implemented in accordance with clear and concrete objectives regarding the expected achievements, and by means of a set of monitoring tools to continuously assess the steady progress of the plan.

As demonstrated by the number of roll-out plans around the world, policy initiatives implemented as part of broadband plans produce measurable positive results. Designing and carrying through a transformational project that would encompass all of the above recommendations is very likely to maximize these positive results as many of the case studies shown in this paper demonstrate.

Broadband policy works when implemented well and delivers vital benefits to economy and society.

This Nokia sponsored research was done with Diffraction Analysis.

Acronyms

CEIBAL	Conectividad Educativa de Informática Básica para el Aprendizaje en Línea
CFH	Crown Fibre Holdings
FCC	Federal Communications Commission
FTTB	fiber-to-the-business
FTTC	fiber-to-the-curb
FTTH	fiber-to-the-home
FTTX	fiber-to-the-XXX
GNI p. c.	Gross National Income per Capita
HSBB	High Speed BroadBand
ICT	information and communications technology
LFC	Local Fiber Company
NFV	network functions virtualization
PFTHD	Plan France Très Haut Débit
PNTHD	Programme National Très Haut Débit
QNBN	Qatar National Broadband Network
SDN	software-defined networking
SMP	significant market power
VDSL2	very high-speed digital subscriber line

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Product code: PR1603018887EN (March)