European Commission

Guide to High-Speed Broadband Investment

About the authors
The guide has been the result of a joint effort from team of four experts in broadband:
- M. Forzati and C. Mattsson from theACREO[1] Swedish ICT institute;
- M. Corbet and D. Cullen from the Independent Networks Co-operative Association (INCA)[2];
  and the contribution from the regions involved into the Engage Project[3] (High Speed Broadband for Rural Europe).

The document is meant to be updated over time with information on technologies, policy initiatives and new regulatory provisions as well as new models of investment and successful projects that achieve the highest socio-economic impact. The digital version is available at the European Broadband Portal[4] as well as any further updates.

Version: 18/9/2014

[1] https://www.acreo.se/
[2] http://www.inca.coop/
[3] http://www.engage-interreg.eu/
[4] European Broadband Portal http://ec.europa.eu/digital-agenda/en/broadband-0

TABLE OF CONTENTS

Preface

Over the last decade or so, our social, economic, cultural and political interactions have become mediated through ICT networks, services and technologies.

Paraphrasing Thomas Jefferson famous quotation that "*information is the currency of democracies*", today the increasing channelling of information into communication networks is turning them into the "synapses", and collectively, into "the nervous system" of our modern democracies and economies. Indeed, access and use of these networks have become increasingly important for the lives of citizens of modern democracies that even their most basic necessities, such as education, health care, transport, electricity etc. have become more and more dependent on the well-functioning, the reach and access to ICT networks.

However, the effects of ICT networks differ depending on the way they are exploited by individual users and organisations. One of the latest quarterly report on the Euro area[5] highlights that it is just these differences in the exploitation of ICT that are primarily responsible for the gaps in productivity across the world and that ICT represents *"a significant driver of growing internal euro area divergences in the post-1995 period*».

The inclusion of the Digital Agenda for Europe (DAE) as an EU flagship initiative is a clear evidence that the Europe 2020 strategy has recognised the role of ICT in the achievement of the objectives of smart, sustainable and inclusive growth.

In 2013 the 'basic broadband for all' target set up in the DAE[6] has been reached through a mix of terrestrial fixed and wireless as well as satellite technologies.[7]

Next DAE broadband targets for 2020 are 100% coverage of 30 Mbps internet and 50% penetration of 100Mbps service in the EU.

Although the bulk of the investment needed to meet these ambitious targets is expected to be undertaken by private operators, public funding will be required in areas affected by market failure.

Given this background, it should come as no surprise if more and more regions and rural authorities are increasingly viewing open access to a good quality and affordable communication network infrastructure as an integral part of the their policy responsibility towards their citizens and the territory they administer.

Investing in ICT networks and services has become a critical element for the efficient delivery of good quality public services, preventing depopulation and relocation of economic activity, promoting social and economic development and increasing cultural and political participation.

This guide to broadband investment aims to assist public authorities in finding their own path to investment by posing appropriate questions about a set of critical decisions, highlighting their implications, at each step of the way to full high speed broadband coverage.

ICT and Business

[5] See: http://ec.europa.eu/economy_finance/publications/qr_euro_area/2013/pdf/qrea4_en.pdf

[6] http://ec.europa.eu/digital-agenda/

[7] http://europa.eu/rapid/press-release_IP-13-968_en.htm

INTRODUCTION

Local and regional public authorities have a crucial role to play in the deployment of Next Generation Networks (NGN) both in rural and urban areas. This guide is a tool to support them in making choices about critical issues and assist them in planning their investments in line with relevant policy objectives and regulation. The guide is structured in easy-to-read chapters outlining the important questions to be asked and guiding local and regional public authorities through the necessary steps in defining and executing a broadband investment in their territory.

EU policy and regulatory context

The European Commission has recently adopted several measures and policy proposals aimed at facilitating the deployment of high speed broadband networks:

- a **recommendation on consistent non-discrimination obligations and costing methodologies**;
- **New EU Guidelines for the application of state aid rules in relation to the rapid deployment of broadband networks**[8];
- A **Commission Regulation (declaring certain categories of aid compatible with the internal market** [9] **including Aid for broadband infrastructures;**
- a **directive on EU rules for cutting the cost of rolling out high-speed Internet**[10];
- a proposal for the "**Connected Continent**" on how to reach European Telecom Single Market.

The aim of these initiatives are to reduce cost of deployment, lower consumer prices, and provide better quality of service, create roaming-free EU, introduce common consumer protections, and safeguards to the open internet.

The regulatory context and policy initiatives are expected to increase the role of private investment in the financing an estimated total investment of €250B[11] required to achieve the EU NGN 2020 objectives.

However, even in the most rosy scenarios, most rural, remote areas and less developed regions with poor demand prospects (low income, education etc.) are likely to require some form of public investment following a range of investment models.

The European Structural and Investment Funds (ESIF) for 2014-2020[12] have identified ICT as one of four Thematic Objectives for thematic concentration of the European Regional Development fund (ERDF) which will support the deployment of Next Generation Networks in all type of regions.

[8] See Recommendation on Costing Methodologies: http://ec.europa.eu/competition/state_aid/legislation/specific_rules.html#broadband

[9] See http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0651&from=EN

[10] See DAE Action 117 on Cost Reduction: http://ec.europa.eu/digital-agenda/en/action-117-reduction-cost-deploying-high-speed-electronic-communications-networks-0

[11] See EU study on the "Socio-Economic Impact of Bandwidth": http://ec.europa.eu/digital-agenda/en/news/study-socio-economic-impact-bandwidth-smart-20100033

[12] See: ESIF Regulation: http://eur-lex.europa.eu/JOHtml.do?uri=OJ%3AL%3A2013%3A347%3ASOM%3AEN%3AHTML

The Rural Development fund (EAFRD) will also play a key role in rural areas with the financing of both small and large projects[13]. EAFRD's legal basis see in fact broadband as public goods and basic services (see Art. 20 of 1305/13) in rural areas available to a very wide public[14].

The 2014-2020 regulation also establishes that access to EU funds to support the deployment of ICT will require a prior fulfilment of two **ex-ante conditionalities[15]:**

- The first requires the formulation of a digital growth strategy to finance measures on services and to support demand.
- The second ex-ante conditionality requires the development of an NGN plan[16] for measures to support high speed and very high speed networks.

For the fulfilment of these two conditions please refer to sections A.2-1 and A:2-3 of the **Guidance to the fulfilment of the ex-ante conditionalities**[17] available on the inforegio website.

Why this guide?

First generation (broadband has had a large and measurable impact on the European society and on the way that business is conducted; consumers can access services, public services can be delivered more efficiently, at lower cost and SMEs can reach global markets in ways that were hitherto unimaginable, or simply unaffordable.

To ensure that Europe remains competitive in the global economy it is important that the underlying communication infrastructure is upgraded so that all citizens, businesses and public services can benefit from the development of new digital applications and services.

Local Public Authorities (public authority) and the public sector in general have a crucial role to play in the deployment of this new communication infrastructure. This guide is a tool to support local public authority in defining their role and plan their effort.

The goal of the guide is not to provide ready-to-apply recipes on how a Public Authority should go about investing in broadband in its region or municipality. It rather aims to assist the public authorities in formulating the important questions, and to provide the conceptual tools and the information needed to make the right decisions matching their needs.

The document guides the public administrations through the steps of producing a broadband plan, making the appropriate strategic choices for their territories and implementing the plan so that the Next Generation Network (NGN) infrastructure for society is deployed. It highlights the important strategic choices that need to be made in terms of investment models, infrastructure type, business models and financing tools.

It also presents important issues like citizen involvement, collaboration with market actors, coordination between different public authority units and with neighbouring municipalities and regions, monitoring and evaluation, etc.

Why move from basic broadband to NGN infrastructure?

When the existing telecom networks were built, the process was mostly driven by monopolistic and state-owned telephone companies to deliver the telephony service. Towards the end of the last century, these networks (and in some cases TV-distribution networks) started being used for data services. Initially synonymous with the *"Internet"*, data services have evolved rapidly and today's so-called broadband networks carry a plethora of services of all types, both of commercial and societal interest.

As more information services and tools are developed and greater volumes of data are transmitted, advanced communications networks are required to meet the need for speed, capacity, quality and reliability. While until recently fixed networks could be built using existing copper infrastructure, bandwidth demand from users and

[13] NB: An operation may be financed only by one fund (Art. 65(11) Common Provision Regulation)
[14] For further reference see Regulation 1305/2013
[15] See Annex XI of the Common Provision Regulation.
[16] See section on the Broadband Plan
[17] See: http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/eac_guidance_esif_part2_en.pdf

providers is quickly reaching a point when a new generation of digital communications infrastructure will be needed, in which optical fibre is brought closer and closer to the end-user and supports a wide range of fixed and wireless technologies.

INFOBOX – Basic broadband versus next-generation broadband in fixed networks

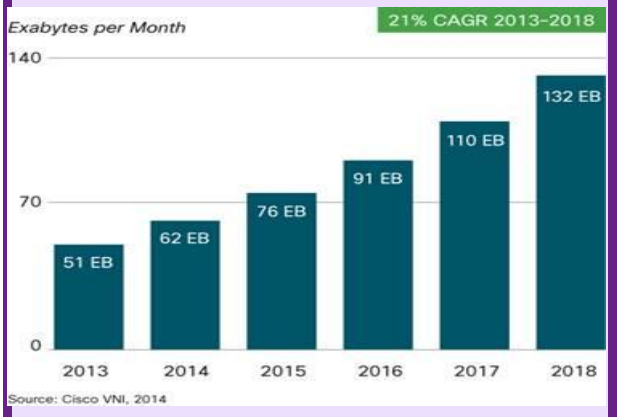
There is often a great deal of confusion when it comes to broadband, Internet and next generation network. Even though the relationship between infrastructure and speeds tends to change with technological development, digital communications services (of which Internet service is only one, digital TV, IP-telephony, security and e-health services are among others) can be classified as follows (ordered in increasing quality):

- **dial-up connections**: this type of connection was introduced on the mass market in the 1990's. It involved accessing the regular PSTN phone line and a modem whenever one wants to connect to the Internet (during which time the phone line is busy); connection speeds are typically up to 128 kb/s (or 0.1 Mb/s).
- **first generation** always-on **broadband connections** : the ones most common in Europe today. They can be achieved using telephone lines, coax cables for TV distribution, satellite dishes, or wireless connections (see below). These connections (mostly adsl) are typically asymmetric: the download speed is typically a few Mb/s while the upload speed is below 1 Mb/s. The DAE targeted 100% broadband coverage by 2013.
- **fast broadband connections (NGN)**: these are connections becoming common in the many parts of Europe. Like basic broadband, they can be achieved on most transmission media, but their speed typically ranges between 30 Mb/s and 100 Mb/s. They are most often asymmetric and special conditions need be satisfied for them to work on traditional infrastructure (typically distance of the user from the first aggregation node, number of users sharing the line, and the installation of advanced equipment in the first aggregation node). The DAE targets 100% fast broadband coverage (>30 Mb/s) over the whole EU by 2020.
- **ultra-fast broadband (High Speed NGN)**: these are connections with speeds above 100 Mb/s, often 1 Gb/s is taken as typical speed. They typically require dedicated fibre connections to the home or the building (premise) (FTTH/FTTP) with other types of infrastructures playing little role so far.

INFO BOX - Increase in data traffic

The combination of factors (capacity-hungry applications, the multiplication of services, devices, users, and simultaneous use) is expected to force investment in an ever more reliable and resilient infrastructure. An infrastructure that must be capable to provide extremely high quality of service (e.g.: symmetry, little latency, jitter etc.) ensuring the delivery of essential/critical services.

The fast spreading of fibre – based networks in some parts of Europe is mostly due to these considerations together with the need to increase the competitiveness and attractiveness of a territory/area with respect to others areas.



The three layers of a broadband network

Services	e-health, elderly care, (connected) TV, Internet, phone, video-conferencing, entertainment, teleworking, e-gov, e-education, e-commerce, smart monitoring, internet of things, cloud computing, etc.		
Active equipment	Switches/routers, data centres	Switches/routers, p2p microwave equipment	Switches, DSLAMS, DOCSIS, radio base stations
Passive infrastructure	Fibre	Fibre, antenna sites	Fibre, copper, antenna sites

A broadband network consists of a **passive infrastructure** (ducts, cables, masts, premises) and **active equipment component** implementing the technology (transponders, routers and switches, control and management servers). On top of that, **services** are delivered.

Similarly to other types of infrastructures (like roads, power lines, water distribution pipes, etc.) broadband passive infrastructure is typically characterised by high capital expenditure (CAPEX), low operational expenditure (OPEX), low economies of scale, stable returns from low rates over a long period, and is highly local, hard to duplicate and inherently subject to ex-ante regulation[18] because it most often constitutes a natural monopoly. On the other hand, technology (active equipment) is characterised by high OPEX, economies of scale, dynamic returns from higher rates over shorter periods, and could in principle be subject to limited regulation.

Moreover, infrastructure is a permanent asset (once the cables are deployed they have an economic life that can be measured in decades), whereas active equipment is subject to fast obsolescence due to the rapid technological development and to the electronics aging (currently, typically below 10 years).

Passive infrastructure represents today the most critical bottleneck in the process of upgrading and deploying a Next Generation Networks. It is in this area that the public authorities have a crucial role to play.

[18] EU Regulatory Framework for Electronic Communication

The structure of the guide

The guide is structured along six chapters, and a number of appendices, which explore specific issues in more detail.

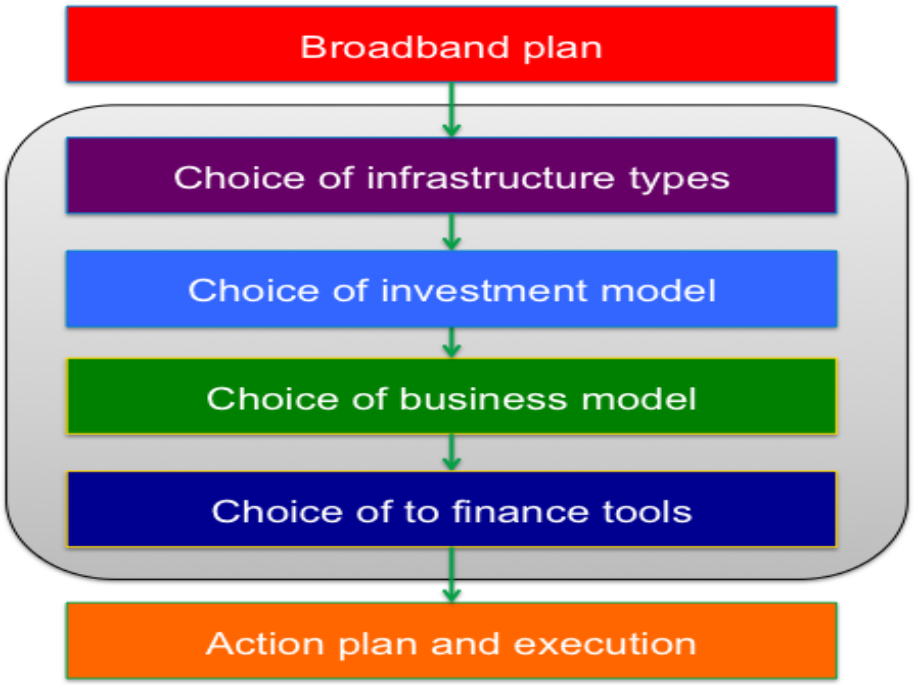
The first chapter introduces the importance of defining a **broadband plan**, which is the high level strategy of what a public authority planning the intervention wants to achieve. A sound broadband plan is a politically supported document containing an analysis (including mapping) of the current situation, the goals to be achieved, the financial support and a mechanism on how to implement it.

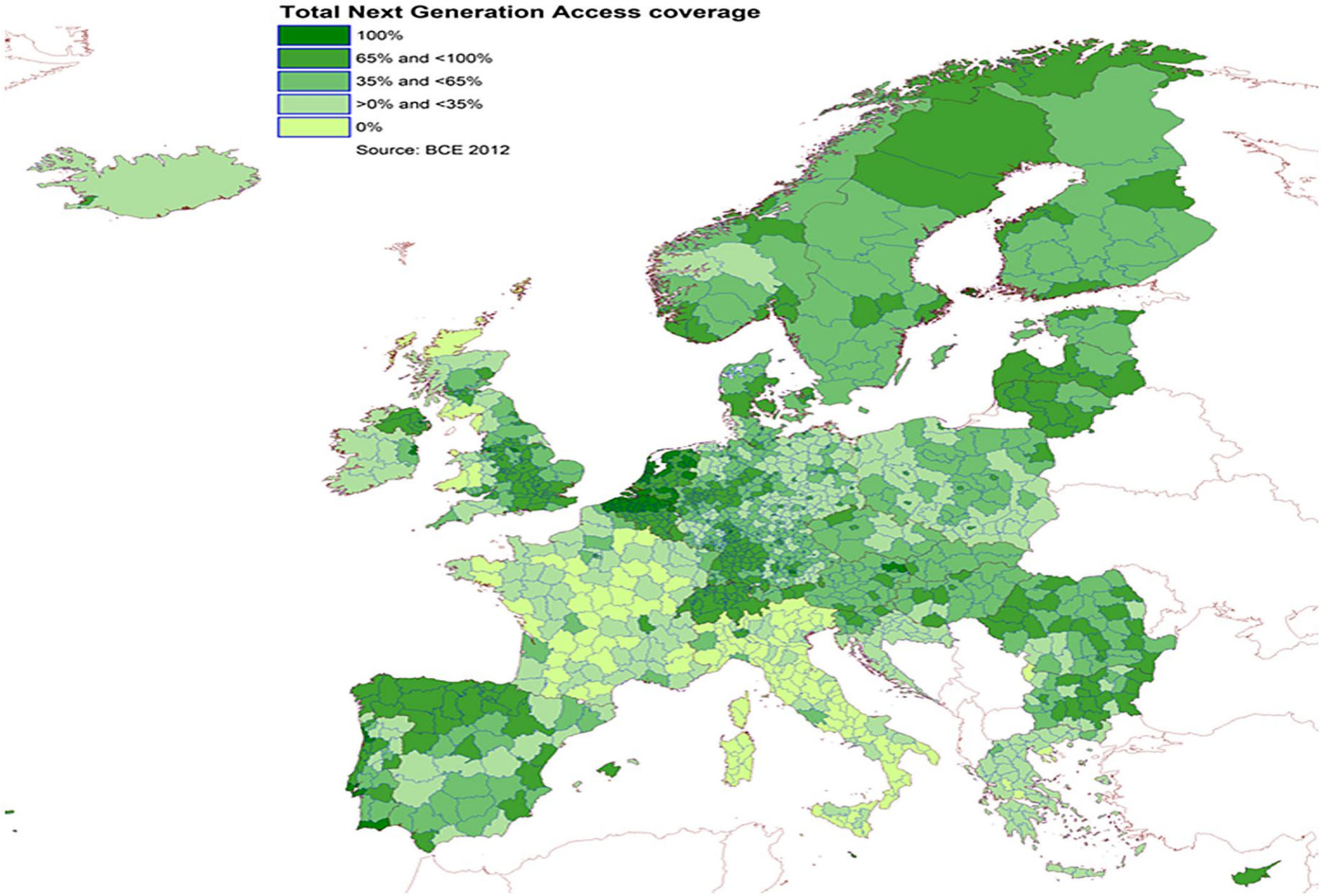
The ensuing four chapters present the four key strategy choices that need to be made in order to achieve the goals defined in the broadband plan. These four choices are:

1. Choice of the **infrastructure type**. Do the Public Administration aim at deploying a new future-proof broadband infrastructure or would it be sufficient to upgrade the existing infrastructure, considering the pros and cons of the two choices?
2. Choice of the **investment model**. What role does the public authority want to play with respect to the implementation, operation, ownership and management of the infrastructure?
3. Choice of the **business model**. Should the public authority opt for a vertically integrated or an open-access network model? Which one is most likely to maximise the financial sustainability of the project, broadband coverage and penetration (also beyond an individual project), promote competition and, most importantly, the socio-economic development of the affected community?
4. Choice of the **financing tools**. How can the public authority ensure an adequate financial coverage for building and operating the new infrastructure and what can it contribute in terms of capital, expenditure and assets?

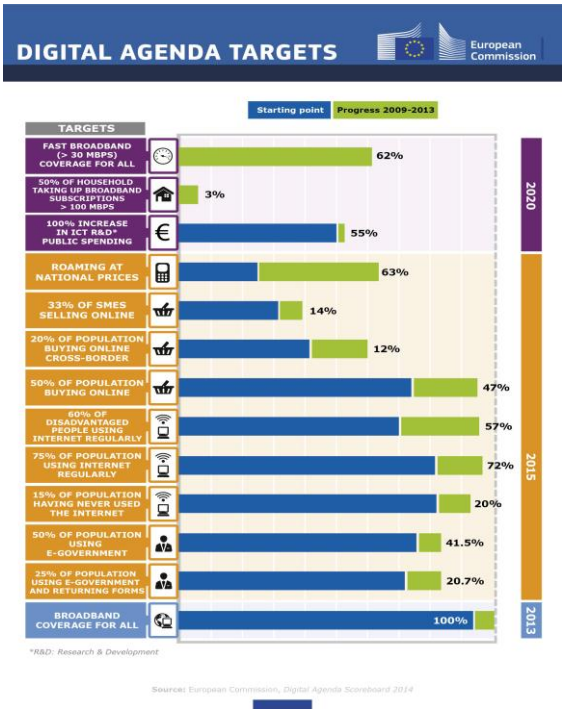
Once these choices are made, an **action plan** needs to be defined and executed, and the process must be monitored closely to ensure that the goals are achieved. This will be tackled in chapter 6.

Finally a **check-list** is provided to keep track of all the steps to be taken and all the aspects to be covered during the whole process. The figure below gives a graphical representation of the guide's core structure.




Total Next Generation Access coverage
100%
65% and <100%
35% and <65%
>0% and <35%
0%
Source: BCE 2012

The first step in the process is to define a politically supported local broadband plan. An effective broadband plan should clarify how broadband investment will help to achieve the objectives of the overall regional development programme: public authority should describe how each objective would benefit from a new broadband infrastructure. This chapter gives an overview of the questions that should be considered when writing a broadband plan.



Why broadband: policy context

Today's individuals, enterprises, organisations and the public sector are increasingly not just users but also producers of digital information. And it is not only people that are connected: machine-to-machine (M2M) communications is driving the information society to a stage where everything is connected. The vast amount of data generated, (so called 'Big Data') is both a great opportunity in terms of new services, improved safety and increased quality of life, but also a challenge in terms of managing the traffic by a digital communications infrastructure. All these factors call for better communications networks.

At EU level, the Digital Agenda for Europe (DAE) sets the overall policy goals to 2020. National and regional policy makers are called to plan investment in order to support the main objectives of regional or rural development policy. Planning broadband in these domains would typically include considerations about:

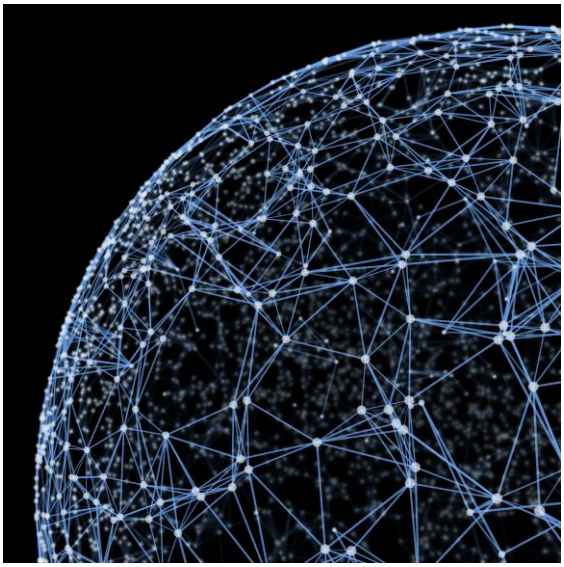
- How next generation broadband infrastructure can help to leapfrog development, speed up innovation and learning, underpin business start-ups and growth, not only for the digital sector, but also across all across other sectors of the economy.
- The role of NGN in closing the gaps in social, economic and territorial cohesion to ensure equity in terms of access to services for rural areas, for less developed areas or for sectors of the population at risk of exclusion (broadband access is becoming as important as access to other utilities like water and electricity);
- The reform of public administration and the transformation of public services to deliver greater efficiencies, and better quality at a lower cost and speed up innovation in all sectors from education, to health, research, agriculture, manufacturing, energy efficiency, environment, tourism, culture, etc.;
- To improve the overall attractiveness of the area with a state-of-the-art infrastructure and good quality services to prevent relocation of economic activity, stem the departure of young people, help to raise business productivity, and facilitate product and service innovation;
- The need to ensure that citizens can benefit fully from the new digital services that next generation broadband will facilitate and that as few as possible suffer from digital exclusion.

We move towards a society where not only people and organisations, but ever more devices are connected online. Next generation broadband has an impact on other policy agendas including the development of smart cities, smart rural areas, new approaches to telemedicine and telecare and education/training, the development of energy smart grids and smart metering systems, etc.

To identify how and where to intervene, a public authority needs to answer these basic questions:

- What are the social and economic development objectives of the region in the next 10 to 20 years?
- How does high-speed broadband fit into those overall objectives and how can it contribute to its achievement?
- What are the needs for services based on high speed broadband among the socio-economic actors in the regions?
- What are the problems to overcome for the rapid deployment and for facilitating usage of high speed broadband in my region?
- Which benefits will broadband create for residents located in the different areas of the region (urban, rural and more sparsely populated areas) and for society at large in terms of economic growth, business development, employment, tourism, education, culture and leisure etc.?

The questions above point to the need for the public authority to carry out an in-depth analysis of the current socio-economic context to map the current situation, verify citizens and business demand, and sustain these needs through a healthy competitive market in high speed broadband services.



Mapping the current situation[19]

Your broadband plan should include a market and infrastructure analysis of your region's broadband situation. Mapping[20] is a key element to identify areas affected by market failure. These are some of the key questions that should be answered:

- What are the socio-economic, demographic features of the territory?
- What are the current coverage, quality and price of broadband access?
- What coverage of next generation, high-speed broadband will our region most likely achieve commercially, if no intervention is made?
- How credible are these plans for private investment for the next three years? Which is the demand for services required by the household and enterprises?
- Which are the public services to be delivered (exclusively) online in the coming 10-20 years?
- Where are the gaps left between the existing and forthcoming private deployment of services and the needs for services expressed by the territory?

[19] For further information please consult also the EU State aid guidelines on Broadband: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:025:0001:0026:EN:PDF

[20] See also: http://www.broadbandmapping.eu/

- What publicly owned infrastructure – particularly ducts, fibre and other 'passive' elements – can be brought into the mix?
- What other utility infrastructure – e.g. energy distribution – could be reused to save cost of investment[21]?
- What role can local communities play in aggregating demand and contributing to investment?
- Are there community or private-sector-led 'bottom up' initiatives emerging in the region?
- How strong is competition for broadband services in the region?

One of the key elements of any business case for infrastructure deployment is **consumer and business demand** and one of the drivers of demand is a healthy **competition** in services. National regulatory authorities[22] gather relevant statistics and can play a key role in assessing the current situation for retail competition, local loop unbundling and services offered by the different providers.

The mapping the existing infrastructure and planned commercial deployment enables the public authority to identify the areas for intervention[23] and establish the likely costs.

How to intervene?

Most of the investment in high-speed broadband is related to passive physical infrastructure. The task essentially involves civil engineering works such as digging trenches, holes, laying duct and fibre, or running new fibre overhead: this phase is highly capital intensive and is characterised by long payback periods[24]. Being so capital-intensive, it is considered as a natural monopoly.

Private investment in new broadband infrastructure in 'white' areas constitutes a challenge because of:

- **High risks** - infrastructure deployment outside urban/high income areas by private sector operators or resulting from public-private co-operation, are perceived as high risk investment, which requires a higher return on investment
- **Longer pay-back periods**, incompatible with the short-term return horizons of service providers and telecom operators (especially if public companies);
- **Insufficient size**: promoters may be too small to attract the interest of large financial institutions or to attract cheap financing;
- **Lack of evidence** substantiating the viability of the business model – broadband is still an emerging asset class as opposed to transport and energy sectors (especially in non-urban areas.
- **Open wholesale access** may be imposed by ex-ante regulation (for incumbents only);

Investment in passive infrastructure may require different level of involvement of the public administration, particularly where the development of the new broadband infrastructure is involved. A public authority is not only competent for town infrastructure planning, for granting permits for "rights of ways" and leverage the fact that it owns ducts, land and buildings (schools, hospitals, etc.). The public sector is, in many instances, the largest single users of broadband services. Moreover, there is an increasing tendency[25] for public authorities that invest in the passive infrastructure, also to establish an operator-neutral network, over which private actors can deliver services.

Operator-neutral networks represent the best precondition to prevent conflict of interests (between the actors operating on the different

[21] Se: http://ec.europa.eu/digital-agenda/en/pillar-iv-fast-and-ultra-fast-internet-access/action-117-reduction-cost-deploying-high-speed

[22] See list of NRAs: http://berec.europa.eu/eng/links/

[23] See Handbook for decision makers - The broadband State aid rules explained: http://ec.europa.eu/digital-agenda/en/news/handbook-decision-makers-broadband-state-aid-rules-explained

[24] See also the EU proposal for a Cost Reduction Directive: http://ec.europa.eu/digital-agenda/en/action-117-reduction-cost-deploying-high-speed-electronic-communications-networks-0

[25] The most common examples are in Scandinavian countries and in countries where public-owned utilities provides other types of critical services (e.g.: Denmark, Netherlands, USA, etc.)

layers of the network), avoid market monopolies and to facilitate competition in the active layer (which drives new services, better quality, and freedom of choice and lower prices). In your broadband plan, you should make the case for the type of intervention to opt for, why is intervention needed, and at which level

Defining the goals

The broadband plan[26] should define concrete goals for broadband coverage in the municipality or region, for instance:

- What percentage of the population shall need to be covered by high-speed broadband in the year 2020?
- What is the percentage in terms of household penetration (actual subscriptions) I wish to achieve by 2020?
- What is the quality of the infrastructure (the downstream and upstream headline/actual speeds, contention rate, etc.) to put in place capable to support the combination of services required in the territory in the next 10-20 years?
- Is this quality in line with the Digital Agenda for Europe 2020 targets?
- In the current level of competition delivering good quality and affordable services as required by the territory?
- Are there affordability problems (for sectors of the populations at risk of exclusion, or SMEs etc.) that would justify public intervention?
- What other measures should I put in place to sustain demand among these sectors of the population or businesses?
- How upgradable shall the new infrastructure be towards longer-term goals (e.g. within the next 10-20 years)?

Identifying stakeholders, establishing collaboration, and mapping demand

There are many stakeholders involved in a broadband project. A broadband plan that creates the right conditions and incentives for all the relevant stakeholders to participate in the project will be able to better leverage on the resources, competence and assets present in the region and ultimately will have higher chances to be a success.

Important stakeholders can be found in the private sector, and the project will increase significantly its success chances by making them business partners, rather than competitors:

- Other companies owning infrastructure (especially fibre, or last mile connections to the end user);
- Operators and service providers interested in selling services over the network;
- Network providers interested in placing active equipment in all the nodes and to deliver those services (see section on business models);
- Other telecom companies willing to lease the dark fibre, e.g. 3G/4G operators, cable TV operators, service providers, and any other operator needing backhauling;
- Non-telecom companies wishing to lease dark fibre for their own needs (e.g. banks, TV production companies, large corporations, etc.);

[26] See also the "Guidance to the ex-ante conditionalities on ICT: http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/2_faq_information_communication_technologies.pdf

There are then important stakeholders requiring access to end-users to deliver social benefit through advanced social ICT services; these stakeholder**s** could be involved as partners in the definition of the infrastructure, also because they are among the **largest potential customers** of the new broadband network, for instance:

- Hospitals;
- Schools;
- Elderly and social housing companies/associations;
- Police, security/safety; militaries;
- Emergency services;
- Utilities;
- Public administration authorities and offices.

The broadband plan should define how the public sector can include its own demand for services and thus act as an '***anchor tenant***' to reduce demand risks in the short/medium term (while waiting that demands pick up over the medium/long term).

The analysis of the socio-economic and demographic features of the territory (income, education, ICT skills, ageing structure, large presence of micro enterprises/SMEs, etc.) can also help to provide a first picture of the potential demand for services. However, a more realistic mapping of demand can best be obtained through the direct involvement of the local population and businesses.

Extremely crucial to the successful engagement of the local population is the involvement of stakeholders with direct access to private end-users (e.g. property ownership or associations):

- Public and private housing companies and property owners (with rental apartments);
- Multi-dwelling unit (MDU) co-operatives
- Single house owners;
- Broadband cooperatives;
- Business/Farmers Associations;
- Chambers of commerce.

Finally, institutional stakeholders obviously play an important role in terms of regulation and support:

- The political and administration officers at local level
- Neighbouring municipalities and regions, which are precious sources of collaboration and inspiration
- National government
- National Telecoms regulators
- EU regulators and grant bodies.

The public authority taking responsibility for the scheme and holding the contract is the 'glue' between these stakeholders.

Aggregating and federating with other municipalities and regions

A federation (or close collaboration) of small municipal and regional networks could give rise to a bigger player, capillary infrastructure assets, with a single point of contact towards the market and higher contractual power. An integrated infrastructure would make it easier to lease out fibre (long continuous links can be offered rather than short unconnected sections), hence increasing revenue potentials.

When it comes to attracting operators onto the network, a network federation would make it easier to connect to major data and interconnection centres in the large cities, where operators can then obtain connectivity to all the networks in the "**federation**", hence reducing the risk of having an "empty network", and instead increasing competition at service level.

Moreover, many administrative and management operations (including sales and marketing) could

be centralised in order to optimise resources, streamline operations and ensure quality.

INFOBOX – Support in drafting the broadband plan

- Neighbouring municipalities and regions can be a source of inspiration for your broadband plan. It is important that the broadband plan is designed to suit your territory, but others' plans and strategies can serve as precious sources of inspiration.
- Contact and collaborate with your neighbours (also across your country borders). Regional collaboration in broadband planning and deployment lead to important benefits, both in terms of size (economies of scale, achieving contractual power, standardised business and technical interfaces) and in terms of mutual in support (on the practical work on the plan and on the action plan).
- Get input from public sources. Use the information that is available publicly (e.g. your national regulatory authority[27], national and European associations of local authorities, relevant government entities responsible for broadband and digital growth, as well as non-governmental organisations.
- Consult and visit the websites of local organisations, business associations and consumer organizations and citizens groups to verify the needs from their respective communities.
- Consulting support from relevant and unbiased experts is also advised.

Next steps: four strategy choices

Having considered the overall socio-economic picture, the broadband endowment and the policy context for your region, you have the information needed to decide between the various commercial and investment options for your intervention to have best effect.

Four strategy choices on four different levels need to be made:

1. Choice of the **infrastructure type**. Does the public authority want to deploy a future-proof broadband infrastructure or would it prefer to upgrade the current infrastructure, considering the pros and cons of the two choices?
2. Choice of the **investment model**. How involved does the public authority want to be in each aspect of the infrastructure, i.e. the implementation, operation, ownership and management?
3. Choice of the **business model**. Which one is most likely to maximise the financial sustainability of the project, the broadband coverage, ensure competition (in terms of services) and facilitate penetration?
   Choice of the **financing mix**. How can the public authority coordinate the collection of the necessary financing of this new infrastructure and what can it contribute in terms of capital, spend and assets?

[27] See list of NRAs: http://berec.europa.eu/eng/links/

Of the three network layers presented in the introduction, the passive infrastructure layer often represents the bottleneck for broadband development and also the most suited layer for intervention by a public administration or public authority. This chapter helps to distinguish the concepts of infrastructure, technology, and network design. It gives an overview of the different infrastructure types, and provides a rough guide on how to plan for an infrastructure deployment in the different parts of a municipality or region.

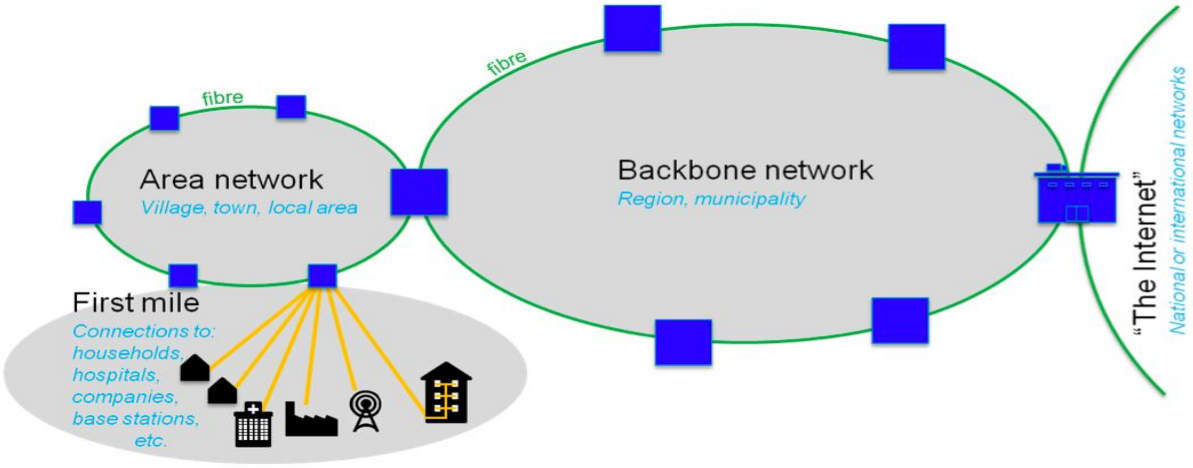
Geographical parts of a broadband network (horizontal dimension)

A broadband access network is generally made up of three distinct parts: the *backbone network*, the *area networks (aka backhaul)*, and the *first-mile connections* to the end-users.

The **backbone network** generally consists of a ring of fibre optic cable (one cable contains several, even hundreds of optical fibres) connecting different areas of the municipality or region. It is here where all the traffic from all users in the region/municipality is aggregated.

The **area networks** connect several *access nodes (AN)* to the backbone networks. This is also often done with a ring of optical fibre cable, although tree topologies can be used (generally cheaper, but less robust). If a relatively low number of end-users are to be connected in the area and funds are limited, microwave links may be used as a short- to medium-term solution. The connection between an area network and the backbone network is usually referred to as *local node (LN)*.

The **first mile-connections** are the links from the end users (which may be single homes, multi-dwelling units, companies, hospitals, schools, local administration offices, radio base station sites, etc.) to the access nodes where the first traffic aggregation takes place.



Infrastructure vs. technology

One common source of misunderstanding is the confusion of these closely related but fundamentally distinct concepts:

- **Infrastructure** is the physical medium over which information can be transmitted. This can be a twisted pair of copper wires (traditionally used for telephony), coaxial cables (traditionally used for TV distribution within

buildings), optical fibres (traditionally used for transmission of very large amount of data over very long distances), or antenna towers and sites if transmission is done wirelessly (e.g. for radio and satellite transmission). Infrastructure typically has a life span >50 years.

- **Technology** is what enables us to transmit information over the infrastructure. In practical terms, it refers to the active equipment needed to encode the information into physical signals to be sent over the cables/ether (the infrastructure). Active equipment typically has a life span 5-15 years.

Each infrastructure has specific physical properties, which define a sort of upper limit for connection speed. The performance of a broadband connection is the result of how effectively the physical properties of an infrastructure are used by a specific technology. Think infrastructure as a road and technology as car and you are close enough.

As we will see in the Business Model chapter, the distinction between infrastructure and technology also has important market and business implications, suggesting different roles for public authorities and for market players.

INFOBOX – Network infrastructure topologies

The topology of a network describes how the different parts of a network are connected. The most relevant topologies for the backbone and area networks are:

- Tree: the traffic from each element is aggregated upwards in a hierarchical manner; A tree topology is generally cheaper, but less robust: in case of a fibre cut or other fault certain parts of the network will be disconnected for long periods of time; moreover for each step up the hierarchy, traffic originating from more nodes shares the same physical connection
- Ring: each network element is connected to two elements in such a way that all connections form a ring. The ring topology has the advantage that any node is connected to two neighbouring nodes (this is sometimes referred as "redundancy"), so if a fibre cut or other fault occurs, traffic can be rerouted the other way often automatically, while the fault is repaired.
- Meshed: each network element is connected to several other elements; this is the most robust but also most complex and most expensive topology.

For the first mile, two main basic topologies:

- **Point-to-multipoint** (p2mp): the first aggregation node is transmitting information to a number of end-users over the same shared medium, using one transmitter. This take place both in wireless communications but also in wired communications, if the physical medium is simply split along the way between the aggregation node and the end users (e.g. fibre point-to-multipoint used in PON, or coax cable TV networks): in this case the same physical signal is received by all end users, which are then sharing the bandwidth.
- **Point-to-point (p2p):** the first aggregation node is transmitting information to a number of end-users over dedicated physical channels, using a corresponding number of transmitters. In the case of wireless. In wireless communications this can be achieved if the communication beams do not overlap with each other, while in wired communications a dedicated line connect the aggregation node with each end user (e.g. fibre point-to-point, and copper telephone lines)

Infrastructure types

There are mainly five types of physical (passive) infrastructure that can be deployed to deliver broadband services:

- Optical fibre lines, consisting of cables of glass fibre currently used in most long-haul, high-speed communications systems.
- Copper phone lines: Legacy telephone unshielded twisted pair cables

- Copper “cable”: TV-distribution coaxial cables
- Antenna sites/towers for terrestrial wireless communications: point-to-point (p2p) microwave, or point-to-multipoint (m2mp) radio
- Satellite dishes (once a satellite is built and launched, generally by commercial actors, no local network is needed, but more costly active equipment is required)

The table below shows the two most basic physical properties of different infrastructure types (physical media): the available bandwidth (following our metaphor: how broad a road is), and the attenuation loss, expressed as distance after which the signal attenuates to 0.1% of the initial power (in our metaphor: how smooth the road is). It can be seen that there is an enormous fundamental difference between traditional infrastructure (such as coax and twisted pair), and fibre.

INFOBOX – What FTTH/FTTP: PON or Ethernet point-to-point

In general Ethernet p2p has the advantage of using dedicated connections to deliver very high speeds using cheap standard electronics, while Passive Optical Network (PON) has the advantage of having considerably smaller footprint (i.e. requiring less physical space) at the aggregation node and much fewer fibres to deal with at the aggregation node. However, these are technology choices and as such are best left to the network provider, or the operators dealing with active equipment and service provisioning. Economic, strategic and historical considerations often determine the choice. As a rule of thumb, incumbents and large operators tend to prefer PON, while independent service providers tend to prefer Active Optical Network (AON).

The type of topology chosen for the passive infrastructure, however, has an influence on the degree of choice. Specifically, a p2p infrastructure may be used to deploy both PON and Ethernet point-to-point, whereas a p2mp infrastructure is only suitable for PON.

The cost of deploying p2p tends to be marginally more expensive than p2mp (which less fibre between the aggregation node and the splitter) so it should in general be preferred. On the other hand, situations may exist in which deploying more fibre is indeed significantly more expensive (for instance in the case of an existing duct with enough capacity for only one of few fibres).

Infrastructure	Current commercial technology (now)		Fundamental properties of physical medium (future)		
	Top technology	Data rate (down/up)	Shared medium in 1st mile?	Available bandwidth	Basic transmission reach
wired					
Fibre p2p	GbE	1/1 Gb/s	No	50 000.00 GHz	80 km
Fibre p2mp (PON)	GPON	up to 2.5/1.2 Gb/s	Yes	50 000.00 GHz	20 – 45 km *(32 – 8 users)*
Coaxial cable	DOCSIS 3	up to 300/50 Mb/s	Yes	1.00 GHz	0.5 – 3.0 km *(high – low speed)*
Twisted pair	VDSL2	up to 60/10 Mb/s	No	0.05 GHz	0.2 – 1.5 km *(high – low speed)*
wireless					
Terrestrial wireless	LTE	up to 60/10 Mb/s	Yes	0.10 GHz	*several km*
Satellite	Ka-band systems	up to 20/8 Mb/s	Yes	10.00 GHz	--

Source: Acreo Swedish ICT; see appendix for details

INFOBOX – Data rate, contention, latency and symmetry

Information is measured in binary units, called bits (b).

The **data rate** expresses how much information is transmitted per second and is usually measured in millions of bits per second (megabit per second), or Mb/s. 1,000 Mb/s = 1Gb/s (gigabit per second)*. Data rate is what is commonly (though somewhat inaccurately) referred to as **connection speed**.

By **contention** it is meant that information transmitted from/to different users must share the same physical medium. This may lead to situations in which the total available bandwidth must be shared among many active users, and hence the actual connection speed the end users see may drop significantly below the **"up to" speed** advertised by operators. In copper access lines, actual speed may also be lower than "up to" speeds depending on the length of the fist-mile connection.

Latency is the time it takes for a data transfer to start. Some applications are 'time-critical' and require low data rates, but very fast response times. Examples of applications with stringent latency requirements are stock-exchange data transfer, gaming and video conferencing.

Connection symmetry expresses the upload/download ratio. While entertainment services like TV and video-on-demand only require high download speeds, others require high upload speeds as well: e.g. cloud computing, video conferencing, social media, certain eHealth and e-education applications, internet of things, etc.

---

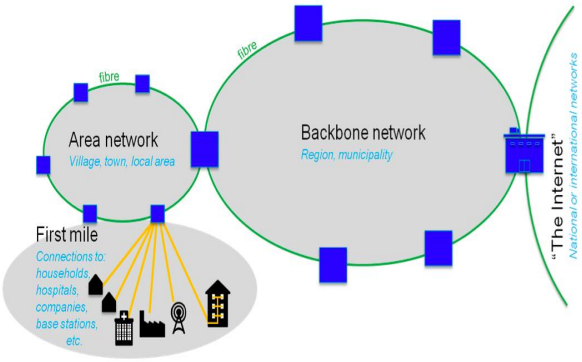
*Note that, due to historic reasons, information storage is measured in basic units of byte (symbol: capital B), whereby 1 byte = 8 bits. Hence file sizes as well as storage capacity in electronic devices are expressed in megabytes (MB) or gigabytes (GB).

Choosing the right infrastructure type for the backbone and area networks

A regional **backbone network** generally consists of a ring of fibre optic cable (one cable contains several, even hundreds of optical fibres) connecting different areas of the municipality or region. The ring topology has the advantage to be robust against single fibre cuts or other faults (see info box). More advanced topologies (e.g. meshed) are sometimes used in the backbone section of the network.

The **area networks** are also often implemented with a ring of optical fibre cable, although tree topologies can be used. If funds available for the

moment are very limited the total end-users to be connected in the area are relatively few, microwave links may be used as a short- to medium-term solution.



Choosing the right infrastructure type for first-mile connections

The optimal infrastructure choice for **the first-mile connections** is the subject of heated debate and the advocates of different solutions are often driven by partisan commercial motives. What we can say is that each situation will present different logistic, economic, demographic conditions, and hence different infrastructure solutions may be best suited.

Although a **fibre connection (FTTH/FTTP)** is reputed to be the ultimate long-term solution a mix of infrastructures can help to satisfy different requirements (see info box). The final solution will depend on the level of ambition of the region, the type/number of services required by the territory, and whether a state-of-the art infrastructure could help to substantially increase the attractiveness of the area to business and individuals alike. The solutions available are listed below, while their pros and cons are summarised in the table at the end of this chapter.

The infrastructure most commonly used in the early phase of broadband is **legacy telephone unshielded copper twisted pair**, over which technologies, such as ADSL, have been successful in providing basic broadband connections in the past decade or so. This solution has the advantage that a copper telephone line is already present in most households. For it to be able to carry fast (or in some cases even basic) broadband connections, however, it often needs to be upgraded and this is not always possible. For short distances (few hundred metres) and good copper lines, VDSL technology can deliver fast broadband today.

A second infrastructure option for first-mile connections is represented by **coaxial cables**, typically used for TV distribution within buildings and in some urban areas also connecting buildings to a TV distribution network. Technology has slightly more room to deliver higher broadband speeds than on telephone lines. Fast broadband is becoming available on many cable-TV networks, and if infrastructure is properly upgraded and distances kept short (tens or few hundreds of metres) ultra-fast speeds may become possible in the short-medium term.

Whenever the upgrade of the wired infrastructure is not possible, and funds for FTTP/FTTH are not available for a certain area, an option is to build infrastructure for terrestrial **wireless** broadband, mainly **antenna sites for point-to-multipoint** connections. WiMax, Wi-Fi, but also 4G/LTE solutions) have the advantage that no first mile infrastructure needs to be deployed except for the antenna sites. These also have the potential to cover areas in which telephone lines are too long, or too bad quality to be used for xDSL.

Satellite connections can be used to cover large, very sparsely populated areas. Satellite connections do not need to use the regional backbone and the area networks, but require the purchase of end-user equipment.

See also **Guide to the implementation of a satellite vouchers scheme**[28].

However, issues concerning quality and affordability of service often make satellite and wireless as complementary rather than alternative infrastructures, even though in specific circumstances (e.g.: very remote/mountainous areas) this may be the only viable alternative.

In the next page a flow chart is presented for the choice of infrastructure to be deployed. Some questions that should be answered when choosing the first-mile infrastructure to use are:

- What is the existing infrastructure available: can it be upgraded to reach the DAE goals for 2020? What about the longer perspective?
- Is the connection to the end-user upgradeable?
- Is the owner of the existing infrastructure interested in collaboration?
- Is the main goal for the public authority to reach the DAE goals for 2020 at minimum cost today (and review the infrastructure in ten years), or do we aim at a future-proof infrastructure?
- What are the needs of the territory in terms of type and quality of service (upload, download speeds, contention, monthly data capacity, etc.)?
- Does the infrastructure provide services that are affordable to the population and business of the area?
- Is there sufficient funding for future-proof infrastructure?
- Are there users in remote or sparsely remote areas?
- How do we plan for the longer-term upgrade of interim-solutions?

INFOBOX – Fibre: FTTH/FTTP… and what is FTTC? and FTTx?

Sometimes, the term FTTx is used as a catch-all but confusing term to describe any infrastructure that contains fibre at least in some portion of the access network. Let's make some clarity.

When the fibre reaches the end-user's home or apartment, we speak of fibre-to-the-home (**FTTH**);

When the fibre only reaches e.g. the basement of a Multi Dwelling Unit (like in a block of flats) and from there each apartment is connected by a dedicated non-fibre in-building network (generally owned by the property owner) we speak of fibre-to-the-premises (**FTTP**).

This can be seen as a first-mile infrastructure if the MDU is seen as the end-customer and the tenants share the connection.

Fibre-to-the-Cabinet (**FTTC**) refers to the situation in which fibre is used to connect a cabinet to which copper first-mile connections (generally operator-owned) are terminated. Hence FTTC is **not** a first-mile infrastructure.

[28] See: http://ec.europa.eu/digital-agenda/en/news/maximising-broadband-connectivity-across-eu-using-european-funding-satellite-broadband-access

First-mile infrastructure[29]

	Pros	Cons
FTTH/FTTP (benchmark)	Future proof, extremely high level of service, symmetry.	High investment in passive infrastructure
Telephone copper line	Relatively low investment needed for passive infrastructure Least disruptive for the end users	High (download) speeds depend on the length of copper line, the number of users, the type of applications, the amount of data traffic and the technology used. New copper-based technologies (e.g.: vectoring, G.fast) can deliver high speeds but suffer from the same limitations[30]. xDSL technology is heavily asymmetrical: upload speeds are generally much lower than download speeds: this may hamper new services like cloud computing, videoconferencing, teleworking, tele-presence, etc. Higher investment needed in active equipment (with a life-time of 5-10 years). Interim solution: investment in fibre infrastructure most likely only postponed by 10-15 years.
Coaxial copper line	Relatively low investment needed for passive infrastructure Least disruptive for the end users	Bandwidth shared among several users: peak traffic periods of the day will reduce the available bandwidth for each user The impossibility of unbundling makes service competition basically absent in the cable market. Seldom present in the digital-divide areas Interim solution: investment in fibre infrastructure most likely only postponed by 10-15 years
Antenna sites for wireless	First mile wire connections not needed. Infrastructure can be used for commercial mobile services as well	Bandwidth shared among several users: peak traffic periods of the day will reduce the available bandwidth for each user. Signal strength decreases fast with distance, and affected by weather. Bad weather and disturbed line-of-sight may reduce signal quality Interim solution: investment in fibre infrastructure may be needed within 10-15 years.
Satellite dishes	Backbone and area networks not needed: low investment needed for passive infrastructure[31]. Easy to connect users scattered over a relatively large area (regional, macro-regional or even national)	Limited total number of users can be covered in one region Inherently high signal latency due to the propagation time to and from satellite: this hampers certain applications Relatively high cost of end-user active equipment. Bad weather and limited line-of-sight may reduce signal quality Data consumption typically capped monthly or daily in current commercial offers

For further information on technological alternatives see also Annex 3 of the Broadband State Aid rules explained.

[29] For further information please see also Annex A3 of the Handbook for decision makers: the state aid rules explained

[30] Regarding access obligations, under EU State Aid Rules when vectoring is used, see section 4.2 and annex A3 of the Handbook for decision makers: the state aid rules explained

[31] Central active and passive infrastructure (the satellites and the earth gateways) is typically provided and financed by satellite operators.

There are different ways for a public authority to become involved in the broadband development of a region. In this chapter we will review four major investment models and the role that the public authority takes in each of them. The choice of one model over another is a political decision based on the cultural and socio-economic situation, the ambition level of the public authority, and the medium and long-term development goals for the region.

Four investment models

The most important choice a public authority faces is how much to commit, and what role to take vis-à-vis the market, the citizens, and the businesses in the region. This should be considered separately from the public authority's role in deciding on the best financial resources, as argued in the chapter on How to finance the project? Four investment models can be identified:

- Direct investment: the **public-run Municipal Network model** (aka Public DBO)
- Indirect investment: the **private-run Municipal Network model**
- **Operator subsidy** (aka **Gap-funding** or private DBO)
- Support of bottom-up community-led initiatives: **the Community broadband model**

The four models are described in more detail below and have been employed in different areas across Europe, often in different network segments (see info box on page 183), with different levels of success. Please note that a municipal network refers to a network typically delivered within the jurisdiction of the public authority adopting the model, whether a municipality, county or region. In all cases, it is built specifically to deliver broadband to that area.

As we will see in the following chapters, once the model of public authority involvement has been chosen, important choices need to be made over three dimensions: the **infrastructure type**, the **business model**, and the **financing model** (each described in detail in the following three chapters). Of course, the degree of influence the public authority will have in these choices depends on the role it has chosen to take, as described below.

The publicly run Municipal Network model

In the publicly run Municipal Network model, the public authority builds a broadband network in the municipality, county or region, hence is it sometimes referred to as public design, build and operate (DBO). The actual DBO however, may actually take place in collaboration with the market as a public-private joint venture or partnership (PPP), without this changing the character of the scheme being directly run by the public authority.

The network built is made available to all market actors under fair and non-discriminatory conditions, either at the passive layer or including the active layer, depending on the business model chosen (as described in the business model Chapter). Generally a company or a dedicated division within an existing utility needs to be established. This entity deploys the network either directly, or through standard procurement to the market (civil engineering and network deployment companies, not telecom operators). The public authority (directly or via the new company/division) keeps ownership of the network and runs operation and maintenance.

Sometimes the public authority builds the network in a public-private partnership, especially when key infrastructure is already owned by a private actor. In that case, a new company is typically set up as a public-private joint venture. This new company will then integrate existing public and private infrastructure (typically through indefeasible right of use [IRU] or shorter term concessions from the public and private owners) and operate in a similar way to the publicly owned company described above. Care should be taken in dealing with public financing and state-aid aspects (see infobox on complying with state aid in chapter "**How to finance the project**").

The public-run municipal network model is very common in the Nordic countries (from Stockholm to Suupohja in rural Finland) and has led to very successful deployments, in terms of coverage, service availability, end-user sign up, competition levels, and financial sustainability. The Southern Swedish region of Skånet has followed a PPP-enabled version of this model, leveraging on the presence of a private actor with extensive fibre backbone and willing to collaborate.

INFOBOX - Municipal networks: built with tax money?

People tend to associate broadband investment run or driven by public authorities with taxpayers' money. As a matter of fact, this is often a minor part of the total financing.

The prime example is probably the City of Stockholm's fibre project, one of the most successful and widely known examples of publicly owned and operated broadband network in the world. The only public money used by the City of Stockholm was the 50,000 SEK (roughly €5,500) to register the *Stokab* company, which is in charge of the fibre deployment and operation. The rest of the money came from bank loans, and revenues from dark fibre lease.

The privately run Municipal Network model (aka concession model)

In the privately run Municipal Network model, the public authority procures the building and operation of a broadband network in the municipality, county or region from a private actor. This is sometimes referred to as public outsourcing, or concession model.

In this model, there is no need for a dedicated company being established by the PA, and the competence required, as well as the financial risks taken, are rather limited. The contracted private firm builds an open, operator-neutral network over which competing service providers can deliver their services to all end users. The public authority keeps ownership of the passive infrastructure but the operation contract with the external firm is typically in the form of indefeasible right of use (IRU) of e.g. twenty years. In order to guarantee fair and non-discriminatory conditions to all service providers (operator neutrality), the private firm building and operating the network should ideally be barred from delivering its own services, although this is not always the case, mainly due to the scarcity of operator-neutral service providers in certain member states, as well as low awareness of this possibility among some PAs employing this model.

The private firm commits the investment (often complemented with significant public financing) and takes all the revenues as well as the business risks for the whole contract period. A the end of the contract, the network infrastructure remains with the public authority, which may then decide to renew the contract, to sign a contract with another company, or even change its involvement altogether, and adopt a public-run Municipal Network model.

This involvement type is becoming relatively common in continental Europe (e.g. in the Nièvre rural county in France or in the Piedmont region in Italy); though most projects are still at a relatively early stage.

The Community Broadband model

Some parts of Europe have a long history of bottom up approaches where communities take matters into their own hands and raise investment to develop projects that meet local needs, often on a co-operative basis. A vibrant sector of broadband co-operatives and small private initiatives has grown up notably in the Nordic countries, the Netherlands and parts of the UK.

In the community broadband model, the broadband investment is done as a private initiative by the local residents, in a so-called bottom-up approach. The role of the public authority in this case is to provide support if and where needed. This may take the form of co-financing (using one the models described in the How to Finance the project chapter), but also of advising, right-of-way (RoW) granting, regulation and coordination with other infrastructure deployments and access to points of presence such as major public data centres.

These initiatives may have state support in the form of grants, other financial instruments or access to public infrastructure to provide backhaul connections. In other cases they are entirely community or private-sector funded.

Where they are well-planned and supported, bottom up initiatives can play a very valuable role in generating consumer and business demand for services and potentially making a contribution to the capital needed to develop a local scheme. Public authorities – at national and regional level - can play the important role of the honest broker that help in establishing the fair conditions for all operators seeking access to the infrastructure.

In some cases community-led networks bring broadband infrastructure and services in the first-mile and local area and connect to municipal networks for backhauling (see Geographical parts of a broadband network info box in the section on Infrastructure Types – page 13). In other cases these networks extend over the backbone as well and connect directly to a data centre with access to national and international networks, such as in some Finnish regions.

Projects employing this type of involvement have generally been very successful in driving the take-up rate among the end users and in building financially sustainable cases. The degree of competition varies between projects: many are using an open network business model with good levels of competition; others prefer to act as vertically integrated operators, or to procure services from one operator under for a number of years.

It is recommended that every region or member state produce a manual on how to start a cooperative for broadband deployment, based on the local pre-conditions and support financial tools available. Member states may already have national guides, as well as financing programmes or incentive schemes that make shares in enterprises like this more tax-efficient for investors.

INFOBOX - Village networks in Sweden

Broadband in the countryside in Sweden has grown really fast thanks to a model developed by the government's broadband commission, the national regulatory authority, and the agriculture ministry. Areas that earlier have been classified to be impossible to have "true" broadband are now connected with FTTH. Behind this is a concept, a movement, called "**fibre to the farm**".

With great engagement and their own personal work, citizens in villages have built fibre networks in sparsely populated areas. These projects are initiated by individuals, the municipality, other

organisations or even an operator. Generally, the inhabitants form a cooperative which builds the area network and the first mile connections to their homes and farms. The network is then connected to an operator's network to get the services. Because the major part of the costs is represented by digging, the network deployment is coordinated with other civil works, in order to reduce the cost.

For the project to succeed it is important that the villagers support with voluntary workforce. In most of the villages several people have a digging machine, everyone gives permits to dig their land share the costs among all the connected. Some financial support is normally available from the EC[32], and by local funding. Hundreds of villages have built networks in Sweden and that has built up considerable experience on how to do that.

The Operator subsidy model

In the Operator subsidy model, the public authority decides not to become directly involved with the broadband deployment in the region, limiting itself to subsidising one market actor (typically a major telecom operator) to upgrade its own infrastructure. Risks associated with building new infrastructure and attracting sufficient customers are borne by the recipients of the funding.

Incumbent telecommunications operators and large alternative providers usually own both the passive infrastructure, active equipment and offer services to end users in a 'vertically integrated' model (see the business model chapter).

In the operator subsidy model, the public authority funds part of the gap between what is commercially viable and the coverage that the public authority aims to achieve. In this case the funding is offered as a grant to one or more private operators to deliver the desired outcome (see more on page 406).

Using an operator subsidy model does not automatically mean that the recipient will be an incumbent operator. However since the model is likely to be based on the incumbent's financial 'gap' and where often the incumbent is the only operator with existing passive infrastructure in the region, there is a substantial advantage in any competitive procurement.

One advantage for the public authority is the comparatively simple contractual arrangements and thus the potential for relatively rapid deployment. Another potential advantage is offsetting the risks to the grant recipient since the public authority has no direct involvement in the network deployment. However the drawback is that the grant funder does obtain financial returns from the project that can be reinvested in future network deployment. Instead, new funding will likely become necessary at each deployment phase, ending up with a larger public investment than initially intended.

Some of the concerns with the operator subsidy model revolve around the extent to which procurement can be made genuinely competitive and demonstrate value for money for the procuring authority. Regulating conditions[33] that provide access to existing passive and active infrastructure for alternative providers can reduce the automatic incumbent advantage. Working to reduce the demand risks can also be beneficial – e.g. by public sector commitment to use the new infrastructure and by ensuring that third party SPs have easy access to the new infrastructure with low transaction costs[34].

[32] See also: State aid N30/2010 – Sweden.

[33] See EU state aid guidelines for broadband: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:025:0001:0026:EN:PDF
and/or the Handbook for decision makers:
http://ec.europa.eu/digital-agenda/en/news/handbook-decision-makers-broadband-state-aid-rules-explained :

[34] See also directive on Cost Reduction

Choosing the model

The choice of one model over another is a decision based on the budgetary and socio-economic context of the area, the ambition level of the public authority, and the development goals for the region. For instance, inability to use or to afford ICT (due to ageing, low education, low ICT skills, presence of many SMEs/micro enterprises and a poor culture of innovation) may slow down penetration and, consequently, also penetration of ICT.

Such contexts would, in most instances, be able to sustain best long term investment models that allow enough time for penetration to growth and consequently for a gradual socio-economic impact to take effect. Furthermore, since most of the benefits of an NGN infrastructure accrue mostly to the overall society and economy, short term investment models are unlikely to match the medium-long term development perspective implicit in both regional and rural development policies.

The investment model adopted in a project can also significantly influence future investment. A model that involves providing grant funding to meet the commercial gap for an operator may achieve short term results and cheaper for individuals project.

However, the model is also much less likely to create **an engine for sustained future investment** than a model that involves the reinvestment of profits to enlarge coverage. This may well result to be more expensive over the longer term particularly where large areas (with even lower level of population density) remain uncovered.

Some questions that a public authority will need to answer in the choice of the investment model are:

- How can we create an engine that ensures future investment in infrastructure beyond the immediate project and funding available?
- Are there benefits in keeping control and ownership of the passive infrastructure and in defining the deployment priorities?
- Would we rather be better off keeping the ownership of the infrastructure but let an operator define and execute the deployment?
- What are the pros and cons to involve vertically integrated operators (incumbents and others) to upgrade or expand the network?
- Do we also see scope to support local bottom-up citizen initiatives?
- Given the socio-economic conditions on the ground, which level of competition is required to facilitate penetration of high quality and affordable services?

The table below summarises strengths and weaknesses of the four models.

Involvement/investment Model	Degree of neutrality between whosaler and retailer	Transfer of financial risk to market actors	Revenue generation for network expansion	Control over project	Availability of an infrastructure for society
Public-run Mun. Net	High	Low	Potentially high	High	High
Private-run Mun. Net	Medium	Low	Medium	Medium	Medium
Community broadband	Medium	Low	Medium	Low	Medium
Operator subsidy	Low	High	Low	Low	Low

BUSINESS MODELS

This chapter describes the different business models available to public authorities and other market actors. The business model defines the roles and responsibilities of different actors in the broadband value chain, with special focus on the public authority. The chapter is opened by a brief definition of the three main business roles, and the different actors in the value chain.

Network layers and business roles

As outlined in the introduction, a broadband network broadly consists of a **passive infrastructure** (ducts, cables, masts, premises), and **active equipment** (implementing the technology: transponders, routers and switches, control and management servers). On top of that, **services** are delivered. The three layers are characterised by different technical and economical properties and different business roles:

- the **physical infrastructure provider (PIP)**, which owns and maintains the passive infrastructure;
- the **network provider (NP)** which operates (and typically owns) the active equipment (incumbent operators, new independent operators, broadband companies)
- the **service provider (SP)** which delivers the digital services (e-health, elderly care, TV, Internet, phone, video-conferencing, entertainment, teleworking, smart monitoring, etc.)

INFO BOX - Actors in the broadband value chain

The **backbone PIP** owns and operates the passive infrastructure in backbone and to some extent in the area networks. It can be a public or private actor with long-term investment plans or, in some cases, a local cooperative.

The **access area PIP** owns and operates the first-mile connections and to some extent also the passive infrastructure in area networks. It can be a telecom operator, a housing association, a local cooperative, the MDU owners[35], the municipality or the home owners also with long-term interests in the area.

The **service providers (SP)** can be small or large companies, either locally or nationally, selling services to the end users over an NP's connectivity network. They only need to place equipment in a central location (e.g. the regional data centre) and interface to the NP's equipment.

The **network provider (NP)** leases dark fibre from the PIP to offer SP connectivity to the end users. It places equipment in all access nodes to which any of its end-users are connected. In the PLOM model, some NP's may offer their own services (possibly in addition to those from other SP's): they are then referred to as **integrated NP+SP**, or **infrastructure-less operators**.

The **end user** may be a private citizen, a small or large company, a hospital, a school, a public administration, etc. purchasing services over the network.

The **wholesale customers** are entities who lease dark fibre from the backbone PIP for their own communications needs. These can be 3G/4G operators, cable TV operators, banks, large enterprises, the public sector, etc.

[35] MDU: Multi Dwelling Unit

Basic business models

Depending on which market actors take up which roles (PIP, NP, SP), different business models arise. If one market actor takes all three roles, it is said to be vertically integrated, and the resulting business model is referred to as:

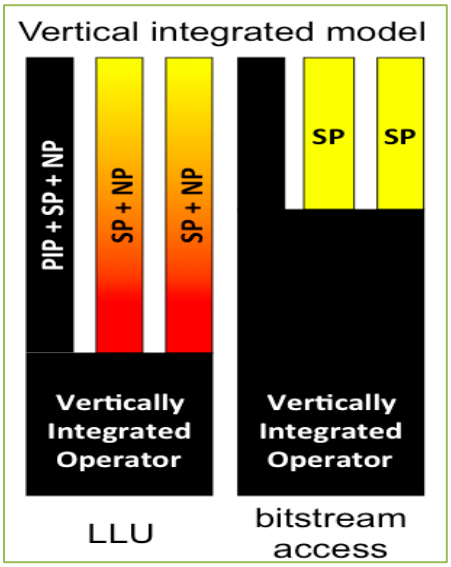
- a vertically integrated model (all large telecom operators)

In some cases, especially if the vertically-integrated actor is deemed to have significant market power (SMP), regulation imposes that network access be opened to competitors, either at the passive or the active layer, as discussed in the section below. In that case, the network owner designs the network to deliver its own services and gives access to its competitors in forms compatible with the network design. Although sometimes incumbents refer to this model as "open access", this is in reality a vertically integrated model with unbundling (either at physical layer, called local loop unbundling (LLU), or at the active layer, called bitstream access), see figure below.

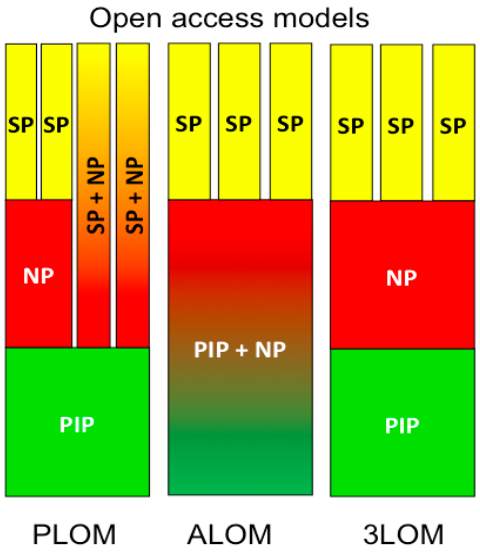
If, on the other hand, the roles are separated, we talk of an open network model. In an open network the infrastructure that is available to all market participants at equal conditions. This can take different forms, depending on whether the network owner (e.g. a PA, a cooperative, or a private firm running a municipal network) operates at PIP level alone, or also at the NP level. If the network owner is only involved at the PIP level, it has two further choices: it may decide to leave the higher layers to market players (competition in the market), or it may decide to contract the NP role to one market actor for a number of years (competition for the market) (typically three to five), with the task of providing end-user connectivity to competing service providers.

Consequently, three open network business models can be identified:

- Passive-layer open model (**PLOM**)
- Active-layer open model (**ALOM**)
- Three-layer open model (**3LOM**)



In all these models, if enough fibre has been installed, fibre in the backbone network is generally leased to third parties (such as 3G/4G operators, cable TV operators, service providers, as well as non-telecom companies like banks, TV production companies, large corporations, etc.), independent on whether competition in the retail market (first mile connections) is at the passive (PLOM) or active layer (3LOM or ALOMs). This maximises the return on the fibre investment: the major cost in fibre deployment is not the fibre cable per se, but rather the civil works to install it, hence tens or hundreds of parallel fibres are usually deployed. Moreover, it directly or indirectly increases infrastructure-owner revenue, which can be reinvested for network expansion.



In the figure in next page, the generic value chain for the open network model is shown. This will actually look slightly different in each of the three variations, but all can be described referring to the same figure.

The next three sections describe the three open network models in more detail. The concluding section gives an overview of the vertically integrated model because of its prevalence among large telcos.

Passive-layer open model (PLOM)

In this model, an entity (e.g. the PA, a local cooperative, or a private investor, depending on the investment model chosen) builds and operates passive infrastructure to be made available to all market actors under fair and non-discriminatory conditions. This entity deploys the passive infrastructure either directly, or through standard procurement to the market (civil engineering and network deployment companies, not telecom operators). The PIP keeps ownership of the passive infrastructure and runs operation and maintenance.

In such a model, the broadband network is open at the passive layer and competing operators (integrated NP+SP, or open-access NP selling connectivity to service providers) get access to the end users through physical connections directly.

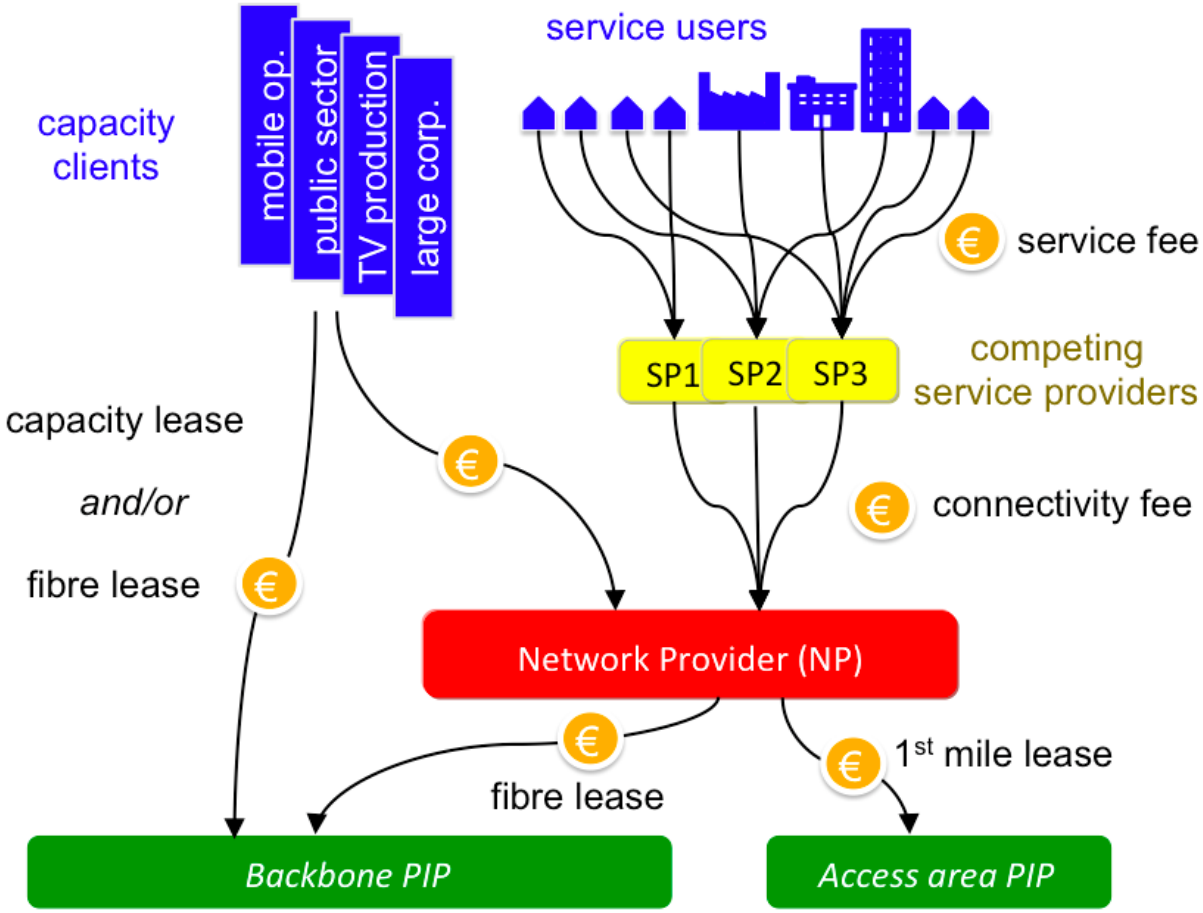
Generally, we can distinguish between backbone PIP (connecting the different parts of the region, county or municipality) and the local area PIP (delivering first-mile and sometimes area network). In some areas, the same entity takes both roles.

Referring to the figure above, the NP and SP roles may be integrated in some operators, while other SPs may prefer to rely on the connectivity services provided by network providers active in the market. The backbone PIP receives revenue from operators, who lease dark fibre to deliver their services (or those from their customers) to the local areas. Here they lease passive connections (fibre, copper, or simply antenna sites and wireless frequency bands) from the access area PIP to deliver services to the end users. End users may or may not pay a fee for that. Like in all other open-network models, the end users choose the services from their operator of choice for a service fee. The access-area PIP may receive revenue from the end users in form of a (one-off) connection fee and/or a monthly network fee (in some cases included in the monthly rent as an extra housing service, the same way as a lift or other common area maintenance).

The PLOM has the advantage of giving operators maximum freedom and control in the design of their access network. The drawback is that in this model, each competing operator needs to deploy active equipment in the access node of each area they want to serve (unless a sharing agreement is reached): if the population density is too low, each access node only aggregates a low number of users making it economically not viable to have more than one operator in each area. This reduces competition and keeps OPEX and CAPEX costs high. Hence the passive-layer open model is best suited for relatively large and densely populated areas, e.g. larger cities.

The solution which many Public authorities have taken in more sparsely-populated areas is either 3LOM, or ALOM, in which competition between service providers is achieved by offering network openness at the active level, so that network cost (network design, active equipment acquisitions & deployment as well as network operation & maintenance) is low enough to encourage market entry.

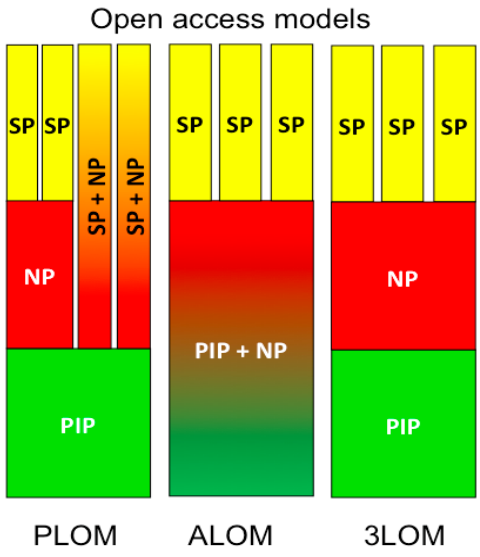
The PLOM is typically used by public-run municipal networks in large cities, in which the public authority takes the backbone PIP role. A prominent example is the Stockholm fibre network.



Active-layer open model (ALOM)

In this model, one entity deploys and operates the passive and active layer (hence acting as an integrated PIP+NP). This entity places active equipment in all access nodes and builds an open, operator-neutral network over which all service providers can deliver their services to all end users.

The value chain for the ALOM, as shown on page 28, sees the backbone PIP and NP roles joined. The backbone NP+PIP receives revenue from service providers to deliver their services to the end users (or, in some cases, receives revenue directly from end-users), through its backbone network and onto the first mile connections (fibre, copper, or simply wireless frequency bands), which it leases from the access area PIP, and for which it may or may not pay a fee. Again, the end users choose the services from their operator of choice for a service fee. In a variation of this model, the network fee is paid directly to the PIP+NP. In both cases, like in the PLOM, the access-area PIP may receive revenue from the end users.



Three-layer open model (3LOM)

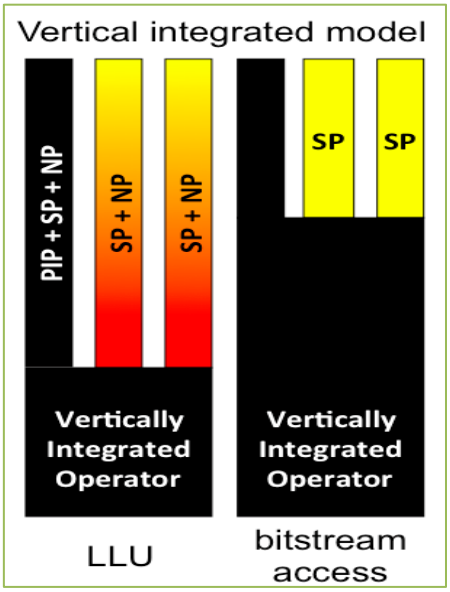
In the so-called three-layer open model, the roles of PIP, NP and SP are explicitly separated. In this case the public authority has the same role as in the PLOM, but at the active layer, the NP role is assigned by procurement to one company (or possibly to one company per geographic area). The NP places active equipment in all access nodes and builds an open, operator-neutral network over which all service providers can deliver their services to all end users. In order to guarantee fair and non-discriminatory conditions to all SP (operator neutrality), the NP is typically barred from delivering its own services.

The typical value chain for the 3LOM is shown in the figure on page 338. The backbone PIP receives revenue from the NP for dark-fibre lease. In order to reach the end-users, the NP also leases passive connections (fibre, copper or simply wireless frequency bands) from the access area PIP to deliver services to the end users. Again, the end users choose the services from their operator of choice and pay a service fee. The service fee from the end user to the SP generally includes a network fee, which is then passed to the NP.

In a variation of this model, the network fee is paid directly to the NP. The access-area PIP may receive revenue from the end users in form of a (one-off) connection fee to the PIP and/or a monthly network fee.

Vertically integrated model

Incumbent telecommunications operators (and to some extent large alternative operators) usually own the passive and active infrastructure and offer services to end users in a 'vertically integrated' model. There are variants where the operator offers access to competing service providers at the wholesale level. There have been many instances where public authorities have built broadband networks following vertically integrated models. This was indeed not uncommon in the pioneering years of municipal networks (e.g. in Scandinavia). The model has however been progressively abandoned in favour of 3LOM or public run ALOM, This change was mainly due to the conditionality of public financial support (the calls did not allow the retail of services by the network provider and called on market players to focus on the efficient delivery of services).



In the case the actor in question has Significant Market Power (SMP), typically in the case of an incumbent operator, or if it has received public funding, network access to its competitors is normally mandated, either at the physical layer (*local loop unbundling* or LLU) or at the active layer (this is generally referred to as *bit stream*). In the former case, competing operators can place their equipment in the access nodes of the areas they want to serve, provided there is physical space for their equipment. In the latter, they place their network equipment in a data centre, where they can interface with the network owner . The latest copper upgrade solutions, such as FTTC+VDSL (see page 23) may be incompatible with local-loop physical unbundling in cases where there is lack of space for competitor operators' equipment in the street cabinets, or if vectoring is used[36]. However, virtual unbundling can be provided in an increasing number of technologies provided certain conditions are respected[37].

[36] Regarding access obligations, under EU State Aid Rules when vectoring is used, see section 4.2 and annex A3 of the Handbook for decision makers: the state aid rules explained

[37] See section 4.2 in Handbook on state aid rules explained

Choosing the business model

The table below shows how different business models can be applied to each investment model. Also, depending on its level of involvement, a public authority will have more or less say in the definition of the business model.

- Demographic, commercial and cultural conditions also play a role in the adoption of one or another model. In general, a business model which allows for a win-win situation for all stakeholders (including the end users, the local businesses, and the service providers, as well as the incumbent) will increase a project's chance of success.

Some of the questions that should be asked are:

- How densely populated is the region? How is the population distributed?
- Is the physical infrastructure allowing for easy end-user access at physical layer for a number of operators? Is the market big enough to make this business case?
- Is significant amount of infrastructure owned by an operator already active as a service provider?
- Are there market actors interested in taking up the NP role?

		Business Models			
		PLOM	**ALOM**	**3LOM**	**Vertically Integrated**
Investment Models	**Public-run Municipal Netw.**	Ownership: PA • PIP: PA • NP: Open market • SP: open market	Ownership: PA • PIP: public authority • NP: PA • SP: open market	Ownership: PA • PIP: PA • NP: market by proc. (3-5y) • SP: open market	
	Private-run Municipal Network		*Ownership: PA* • *PIP: market by proc. (IRU 20 y)* • *NP: market by proc.* (IRU 20 y) • SP: open market		Ownership: PA • PIP: market by proc. (IRU 20 y) • NP: market by proc. (IRU 20 y) • SP: market by proc. (IRU 20 y) and LLUB/bitstream access
	Operator subsidy		Ownership: telco JV • PIP: owners • NP: owners • SP: owners + open market		Ownership: telco • PIP: owner • NP: owner • SP: owner + LLUB/bitstr. access
	Coop support		Ownership: coop/investors • PIP: owner/market by proc. • NP: owner/market by proc. • SP: open market	Ownership: coop/investors • PIP: owner • NP: market by proc. • SP: open market	Ownership: coop/investors • PIP: owner/market by proc. • NP: owner/market by proc. • SP: owner/market by proc.

This chapter describes the different financing models available to a public authority wishing to invest in a broadband project. The financing model defines how the deployment, operation and management of the broadband network can be financed by public and private funds. The chapter also includes considerations on state-aid, especially in the case of public-private co-investment.

Different tools

A PA can finance a broadband project in many different ways. Typically a mix of financing tools is used and both debt and equity financing are used in a project. In the following sections, the main financing tools available are presented:

- Private equity and debt raised on the financial markets from the companies in charge of deploying the infrastructure (Corporate financing)
- Equity and debt contributed by the partners in a joint ventures or raised on the financial market (project finance)
- Public equity or debt (soft loans, project bonds, grants, sovereign funds)
- Government-backed bank loan and/or bonds (guarantees)
- Community-financed (bottom-up approaches, including crowd funding)
- Self-financing (re-investment of revenues from network connection fees, fees to service and network providers, dark fibre rental revenues, etc.)

Revenue-based financing

If the public authority chooses one a public-run municipal network investment model (see page 183), it generally receives revenue from wholesale dark fibre lease and/or transmission services, as well as retail infrastructure lease or connectivity fees (or network fees) depending on the business model in place (see chapter on the business models). This can indeed become a major financing source, when the network is complete and companies, public bodies and end users start using the network.

Most notably, the City of Stockholm currently raises around €20m in revenue per year from operators and other users of the fibre infrastructure, while the London Borough of Hammersmith & Fulham is currently tendering a Concession Agreement for the use of their CCTV ducts in order to encourage commercial broadband across its area.

Of course, this source of financing only appears once the infrastructure is in place and services are being offered over the network. It is therefore suitable to recovering public sector funds, to accelerate infrastructure deployment or lower costs.

Private capital and financial markets

Financial markets can be accessed for investment funds. It is estimated that funds up to €250bn[38] are

[38] See Study on the socio-economic impact of bandwidth (SMART 2010/0033): http://ec.europa.eu/digital-agenda/en/news/study-socio-economic-impact-bandwidth-smart-20100033

needed for the roll-out of a pan-European FTTH network. Financial markets provide equity or debt financing, although hybrid solutions (mezzanine funding) are more and more common. Investment funds looking for a stable return on investment may focus on safe, tangible assets such as next-generation broadband infrastructure. These are primarily:

- Project financers such as banks, investment funds and private equity investors may be interested in providing early-stage financing, looking for a higher risk premium. These equity or debt investors may look for an exit between 3 and 5 years once the business is established as be replaced by other investors looking for a low-risk, long-term returns on their investment
- Infrastructure Funds, Pension Funds and other Institutional Investors may invest in and established infrastructure from the above after 3-5 years and seek long term investment at lower interest rates.

Other sources, such as venture capital, are not normally investing in infrastructure and are likely to be less suitable as they are focused on short-term higher risk opportunities- and demand high interest rates with early exit options as a result.

Public funds

Public funds can generally be used for lending and grants, subject to any specific conditions that they may be attached to their use (as identified within the description of each fund).

Grants are focused on enabling economic and social improvement and are available at local, regional and national government levels, as well as at a European Union level, most notably the European Regional Development Fund (ERDF), which provides funds to each European Region to trigger business growth. ERDF has a track record of supporting broadband deployment initiatives on a co-financing basis. The co-finance rate varies across the different categories of regions.

Co-financing can come from other public as well as private sources. Other social enterprise or charitable funds could also provide the matched funding.

Government-backed bank loan and bonds

Many public authorities have secured a large portion of their initial financing through soft or commercial-terms bank loans. For this to be sustainable, a valid business plan must be presented (see section on the action plan), in which medium- and long-term revenue exceeds the negotiated loans (principal+interest).

If special conditions (e.g. favourable interest rates in soft loans) are obtained thanks to the government backing guarantee, this should be treated as state-aid. If on the other hand, it can be proved that the loan was received according to market conditions, then the MEIP principle applies (see the info box on Complying with State Aid regulation – page 33) [39].

Community (bottom-up) financing

Communities can raise finance to support the development of infrastructure in their areas. Typically this takes place in community broadband projects (see investment models chapter), particularly in isolated rural communities (or clusters of these), but also in smaller urban communities. In general this scheme is more suitable to villages or other communities with strong commitment in bringing broadband to their local area.

Generally, these finance schemes consist of selling 'stock' or shares in a community company, which either implements and runs the network themselves, or commissions this through suppliers. In-kind contribution from citizens (in the form of voluntary digging work and equipment) is also often successfully used especially in rural areas.

Citizens are often also asked for a commitment or 'pre contract agreements' to take next-generation broadband services once the network is

[39] See: Draft Commission Notice on the notion of state aid pursuant to Article 107(1) TFEU,

operational as part of the stock package. This has the added benefit of driving early take-up, which significantly strengthens- and reduces the risk- in the business case. Often, citizens contribute labour as well, e.g. in the form of digging trenches for the fibre deployment.

It is recommended that every region or member state produce a manual on how local initiatives can manage the bottom up financing and how to match it with other financing tools.

INFOBOX - Complying with State Aid Regulation

Basic elements of a State aid assessment

The Broadband Guidelines distinguish "basic broadband" and "NGA networks". Furthermore, the Guidelines are based on a classification of your area according to its existing or expected future broadband infrastructure deployment status, thereby defining the market situation both for basic and for NGA broadband networks. As to the market situation the Guidelines specify the following cases:

- In **white areas** no provider of broadband access services currently is operating and there is no such provider to be expected in the coming three years either. In this case, a public intervention is likely to be in line with the common interest and therefore State aid may be appropriate.
- In **grey areas** there is one (infrastructure-based) provider already active, however, another network is unlikely to be developed in the next three years. In this case, a more detailed analysis and a thorough compatibility assessment will be necessary.
- In **black areas** there are or there will be in the next three years at least two basic broadband networks of different operators. Broadband services therefore are provided under competitive conditions (infrastructure-based competition) and it can be assumed that there is no market failure. Accordingly, there is very little scope for State intervention to bring further societal benefits by subsidizing another basic broadband network.

Measures not constituting State aid

You might focus your activity on specific measures to support broadband deployment in your area which usually are not constituting State aid:

- If you are rolling-out a broadband network for non-commercial purposes, i.e. if you are constructing a network or procuring broadband services only to satisfy your own needs, such a measure - under certain circumstances - might not constitute State aid.

  You might, however, come to the conclusion that the network established for your purposes should be marketed also to third parties, i.e. outside public institutions. Such a network opened for the use of broadband investors or operators is likely to be classified as State aid. A non-commercial network with involvement of third parties is a complex project, please consult your national State aid contact point for further advice.
- Your project might meet the Market Economy Investor Principle (MEIP). Broadly speaking, this principle states that if you are placing capital, directly or indirectly, at the disposal of an undertaking and such support corresponds to "normal" market conditions it cannot be regarded as State aid.

  If your equity participation or capital injection does not present sufficient prospects of profitability, even in the long term, your

intervention must, however, be regarded as State aid. This needs to be done in self-assessment, which of course raises your risk of a legal challenge in case of a complaint, because, according to Article 108 TFEU, notification of state aid is necessary. You should be aware from the outset that fulfilling the requirements of the MEIP is a tricky matter and you should care for suitable advice and support to determine whether your specific circumstances might be feasible for application of this principle[40].

- Under specific conditions the deployment of your broadband network and the provision of broadband access to end users can be viewed as a **Service of General Economic Interest (SGEI)**. However, normally it is not up to you as the local decision makers to decide alone on an SGEI status. If the SGEI conditions are fulfilled the public financing of broadband deployment is perceived to be (1) no State aid or (2) compatible aid. However, approval of an SGEI for your broadband project is one of the most complicated ways to proceed.

Measures constituting State aid but for which no notification is required.

There are several measures constituting State aid but for which no notification is required:

- Your envisaged broadband project fits into a state aid scheme which is already approved as compatible under the broadband guidelines within your country. In this case there is no need for you to notify your concrete measure.
- The "de minimis" rule: You qualify yourself for the application of the "de minimis" rule if the total amount of grants for the same eligible costs over any period of three fiscal years does not exceed EUR 200,000. The amount does not need to be a cash grant and can in principle also be in kind (e.g. in the form of ducts), a reimbursable grant or even a participation in a company. Also loans are possible under the "de minimis" rules, here the threshold can be up to EUR 1,000,000, depending on collateral and duration of the loan. However, you are not allowed to cumulate aid[41].
- The revised **General Block Exemption Regulation (GBER)**exempts from State aid notification aid for broadband infrastructures up to €70M per project (passive broadband infrastructure, broadband-related civil engineering works, deployment of basic broadband networks and deployment of NGA networks) as long as the investment takes place in white areas, the aid is allocated on the basis of a competitive selection process and the network operator offers the widest possible active and passive wholesale access, including physical unbundling for NGA networks.
- Other block exempted forms of aid include:
  - Regional aid
  - Aid to SMEs;
  - Risk capital investment in an SME active in broadband deployment.

See additional information:

- Handbook for decision makers - The broadband State aid rules explained[42]
- EU State aid Guidelines on broadband[43]
- General Block Exemption Regulation[44]

[40] See the Draft Commission Notice on the notion of state aid pursuant to Article 107(1) TFEU, http://ec.europa.eu/competition/consultations/2014_state_aid_notion/draft_guidance_en.pdf

[41] See the Commission Regulation 1407/2013 of 18 December 2013 on the application of Articles 107 and 108 of the Treaty for the Functioning of the European Union to *de minimis* aid, http://ec.europa.eu/competition/state_aid/legislation/de_minimis_regulation_en.pdf.

[42] See:http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5355

[43] See: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:025:0001:0026:EN:PDF

Financing of public-private joint ventures and private-run deployments

Sometimes, private actors owning existing infrastructure are willing to cooperate with the public authority to build a municipal network (public- or private-run). In this case, the investment effort is partly supported by the private actor, which becomes directly involved in the deployment and operation of the CAPEX-intensive passive infrastructure.

This may be because that entity has significant amount of infrastructure already which can leveraged to build a shared, open and operator-neutral broadband infrastructure, rather than going for costly infrastructure duplication. Or it may arise from the PA's choice for the privately run-municipal network, as described in the chapter on investment models. Whenever the operator subsidy model (and to some extent the community broadband model) is used, financing directly to private actors arises and state-aid considerations become more crucial.

Broadly speaking, the public authority can provide financing either as an investment (equity and debt financing) or as a grant. The former enables expansion because it is considered to be 'patient capital' that is provided on longer tenures or is lent at a lower interest rate, or as credit enhancement scheme apt at lowering the risk profile of the project through the provision of e.g. junior debt.

This is very attractive to other private investors as it provides greater stability to the equity base of any scheme and may improve the credit rating of the project company or joint venture. This encourages further private investment; in other industry sectors (e.g. construction) patient capital has been able to raise 2 to 5 times the public funds applied.

Equity Finance. In a public-run municipal network, the public authority invests in a commercial entity (which may or may not be co-owned by a private partner) that will build and operate the broadband network. This finance can take the form of:

- Cash or bonds that the entity can use as security;
- Physical assets such as ducts, fibre cables and street furniture such as lamp-posts, equipment cabinets etc. These can be translated into a cash value, for instance the equivalent of the reduction in implementation and operating costs that can be achieved by use of the asset over the life of the business case.

The authority would receive shares equivalent to the value of the investment in the entity. These must be treated in the same way as any other share paid for by 'normal market investors' in the entity alongside the authority. This is an important test of whether the Market Economy Investor Principle (MEIP) applies (see state aid InfoBox). In particular:

- The value of the equity share would increase in value as the value of the assets increases
- The share would attract dividends declared by the entity on any profits achieved.

Debt Finance. The authority can offer finance through by providing a loan to the entity. This loan would:

- normally be cash; but could also be
- long term use of assets where the authority retains ownership and title; or
- a guarantee or security against other loans taken out by the entity.

The authority can offer to facilitate this finance with banks on attractive terms to encourage other investment, in the same way as 'patient capital' above. As long as the terms and any related interest rate are equivalent to those that would be offered by commercial markets, this finance would not be considered as state aid, as the MEIP would apply[45].

[44] See: http://ec.europa.eu/competition/state_aid/legislation/gber_regulation_en.pdf

[45] See the Draft Commission Notice on the notion of state aid

Authorities may assist an entity by offering to facilitate this loan on more favourable terms with banks than the entity might reasonably expect to achieve on open markets. However, this would provide a benefit to the entity and would be considered as state aid.

Grants. An authority may choose to provide an entity with a grant to assist in building and operating the next-generation passive infrastructure and active layer as required by the strategy and necessary level of intervention. This is extensively used in the operator subsidy model.

As stated above, a grant will always be considered as state aid. It also has the effect of constraining private investment in a scheme. This is because private investors regard the provision of state aid as recognition that market failure exists. This reduces confidence in the returns they could expect from the market in comparison with other opportunities.

The authority can attach a range of conditions and requirements on the provision of the grant, including (but not limited to):

- achieving defined economic and/ or social outputs that the entity can take responsibility for;
- returning part of the grant if the entity achieves greater than anticipated benefits from the scheme (such as excessive turnover or profits). This is known as 'claw back[46]';
- transparency of accounts and performance of the entity in relation to the scheme the grant is provided for.

Other types of support

- A region could decide to actively **improve demand side conditions e.g. by using "ICT innovation vouchers for SMEs**[47], either to cover (part of) the end users' costs of installation or purchase of broadband devices, or of the monthly subscription. Guidance[48] to establish this type of vouchers was published in November 2013.
- In case you want to use this instrument you first should check whether you fall under the "de minimis" rule.
- Alternatively, vouchers for SMEs might be block exempted as SME aid or aid to innovative enterprises. If this holds true of your broadband project you are fine because there are no further State aid requirements you need to meet.
- If your support is greater than the "de minimis" threshold of 200,000 Euro per beneficiary or not block exempted you might, however, fall under the scope of State aid, if indirect aid comes into place. Indirect aid may be the case because the amounts you hand over to e.g. households or SMEs in your area end up with suppliers.

- In cases of extreme remoteness and in very sparsely populated areas, a region may wish to reduce the cost of deployment and arrange vouchers for satellite services:

- In order to be on the safe side you should approach a suitable institution in your country and ask them to check your envisaged measure for legal certainty. A short guide on how to implement this specific type of vouchers scheme is also available (see below).

For further information please see:

- **EC blueprint for ICT innovation Vouchers**: http://ec.europa.eu/digital-agenda/node/67716
- **ICT Innovation Vouchers Brochure**: http://ec.europa.eu/digital-agenda/node/67113
- **Guide to the implementation of a satellite vouchers scheme**: http://ec.europa.eu/digital-agenda/en/news/maximising-broadband-connectivity-across-eu-using-european-funding-satellite-broadband-access

pursuant to Article 107(1) TFEU, http://ec.europa.eu/competition/consultations/2014_state_aid_notion/draft_guidance_en.pdf

[46] See also State aid handbook for Decision Makers: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5355

[47] See also : http://ec.europa.eu/digital-agenda/en/ict-innovation-vouchers-scheme-regions

While the broadband plan defines the overall goals and strategy regarding broadband in the region or municipality, the action plan is a document in which all the different activities are defined and specified. It also contains the cost and revenue estimation in the different phases of the deployment. It specifies the roles and responsibilities of different actors, and how to engage and coordinate the stakeholders, and how to monitor the project running and outcome. This chapter gives an overview what should be included in the action plan and some tips on its execution.

Establishing internal and external coordination and collaboration

A broadband investment is a complex project in that it touches all parts of the public authority and of society. Moreover, like any major infrastructure project, it requires coordination of many different activities. It is therefore important to:

- Assign a Coordinator for the broadband strategy. Work on a broadband plan has a wider scope than an IT related issue, and can therefore not be delimited and delegated to the local "IT guy". The Coordinator is responsible for coordination within the local work with broadband plan. If you do not have the necessary competence, acquire that by employing a knowledgeable and experienced person to coordinate the different phases and parts of the project.
- Establish coordination between broadband and the upgrading of roads, water and sewerage, electricity, district heating, wind power and other infrastructure with which it is possible to share civil-work costs[49].
- Organise workshop with all your administrative units. The availability of broadband is important for all municipal activities, hence all the public authority administrative units should be involved in with broadband strategy.
- Personal interviews and/or workshops with unit managers. The coordinator needs to gather more concrete opinions and comments from various units within the public authority during all phases of the project.

Mapping current infrastructure

In the broadband plan an overview is given of the broadband situation in the territory. The action plan will have to start by analysing the current state of broadband infrastructure in detail.

The incumbent telecom operators, alternative wire line or wireless operators and cable providers may all have existing infrastructure in the region and this, together with their expansion plans, should be mapped as much as possible in order to fully identify the scope of the problems and any opportunities.

Similarly public sector organisations and utilities outside the telecoms sector will often have extensive infrastructure that under the right

[49] See the EU Cutting Cost Directive: http://ec.europa.eu/digital-agenda/en/news/less-digging-cheaper-broadband-commission-proposes-rules-cut-broadband-installation-costs

conditions could be brought into play to extend coverage or to offer alternative backbone or backhaul access to alternative operators. If these elements can be brought into the overall plan they will have an impact on the type of business model selected – i.e. the public sector or utility becomes an investor in the new infrastructure, rather than simply grant funding the gap in a commercial operator's business case.

For further information see the results of the EU study on "Mapping of broadband and infrastructures" which review different mapping initiatives and proposes a methodology to conduct the mapping of infrastructure, services, investment and demand.

Financial planning

Deployment costs should also be estimated in the action plan and matched to the possible customer base: indicative key figures are generally not hard to come by and are good enough at this stage. The technical solution does not differ from ordinary infrastructure deployment and any installation professional can advise on that.

Topology and deployment planning

Because municipalities and regions are probably the largest users of broadband in the local market, a plan to connect all buildings with fibre should be made (public administration, healthcare institutes and hospitals, schools, etc.). This generally constitutes the core of the backbone network. Moreover, since public buildings are generally near significant numbers of other residential and commercial buildings, this will also create good preconditions for the rest of the broadband deployment (area and first-mile connections).

The business plan should also identify potential customers, not only end users but also future operators and service providers. Mobile evolution (with LTE requiring ever higher data rates to the antenna sites) is expected to drive the need for fibre in the backbone and backhaul stretch. When a new operator-neutral infrastructure is in place this will support new actors to enter the local market: if infrastructure can be leased, several operators will see a positive business case in delivering services without the need to build their own dedicated infrastructure.

The public authority should also make a master plan for the network, so that all parts of the local private market, houses, MDU, business parks and shopping centres are reached. This should result in a mapping of the area and a high-level network design. Again, service providers and operators will probably be a large customer base.

Agreement with construction companies and housing organisations should be sought as these often represent the key to the end users. And indeed in many cases these take the role of Access Area PIP.

Because of the significant civil works implied in broadband deployment, it is important that broadband infrastructure is included when new city planning is produced.

Discussions with service providers and operators should be started early on so they know what is being planned and they can plan their sales activities accordingly.

But first and most important, after planning, do not rollout until you have held discussions with possible customers or users of the network.

INFOBOX – How to run the procurement process

The actual deployment is generally done by:

- Procuring the deployment to a broadband installation company
- Defining a contract to establish one open network with other infrastructure owners, if present

This will look slightly different depending on what investment and business models were chosen.

Once the public authority has decided on an approach, it is ready to determine the best procurement route. The process flowchart overleaf maps the key decision steps described below.

The starting point is to confirm the public authority is:

- Providing public funds as a grant or at a subsidised rate below the financial markets; or
- Buying services for its own use, or for use on publicly-run networks;

If so, then EU public procurement regulations will apply and the public authority will have to run an EU compliant procedure.

Note: there is a difference in procuring works and network operation (referred in procurement law as "services") in that the former has fewer restrictions. Please refer to the link above for the regulations and financial thresholds on works.

If EU procurement is required, the public authority should explore whether one of the many Frameworks let under OJEU (the Open Journal of the European Union) provide access to suppliers already qualified to provide the services. This will dramatically reduce the time and cost of procurement.

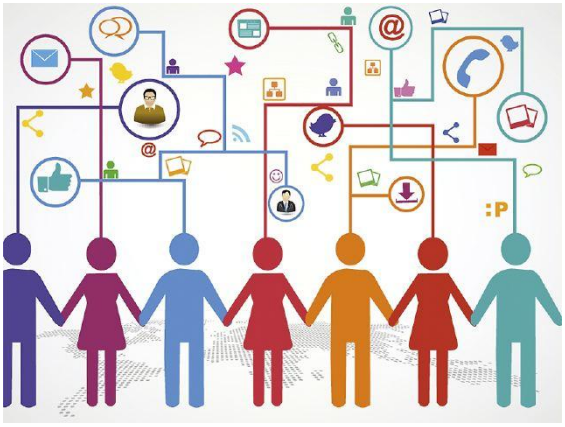
The size of procurement will depend mostly on the type of business model selected. For open access models, the size of the call for procurement will need to ensure that the project is not too small to compromise its financial viability as the attractiveness of the project for operators called to provide services will increase with the number of potential customers covered by the project.

The issue of size is particularly relevant when an operator subsidy investment model is used which allows the winning bidder to deliver its own services (i.e. vertically integrated business model with LLU or bit stream access).

In such cases, if the procurement call is too large it may risk to have very few potential bidders (often one only) and result in tenders that are poorly competitive. The splitting of procurement in multiple (but still viable) lots, assigned to different providers, may be more appropriate in these cases.

The public authority should consider using expert assistance to produce the specifications and support the procurement.

For further information about the use of EU electronic tendering procedure please consult the Information system for European public procurement (SIMAP : http://simap.europa.eu/index_en.htm)



Stakeholder communications and management

The full engagement and involvement of all the relevant stakeholders is essential for a project's success. The main approach to managing relationships with **suppliers** is through the formal channels established in the various collaboration contracts. These channels should include formal reporting and meeting structures and the frequency of meetings at all relevant levels.

However, the main suppliers may also have relationships with subcontractors and investors, who will gain assurance and confidence from meeting with the public authority alongside their prime contractor. It may be useful to consider offering this option to the main supplier contractor.

The main approach to **government agencies** is likely to be defined through Service Level Agreements or contracts relating to the provision of funds and/ or the commitment to achieving key outputs. There should be formal reporting and meeting arrangements contained in these documents.

The role of **marketing** the products and services provided over the network is obviously the responsibility of each service provider. However, the public authority has a clear role in raising awareness of:

- the expected economic and social benefits of broadband
- an updated map of the broadband availability throughout the rollout of the project
- facilitate demand aggregation from businesses, households and other relevant public authorities

The public authority should also assist in managing the expectations of end-users within the region. Communities can become quickly disillusioned if their expectations are raised too far ahead of availability, which can lead to a significant lack of take-up when broadband is rolled out to them.

It is recommended that a **joint Marketing and Communication strategy** be developed (together with a matching action plan). This strategy will consider the economic and social objectives, anticipated markets, infrastructure roll-out etc.

Activities in the marketing and communication plan should include:

- consultations with subsets of the key stakeholders, particularly end-user customers
- benefit awareness days
- 'broadband education' events
- scheme and area 'launches' throughout the roll-out
- promotions consistent across all media channels
- identification and publication of 'success studies' on a regular basis

The public authority can also use all existing communications channels with the populations of the region for executing the marketing and communication plan. This will increase the credibility and confidence in both the broadband network and *any* SP using it, as well as strengthening the PA's role as a community leader.

Finally, citizens and businesses are the stakeholders that generate take-up, utilise services for social improvement and deliver economic benefit to the region. They are also the most unpredictable stakeholder group. Empirical evidence demonstrates that the strongest community engagement is *always* found when it is led and managed from *within the community itself*. This is best achieved by a **Broadband Champion**. Some communities have a champion already. In others, the champion has to be found.

Whether they exist or need to be nurtured, a Champion can be identified through being a person who is:

- already involved in the community. Often in another role
- respected by the community for that role and his/ her achievements
- passionate about maintaining the 'life' of the community
- frustrated by the lack of broadband and the effect it is having on the community's social and economic life
- a good communicator
- with a good general understanding of broadband

Sometimes, a Broadband Champion can be found among the community's Antagonists. These are people who do not believe in the benefits that arise from a community joining the digital economy. Some of them have many of the characteristics listed above. The awareness, consultation and education activities of the marketing and communication plan can help them realise these benefits.

In order to ensure consistency across all stakeholders, the various approaches above, together with the marketing and communication plan, should be owned by the PA. A dedicated resource should be allocated to implement and manage across the entire programme. Support should be given to all stakeholder group leaders, especially the community Champions.

However, it is important to remember that the programme should enable and encourage Champions to learn from each other but they must always stay 'rooted' in their community. This is where they add the greatest value and contribute most of everyone to the success of the project.

Stimulating demand

The public sector has a significant role in stimulating demand as a major purchaser of services for its own use ("**anchor tenancy**[50]") as well as potentially procuring the new network. However it also has a responsibility to encourage the development of new services and the establishment of infrastructure. In the long term, using the infrastructure to drive demand in the digital economy is a natural part of regional development and planning and the regional growth.

The broadband plan should be prepared in consultation with the local residents, businesses and enterprises. It should also highlight the PA's profile in this regard. It is important that people can follow and determine how broadband plan

[50] See **Handbook for decision makers - The broadband State aid rules explained** as it may involved state aid.

affects different parts of the region and the impact it is likely to have on society.

The presence of a "local broadband champion" is crucial in stimulating demand and encouraging activities for development of initiatives and improvements using broadband. Community activities are the best way to get closer to the users and to have local access.

In some regions, a few Service Providers (SPs) dominate the market, controlling a very high percentage of market share between them. In these situations, the major SPs will have a huge brand presence and profile. This often sets expectations in the minds of consumers, who may think that quality broadband is not available unless at least one of these SPs agrees to provide services over the network.

It can sometimes be difficult for smaller local broadband networks to attract a large SP with their own network management system, and limited appetite for small customer gains. Networks should therefore be designed to make it as easy as possible for SPs to interface their systems to and deliver services over them. This can be done by adopting standard business and technical interfaces, and by coordinating and federating with neighbouring municipalities and regions. However, the public authority also has a role to play in encouraging competition by promoting the value of smaller SPS, who may be able to adopt a new network more easily (and be more willing to do so). This can often accelerate take-up in the early stages, leading to a more sustainable business case.

Local communities can play a very important role in driving demand for new services and in some cases providing part of the investment needed. There are many examples of successful 'bottom up' initiatives developed on a co-operative or private sector basis, often with public sector support in Scandinavia and Finland, the Netherlands, UK and other parts of Europe.

How to monitor and manage the outcome

It is essential for a public authority to implement effective governance mechanisms both during the deployment as well as when the network is operational, and performance should be periodically benchmarked against objectives. This is to ensure that public money is being used appropriately, to check how decisions are being made, and to make sure stakeholders are behaving in the right way. It is also important to ensure that public money that is invested in broadband projects is seen to deliver tangible benefits.

For all monitoring organisations, monitoring requirements should be set out in the contract, to ensure that the suppliers provide best value for the public money spent. For instance, for a network provider (NP), the contract should specify target number of service providers signed up, quality parameters, number of households connected, and a target number of active customers.

Responsibility for monitoring performance of the contract for broadband deployment is usually with the entity undertaking the project as the contracting party. However, the entity might decide to outsource its monitoring activities. .

Monitoring can be conducted by the local group or co-operative that is undertaking the project. The advantage of this approach is that the monitoring organisation is very close to the operations of the project and so will be able to identify any issues very quickly.

Monitoring by regional or municipal public bodies can bring greater financial or political strength to the monitoring activity. The public authority should use the economic objectives contained in the Broadband Plan to define this. The monitoring should regularly assess performance against these objectives for the charges raised by the supplier.

Commercial performance monitoring

There are a number of options for monitoring the commercial aspects of a broadband investment project. Milestones and penalty payments are a form of control over network deployment. Payments are linked to specific states of advancements or execution time of a roll-out plan.

When the state aid guide applies, the Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks set out two important commercial considerations for public authorities to ensure State aid compliance.

The contract must ensure that the suppliers provide Best Value (or Value for Money) for the public money spent. The public authority should use the economic objectives contained in the Broadband Plan to define this. The monitoring should regularly assess performance against these objectives for the charges raised by the supplier.

The contract must also contain the rights of the public authority to 'claw back' a significant percentage of all profit or income above 'excessive' levels as defined within state aid rules[51].

The supplier must commit to provide transparency in their accounts to allow periodic audit of their balance sheets.

INFOBOX – Requirements for operations which generate net revenue after completion

For operations which generate net revenue after their completion Article 61 of Regulation (EU) No 1303/2013 requires that the eligible expenditure of the operation to be co-financed from ESI Funds must be reduced in advance taking into account the potential of the operation to generate net revenue over a specific reference period.

Net revenue should be understood as cash in-flows directly paid by users for the goods or services provided by the operation, such as charges borne directly by users for the use of infrastructure, sale or rent of land or buildings, or payments for services less any operating costs and replacement costs of short life equipment incurred during the corresponding period.

The potential net revenue of the operation must be determined in advance by either the application of a flat rate net revenue percentage for the sector or sub-sector applicable to the operation (if provided in Annex V of the regulation or a delegated act) or the calculation of the discounted net revenue of the operation by using the method set out in the delegated act (Commission Delegated Regulation (C(2014) 1207 Final[52]). The above provisions do not apply to certain operations e.g. to operations whose total eligible cost before taking into account the potential net revenue does not exceed EUR 1 000 000 or to operations for which support under the programme constitutes compatible State aid.

For major projects, whose total eligible cost exceed EUR 50 000 000 or EUR 75 000 000 as defined in Article 100 of the above regulation, a cost-benefit analysis must be carried out including an economic and a financial analysis, and a risk assessment in order to demonstrate that the major project is worth co-financing from an economic point of view and that it needs co-financing from a financial point of view.

The methodology for cost-benefit analysis of major projects with its key principles is described in the Commission Implementing Regulation (EU) No…/..

[51] See section on state aid.

[52] See :http://ec.europa.eu/regional_policy/what/future/pdf/preparation/1_da_cpr_act_en.pdf

In addition, the Commission guide to Cost-Benefit Analysis (last edition published in 2008) is currently being updated and will be available in 2014. It will include specific cost-benefit analysis guidelines for broadband sector and a broadband case study.

Non-commercial performance monitoring

There are also non-commercial aspects of a project that should be monitored. It is a key principle of State aid guidelines that publicly funded broadband projects should consider open network solutions that enables competition among multiple service providers, supports innovation in products and services, and minimises market distortion. It is important to ensure that open access is defined in terms of access to specific services and products (e.g. wholesale bandwidth or dark fibre or duct access). Access should be provided to all products, all of the time, without discrimination in terms of traffic management, blocking, throttling or degradation of quality of services in competition to services run by other service providers.

Operational readiness: The public authority should monitor the number of deployed network infrastructure elements (e.g. fibre termination electronics, wireless transmitters), and the overall service availability on different parts of the network.

Fault occurrence: The public authority should monitor the occurrence of faults on the network, including those that are notified by customers (e.g. residential vs. business vs. public sector) and those that are discovered by network staff. The fault monitoring should include analysis of how the number of faults varies with increasing usage, and seek to identify any common causes of faults.

Maintenance: The public authority should monitor the frequency and nature of maintenance that is required on the network, including scheduled maintenance, corrective maintenance and preventative maintenance. In the case of scheduled and precautionary maintenance, the public authority should look to ensure that this is done at a time when it will cause least disruption to customers.

Network take-up: The public authority should monitor the take-up of the network by wholesale and retail customers. For retail customers this could include the number of new connections, while for wholesale customers this could include measuring the installation of their equipment or the take-up of other services. Where a network operator has specific responsibilities to market the broadband services or stimulate demand, the public authority should also separately monitor that these activities are taking place (in addition to monitoring the resultant take-up).

Network performance: The public authority should monitor the speed and quality of services being delivered to end users, to ensure that the benefits of next-generation broadband can be realised, and to allow comparison with other projects.

Different levels of involvement (see four investment models in the previous chapter) imply different levels of influence on the decision making on a project.

If the network infrastructure is fully owned by the Public Authority, as in the municipal network models, then the Authority has full control over any decision-making (especially if it even runs the network, either at passive or active layer, as in the public-run municipal network model).

A good approach to take into account the needs of the market is to have a board of public body stakeholders to oversee all decision-making. This approach has the advantage of leveraging private operator expertise to operate the network while retaining overall control within the public sector. This is obviously always the case when the municipality network is built in a private-public joint venture.

Finally, governance can be exercised through alternative methods of influence. This approach may be necessary when the public authority is not directly involved such as in the operator subsidy model, or in the community broadband model. The public authority can still be able to monitor activity on the project, and refer any undesirable outcome to another enforcing body (e.g. the national regulator).

ANNEX 1: Directive 2014/61/CE on broadband cost reduction in a nutshell

Pilar 1: Access to & transparency of existing physical infrastructure The Directive aims at creating a market for physical infrastructure such as ducts, poles, manholes without covering cables, or dark fibre. Therefore, any electronic communications or utilities operator may enter this market and offer access to its physical infrastructure. Moreover, any network operator has the obligation to give access to its physical infrastructure for the deployment of high-speed broadband networks (30 Mbps and above), upon reasonable request and under fair terms and conditions, including price. Access may however be refused for objective transparent & proportionate reasons. A Dispute Resolution Mechanism is foreseen in case no commercial agreement can be found.	Who	Network operators: energy, water; transport & other utilities operators and providers of public communications networks
	What	Right to offer access to physical infrastructures and obligation to meet reasonable requests for access to it for deploying high-speed broadband
	How	Access granted on commercial basis, on specified request, under fair terms & conditions, including price. Objective reasons to refuse access e.g., technical suitability, safety, security, availability of space, existence of alternatives
	What if	Dispute resolution within 4 months
In order to enable access to physical infrastructure, public sector bodies and network operators must provide on request minimum information including a contact point. They must also consent to on-site surveys, at the cost of the access seeker. Access to information may be limited for network security, national defence, public safety or confidentiality reasons.	Who	Public sector bodies & network operators
	What	Information on location & route, type & current use of existing infrastructure, contact point
	How	Via a Single Information Point, upon specific request, on proportionate, transparent & non-discriminatory terms and conditions
	What if	Dispute resolution within 2 months
Pilar 2: Coordination & transparency of planned civil works Any network operator may negotiate coordination of civil works with electronic communications providers. In addition, undertakings performing civil works fully or partially financed by public means have to meet any reasonable request for coordination of civil works, provided that any additional cost is covered by the communications provider and that the request is made timely.	Who	Network operators performing civil works
	What	Right to negotiate coordination of civil works and obligation to meet reasonable requests to coordinate civil works if wholly or partially financed with public means
	How	On transparent & non-discriminatory terms. Possibility of exceptions
	What if	Dispute resolution within 2 months
In order to enable agreements on coordination of civil works, planned civil works have to be made public 6 months in advance. When an undertaking authorised to provide public communications networks requests information about the planned civil works, the network operator has to make available minimum information about the planned civil works. Access may be refused if information is already publicly available or via a Single Information Point. Member States may limit access to	Who	Network operators
	What	Information on location, type, network elements, starting date, duration, contact point, for works pending authorisation or planned in the next six months
	How	Upon specific written request.

the information in view of the security & integrity of the networks, national security, public health or safety, confidentiality or operating and business secrets.	What if	Dispute resolution within 2 months
Pilar 3: Permit granting All relevant information on procedures for granting permits for civil works must be available via a Single Information Point. Member States are encouraged to organise the application for permits by electronic means. In any event, unless national law specifically provides otherwise, any permit decision should be made in general within 4 months.	Who	Competent permit granting authorities
	What	Grant or refuse permits by a motivated decision within 4 months by default
	What if	Possibility of extension of the deadline
Pilar 4: In-building infrastructure All new buildings shall be equipped with physical infrastructure, such as mini-ducts, capable of hosting high-speed networks and with an access point, which can be easily accessed by the providers of public communications networks. The same is valid for major renovations. Member States may provide for exemptions on proportionality grounds, such as for monuments or military buildings.	Who	Building owners or developers
	What	Equip buildings with in-building physical infrastructure & access point
Providers of public communications networks have the right to access the access point at their own cost and, through it, any existing in-building physical infrastructure. Holders of the rights to use the access point and the in-building physical infrastructure shall meet reasonable requests for access under fair and non-discriminatory terms and conditions, including price. Member States may grant exemptions from this obligation when access to an in-building network is ensured on objective, transparent, proportionate and non-discriminatory terms and conditions (open access model).	Who	Holder of right to use the access point and/or the in-building physical infrastructure
	What	Meet reasonable requests for access from a provider of public communications networks
	How	Under fair and non-discriminatory terms and conditions, including price & without prejudice to ownership rights
	What if	Dispute resolution within two months
Dispute Resolution Body & Single Information Point Member States have to appoint one or more independent body/ies to resolve disputes between network operators regarding access to infrastructure, access to information and requests for coordination of civil works. Member States have the flexibility to appoint already existing body/ies, or create new body/ies *ad hoc*. Moreover, Member States have to appoint one or more Single Information Points where information on physical infrastructure and on permits can be made available.	How	Flexibility for the MS to appoint one or more already existing or create new body/ies.

TERMS AND ABBREVIATIONS

This is a list of terms and abbreviations used in the guide.

ADSL	Asymmetric Digital Subscriber Line, a first mile technology operating over copper phone lines
AN	Access Node
AON	Active Optical Network, a technology for FTTH/FTTP (aka Ethernet point-to-point)
CAPEX	Capital expenditure
DOCSIS	Data Over cable System Interface Specification – a cable TV network solution
DSL	Digital Subscriber Line
FTTH	Fibre-to-the-home, a first-mile infrastructure
FTTP	Fibre-to-the-Premise (typically an MDU), a first-mile infrastructure
FTTC	Fibre-to-the-Cabinet (from which the first-mile connection starts), a local area infrastructure
GPON	Gigabit Passive Optical Network – shared fibre access network architecture (ITU-T G.984)
HDTV	High-definition television
IRU	Indefeasible right of use
ISP	Internet service provider, e.g. a SP delivering Internet service
LLU	Local loop unbundling
MDU	Multi-dwelling unit – an apartment block
NP	Network Provider, operates the active equipment and delivers SP's services to the end users
OPEX	Operational expenditure
PIP	Physical infrastructure provider, owns and operates the passive infrastructure
PON	Passive optical network
RoW	Right of Way
SMP	Significant market power
VDSL	Very-high bit-rate Digital Subscriber Line
SP	Service Provider, sells services (e.g. Internet, TV, telephony, etc.) to the end user
xDSL	Digital Subscriber Line of any type

REFERENCES AND FURTHER READING

INFO REGIO: http://ec.europa.eu/regional_policy/index_en.cfm

Digital Agenda for Europe: http://ec.europa.eu/digital-agenda/

Digital Agenda Scoreboad: https://ec.europa.eu/digital-agenda/en/scoreboard

European Broadband Portal: http://ec.europa.eu/digital-agenda/about-broadband

Rural Development: http://ec.europa.eu/agriculture/index_en.htm

EU Guidelines to State Aid on Broadband: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:025:0001:0026:EN:PDF

General Block Exemption Regulation: http://ec.europa.eu/competition/state_aid/legislation/gber_regulation_en.pdf

Connected Continent - a single telecom market for growth & jobs: http://ec.europa.eu/digital-agenda/en/connected-continent-single-telecom-market-growth-jobs

Connected Communities: http://ec.europa.eu/digital-agenda/en/news/call-local-regional-and-national-leaders-take-advantage-new-eu-broadband-funding-and-support

Guidance on Ex ante Conditionalities : http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/eac_guidance_esif_part2_en.pdf

Connecting Europe Facility: http://ec.europa.eu/digital-agenda/en/connecting-europe-facility

Cost Reduction Directive: http://ec.europa.eu/digital-agenda/en/news/proposal-regulation-european-parliament-and-council-measures-reduce-cost-deploying-high-speed

DAE toolbox: http://s3platform.jrc.ec.europa.eu/dae-toolbox

Study on Broadband and Infrastructure Mapping; http://www.broadbandmapping.eu/

Study on the socio-economic impact of bandwidth: http://ec.europa.eu/digital-agenda/en/news/study-socio-economic-impact-bandwidth-smart-20100033