

Report for the European Commission

Guide to broadband investment

Final report

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1 Executive summary

1.1 Introduction and aims of the guide

This document sets out best practice examples in planning an investment of public funds in broadband projects. The guidance provided is targeted at all Managing Authorities¹ in the European Union (EU). The guide has been prepared by Analysys Mason on behalf of the European Commission (EC), and details the issues associated with investment planning and procurement that must be considered by any Managing Authority that is aiming to implement an EU-funded broadband project.

The EC has recognised that Member States will need to make significant investments in broadband infrastructure to meet the objectives set out in the Digital Agenda for Europe (DAE): by 2020, all Europeans should have access to the Internet at speeds above 30Mbit/s and 50% or more of European households should have subscriptions above 100Mbit/s.

The EC considers this guide a particularly important resource for Member States which have the facility to use funds from the current (2007-2013) and the future programming period (2014–2020) to assist in the deployment of new broadband and high speed broadband infrastructure. Those Member States are urged to use this guide to develop an action plan that will ensure the DAE targets for 2020 are met.

The EU's aims of regional policy are to achieve social, economic and territorial cohesion². Territorial balance and improved quality of life in rural areas are other objectives underlying the EU rural development policy³. Access to an affordable, good-quality and open ICT infrastructure for all citizens will contribute to cohesion and rural development policy aims and to increase innovation and productivity of regional and rural actors. As a result, it is of primary importance for Managing Authorities to be aware that access to affordable broadband has a positive effect in terms of meeting the most basic needs of the households, communities, public administrations and businesses in a territory.

By ensuring that ICT services are available to as many people as possible, Member States will contribute to cohesion, to innovation, and to social, economic and political change. Most of the benefits of new ICT services will be derived from outside the ICT sector. Since large amounts of

¹ For the purpose of this document and for simplification reasons, Managing Authority should be understood as public authorities (national, regional, local) responsible for supporting the deployment of high speed networks in the context of the EU Structural (ERDF) and Rural Development funds (EAFRD). In the context of this guide, it also refers to agencies (e.g., intermediate bodies such as regional/rural development agencies) delegated to provide public support to these networks and even Paying agencies under the Common Agriculture Policy..

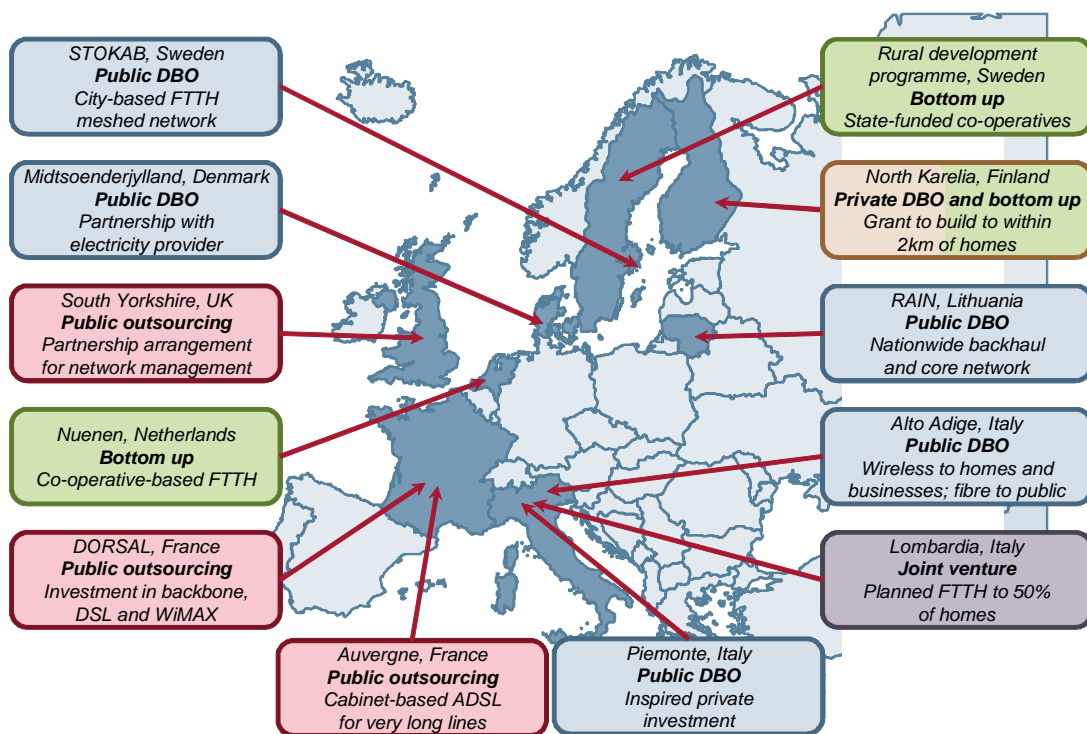
² Managing Authorities should consult the EC cohesion guidelines, available at: http://ec.europa.eu/regional_policy/sources/docoffic/2007/osc/l_29120061021en00110032.pdf

³ Managing Authorities should consult the EC rural development guidelines, available at: http://ec.europa.eu/agriculture/rurdev/leg/index_en.htm

public funds are involved, it is important for Managing Authorities to keep the goals of delivering socio-economic benefit to entire territories in mind, and prioritise the long-term benefit of all socio-economic actors of regions and rural areas over short-term gain of any specific socio-economic actor.

1.2 Basis and content of the guide

The main basis for the recommendations presented in this guide is a series of interviews with stakeholders from example projects which have already been successfully implemented. These example projects are summarised in Figure 1.1.



Note: DBO = design, build and operate; FTTH = fibre to the home

Figure 1.1: Summary of example projects [Source: Analysys Mason]

Due to the complexity and unique circumstances of each broadband investment, this guide is not intended to provide a rigid, prescriptive framework within which investment decisions should be made. Instead, it gathers together insights from the example projects to help Managing Authorities understand each of the key issues they must consider as they move through the investment preparation and planning process, and to help them make informed decisions.

In addition to the interviews with stakeholders from the example projects, our research has also included insights from the following sources:

- feedback from the eris@ annual conference regarding a range of possible financial models for broadband investment
- *Models for efficient and effective public-sector interventions in next-generation broadband access networks*, Analysys Mason report for the Broadband Stakeholder Group, 9 June 2008⁴
- a blogosphere consultation co-ordinated by eris@
- feedback from the first Digital Agenda Assembly held in Brussels on 16 and 17 June 2011.

The guide is structured as a series of questions that a Managing Authority must ask itself when planning a broadband infrastructure investment. The structure of the guide is shown in Figure 1.2.

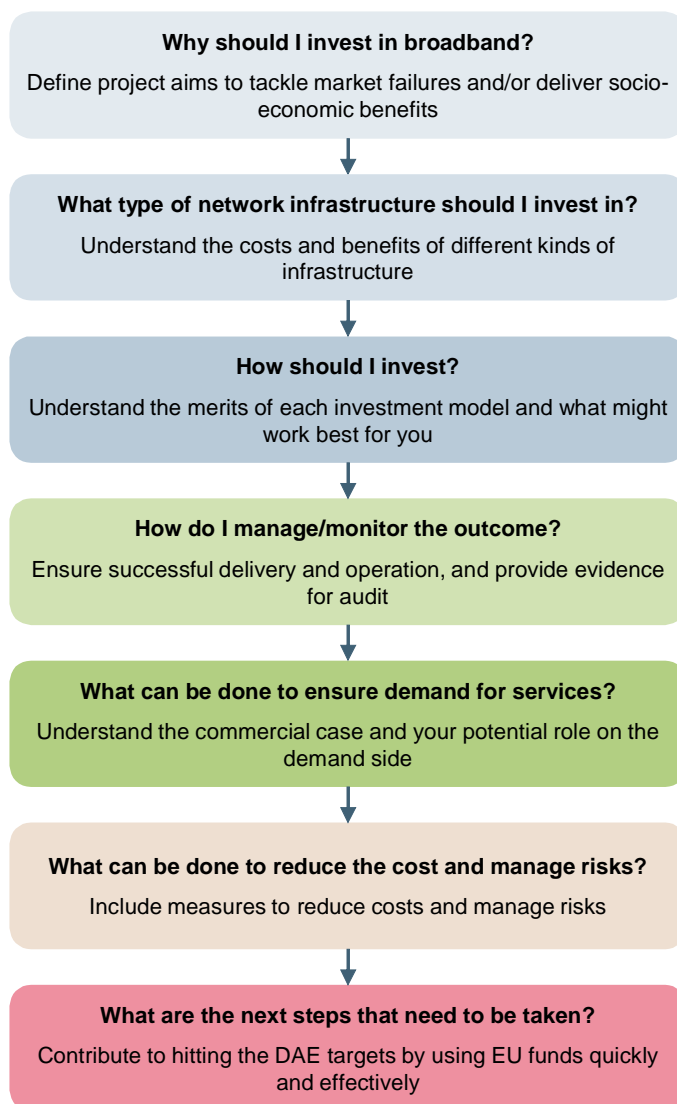


Figure 1.2: The seven stages of planning a broadband investment
[Source: Analysys Mason]

This guide is complementary to existing guidance material which is publicly available, including:

⁴ Available at http://www.broadbanduk.org/component/option,com_docman/task,doc_view/gid,1008/Itemid,63/

- Guide to Regional Broadband Deployment (1st edition)⁵
- Check List of Actions for Public Authorities Considering Broadband Interventions in Under-served Territories⁶
- FTTH Business Guide (2nd edition)⁷.

Additional guidance for the implementation of each investment model will be made available on the European Broadband Portal⁸.

The guide should be read in conjunction with the following important European Policy areas:

- The implementation of the EU's cohesion policy, as outlined in the *Strategic report 2010 on the implementation of the programmes 2007–2013*⁹
- The implementation of the EU's rural development policy, as outlined in the report on the implementation of the national strategy plans and the Community strategic guidelines for rural development (2007-2013)¹⁰;
- The EC Communication on *Regional Policy contributing to smart growth in Europe 2020*¹¹ and the accompanying Staff Working Document¹²
- The EC Communication on *Digital Agenda for Europe*¹³
- The EC Communication on *European Broadband: investing in digitally driven growth*¹⁴
- Policy actions aimed at the achievement of EU targets for broadband networks¹⁵.

1.3 Guidance on different investment models

A key aspect of the investment preparation and planning phase is the choice of investment model.

⁵ Available at <http://www.broadband-europe.eu/Lists/Competences/Guide%20to%20regional%20broadband%20development%20-%201st%20edition.pdf>

⁶ Available at <http://www.broadband-europe.eu/Pages/checklist.aspx>

⁷ Available at <http://www.ftthcouncil.eu/documents/Reports/FTTH-Business-Guide-2011-2ndE.pdf>

⁸ See <http://www.broadband-europe.eu/Pages/Home.aspx>

⁹ Available at http://ec.europa.eu/regional_policy/policy/reporting/cs_reports_en.htm

¹⁰ Available at: http://ec.europa.eu/agriculture/rurdev/publi/index_en.htm

¹¹ Available at http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/smart_growth/comm2010_553_en.pdf

¹² Available at http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/smart_growth/annex_comm2010_553.pdf

¹³ Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF>

¹⁴ Available at http://ec.europa.eu/information_society/activities/broadband/docs/bb_communication.pdf

¹⁵ Available at http://ec.europa.eu/information_society/newsroom/cf/pillar.cfm?pillar_id=46&pillar=Very%20Fast%20Internet

The investment models presented in this guide have been selected on the basis of public data on broadband projects from around Europe, and input from DG REGIO and eris@. The models represent a range of options for combining public and private investment, and are presented in increasing order of involvement by the Managing Authority. Each model is applicable in different circumstances, depending on the scope of the required infrastructure, the specific aims of the Managing Authority, and the investment/risk appetite of potential private sector partners. The five investment models are shown in Figure 1.3 and summarised below.

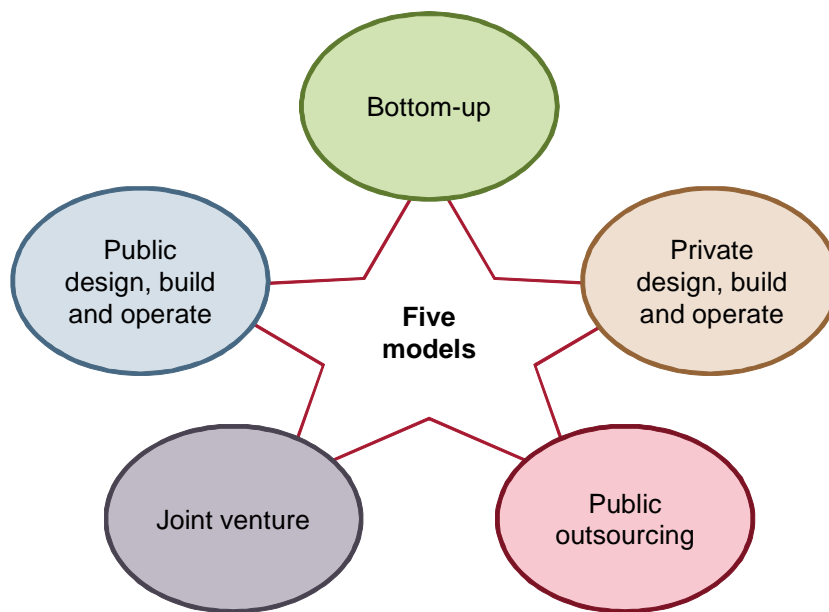


Figure 1.3: Summary of available investment models [Source: Analysys Mason]

*Bottom-up model*¹⁶ The bottom-up, or local community, model involves a group of end users organising themselves into a jointly owned and democratically controlled group (frequently a co-operative) capable of overseeing the contract to build and operate their own local network.

Private design, build and operate (DBO) model The private design, build and operate (DBO) model involves the Managing Authority issuing funding (often in the form of a grant) to a private sector organisation to assist in its deployment of a new network. The public sector has no specific role in the ownership or running of the network, but may impose obligations in return for the funding.

¹⁶ In this context, 'bottom-up' does not refer to the LEADER initiative.

Public outsourcing model Under a public outsourcing model a single contract is awarded for all aspects of the construction and operation of the network. The major characteristic of this model is that the network is run by the private sector, but the public sector retains ownership and some control of the network.

Joint venture model A joint venture is an agreement under which ownership of the network is split between the public and private sector. Construction and operational functions are likely to be undertaken by the private sector.

Public design, build and operate model A public DBO model involves the public sector owning and operating a network without any private sector assistance. All aspects of network deployment are managed by the public sector. A public sector operating company may operate the entire network, or may operate the wholesale layer only (with private operators offering retail services).

Guidance regarding the advantages and disadvantages of each investment model and the suitability of each to different circumstances is given in Figure 1.4.

<i>Model</i>	<i>Advantages</i>	<i>Disadvantages</i>	<i>Recommended use</i>
Bottom up	<ul style="list-style-type: none"> • Long-term, non-profit view, suitable for high-cost infrastructure (e.g. FTTH) • Focuses demand and encourages local social cohesion 	<ul style="list-style-type: none"> • Localised deployments, with risk of differing technologies 	For targeting localised areas and for gaining the most benefit from small amounts of funding
Private DBO	<ul style="list-style-type: none"> • Larger scale (than bottom up) • Low public burden, which can lead to faster deployments 	<ul style="list-style-type: none"> • There is a minimum funding threshold to attract private interest • Limited control over operations, which may reduce the socio-economic impact 	For larger-scale investments, where sufficient funding is available to attract private interest in rural areas, and where the operations (and risk) of the network can be confidently transferred to a private operator
Public outsourcing	<ul style="list-style-type: none"> • Public financial stability with private expertise • Greater control (than private DBO) 	<ul style="list-style-type: none"> • Reduced financial benefit to private sector (compared to private DBO) • Additional bureaucracy 	Where the Managing Authority requires a high level of control over the network, and where the private operator has a more conservative risk profile than the private DBO model

<i>Model</i>	<i>Advantages</i>	<i>Disadvantages</i>	<i>Recommended use</i>
Joint venture (JV)	<ul style="list-style-type: none"> • Potential financial benefit for both parties, based on risk sharing • The creation of special-purpose vehicles (SPVs) can make the model very scalable, and allow alternative investment sources 	<ul style="list-style-type: none"> • Potential conflicts of interest must be resolved and may block creation/ successful operation of the JV • Few examples of implemented JVs to indicate best practice 	Where the interests of the public and private sectors can be closely aligned
Public DBO	<ul style="list-style-type: none"> • Managing Authority has full control to promote competition and enforce standards • Managing Authority can ensure socio-economic benefits are prioritised 	<ul style="list-style-type: none"> • Size and scope limited by public expertise • Potentially excludes private sector expertise 	Where a Managing Authority needs to have absolute control over the operations of the network, or where small targeted investment will inspire investment from private sources

Figure 1.4: Summary of advantages, disadvantages and recommended uses of the investment models [Source: Analysys Mason]

In terms of the choice of investment model, a Managing Authority should consider the delivery of benefits to end users over the *long term* as a key criterion in making that choice. The EC believes that from a cohesion perspective, longer-term investment models work best for financing high speed infrastructures, promote competition and allow the delivery of cheaper and better-quality services for end users. This is particularly the case when an investment focuses on future-proof passive or backhaul infrastructure, which supports effective competition among a wide range of service providers. Issues associated with the long-term management of end-user benefits and effective competition are discussed in more detail in Section 1.5.

However, the EC wishes to encourage innovation in the choice of investment models, and is keen to stress that there is no one model that is preferred above all others. Indeed, it is an important role of a Managing Authority to use an appropriate combination of investment models from different stakeholders to match their needs and to deliver a long-term solution for end users.

A Managing Authority also needs to be innovative in terms of both the sources of funding and the available financial instruments for investment. It must consider private investment from both within and outside the telecoms sector, including operators, institutional investors, utilities, end users, content providers and equipment providers. In terms of financial instruments available to the public sector, the European Investment Bank (EIB) has developed examples of innovative products and services,¹⁷ such as:

¹⁷ See <http://www.eib.org/products/index.htm> for more information.

- Individual loans
- Intermediated loans
- Structured finance facilities
- Risk sharing finance facilities
- Guarantees.

Regardless of the mix of public and private investment, a Managing Authority should choose the investment model on the basis of its ability to offer end users a range of affordable, high-quality services on a long-term basis.

1.4 Next steps following preparation and planning

The guide also includes detailed guidance on the next steps that need to be taken, following the investment preparation and planning phase, as shown in Figure 1.5.

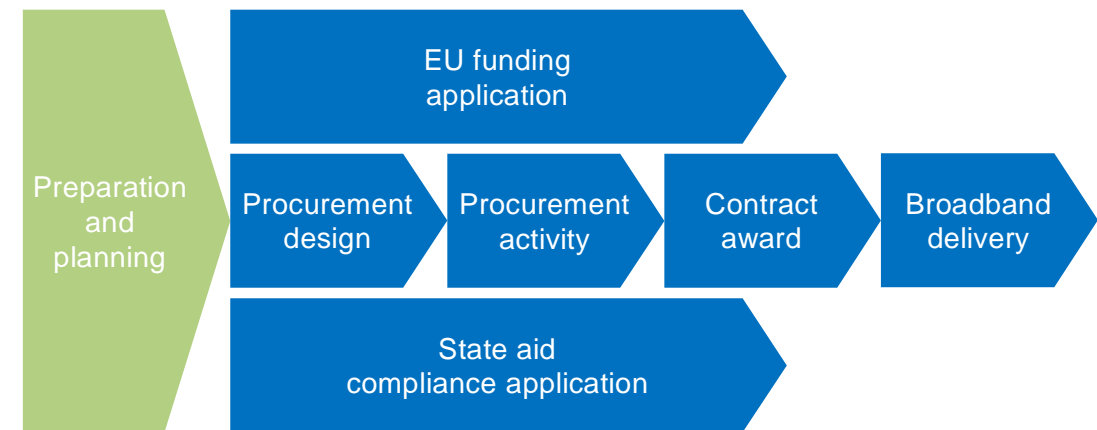


Figure 1.5: Next step activities [Source: Analysys Mason]

There are three key activity flows that follow preparation and planning: the EU funding application, complying with State aid regulations¹⁸, and the four separate activities that contribute to procurement and delivery. These three activity flows are carried out broadly in parallel, and a summary description of each activity is provided below.

1.4.1 EU funding application

To complete an EU funding application, or any other relevant funding application, a Managing Authority will need to assess the funding application guidelines and application form(s), and ideally check that its understanding is consistent with that of the funding body, through the use of meetings and dialogue.

¹⁸ Under the State aid regime, projects developed under the "de minimis" rule do not need a state-aid clearance.

There are a variety of sources of EU funding, and these can be combined with national or local sources of public sector funding, before being leveraged with private sector financing where appropriate, as discussed in Section 1.3.

1.4.2 Complying with State aid regulations

The EC monitors the investment of public funds to ensure that State aid is not used to unduly favour one or more private entities in a way that would distort a market. The key activities for achieving compliance with State aid regulations relate to justifying the need for public intervention¹⁹. However, there are four situations in which a State aid notification is *not* required:

- If the investment is made on terms that are equivalent to those available to the market
- If the level of aid is below a threshold of EUR200 000
- If the broadband network is only used for public services
- If the broadband project is being implemented as part of a national framework scheme which has already received State aid approval.

If none of the above conditions is met, an individual State aid notification must be submitted to the EC. A Managing Authority should prepare a State aid pre-notification paper in consultation with the relevant government department.

In addition to describing the project objectives and approach in the State aid pre-notification paper, the Authority will need to gather and prepare evidence about the broadband demand and supply situation in the localities of interest for the project. This includes a requirement for detailed mapping and coverage analysis, to determine whether infrastructure has already been (or is about to be) deployed on the supply side, as well as a mapping of the expected service requirement on the demand side.

Other inputs to the State aid process are derived from the project design, the procurement requirements specifications and the responses from bidders during the procurement process. In particular, the requirements specifications and questions posed by bidders during the procurement should be designed to help satisfy the EC's guidelines on State aid for broadband.

1.4.3 Procurement design, procurement activity, contract award and broadband delivery

The procurement design is shaped by a number of factors and options that should be assessed methodically by a Managing Authority and developed into a coherent, agreed procurement strategy. Due to the wide range of factors involved in procurement design, a Managing Authority is likely to need specialist procurement and technical support to ensure the procurement will both meet its objectives and comply with procurement legislation and State aid guidelines.

¹⁹ For more detail, see *Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks*, available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:235:0007:0025:EN:PDF>

Each procurement route will include a specific set of activities. For example, the OJEU Competitive Dialogue procedure includes the following steps:

- market awareness
- pre-qualification questionnaire (PQQ)
- invitation to participate in dialogue (ITPD)
- dialogue process
- invitation to tender (ITT)
- contract award.

A Managing Authority may award the contract to the winning bidder, once the key dependencies of State aid approval and funding confirmation have been achieved.

The broadband delivery stage is a complex undertaking and presents the contracting Authority with a variety of challenges. Many areas will require close monitoring and management, including checking the functionality/performance of the network, checking deployment costs and checking the services offered / prices charged to wholesale and retail customers.

1.5 Conclusions and recommendations

Based on research of the example projects and analysis of the steps that need to be taken towards effective broadband delivery, we have derived the following conclusions and recommendations for any Managing Authority that is planning a public broadband investment.

Socio-economic benefit must be managed alongside project sustainability to deliver long-term benefits

Due to the large investment required to deploy broadband networks, public investment of some kind will often be required (particularly in rural areas). When large amount of public funds are involved to deliver the *socio-economic aims* of EU policies, the *long-term* needs of territories must be prioritised over the commercial aims of specific private companies.

For this reason, a Managing Authority might favour those models which provide long-term control over the operations of the project to ensure that the needs of the entire territory are met. Effective control of the project by the Managing Authority will also help to ensure that access to the network infrastructure is made available on an *open* and *non-discriminatory* basis (as discussed in more detail below). Effective control of the project will also allow the Managing Authority to ensure that the network is operated in a way that supports the delivery of long-term socio-economic benefits (e.g. by ensuring that service availability and performance meet minimum requirements, and also ensuring that the desire for commercial returns does not overtake the need to provide affordable services).

However, the private sector can bring invaluable expertise to broadband projects, and commercial discipline that can ensure projects are delivered efficiently. The involvement of large-scale private operators can help to ensure

the sustainability of the project, as their expertise and experience can help in adapting to changes in the market or embracing technological developments.

It is therefore essential for a Managing Authority to engage with potential private partners at an early stage of the procurement planning process to gauge their appetite for different investment models, while keeping the procurement process transparent and non-discriminatory.

The bottom-up model may often be suitable for small-scale fibre projects

Fibre to the home (FTTH) provides the very highest connection speeds to end users, but is usually very expensive to deploy. Our research suggests that the bottom-up model is a suitable complement to small-scale FTTH deployments, as co-operatives can take a long-term not-for-profit view of the investment. Larger-scale deployments may be possible, where an existing large-scale co-operative exists (e.g. a local utility company). In the example projects we observed bottom-up models being deployed both on a small scale (e.g. Nuenen and Swedish Rural Development Programme) and on a larger scale (e.g. the local co-operative electricity companies deployed fibre in Midtsoenderjylland, Denmark).

However, Managing Authorities may face a challenge in leveraging the bottom-up model for a project involving widespread deployment (if large-scale co-operatives do not already exist). They should explore measures to aggregate discrete co-operative areas and promote common technical standards to enable major players in the industry to participate and hence deliver benefits to end users, particularly regarding the choice and affordability of services.

Small investments can provide a catalyst through innovative partnerships

None of the example projects incorporates a formally established joint venture (the Lombardia project is still at the planning stage). However, particular elements of some projects were undertaken using a collaborative approach. In many cases, small investments led to innovative partnerships, and provided a catalyst for further investment from other sources.

These examples included the Managing Authority in Piemonte, Italy investing in services in return for investment in infrastructure by the incumbent. And in North Karelia, many end users were inspired to commit to the bottom-up funding of the network once they saw cable being installed along their street.

Managing Authorities should engage with potential private partners to explore the possibility of innovative partnerships to catalyse investment.

Open access to infrastructure supports effective

As discussed above, a Managing Authority should aim to ensure that the broadband investment delivers a choice of affordable, innovative services from a range of retail suppliers over the long term. This aim is supported by

competition

promoting effective and sustainable competition on the network, which in turn is supported by providing open and non-discriminatory access for operators to use the infrastructure to provide services.

Infrastructure access is possible on two broad bases:

- Access to the *passive* infrastructure, such as underground ducts, dark fibre and terrestrial wireless sites
- Access to the *active infrastructure*, which refers to the active electronics such as those attached to fibre or copper cables, or terrestrial wireless and satellite electronic equipment.

The concept of *open* and *non-discriminatory* access refers to a situation in which any operator can interconnect with the network on the same terms as any other. The infrastructure operator must ensure that it does not unduly favour any service provider(s) over any others. For this reason it is advantageous to use a model under which the infrastructure operator is not also a service provider, as this reduces any incentive for favouritism. It is a condition of granting State aid approval that the recipient of the aid provides open wholesale access, regardless of the presence of significant market power (which is determined by national regulatory authorities through an established ‘market review’ process).

It is generally accepted that if an operator has access to the passive infrastructure (e.g. copper, dark fibre or underground ducts) it will have more freedom to develop innovative services, and therefore compete with other operators and hopefully deliver lower prices to consumers. However, access to passive infrastructure generally requires a higher level of investment both from the access provider (which must ensure sufficient capacity in ducts, dark fibre, cabinets, etc.) and from the access seeker (which must provide its own active equipment). In areas where the business case for next-generation access (NGA) broadband networks is already challenging (such as rural areas), the additional investment required by the access seeker may mean that passive infrastructure access may be less likely to support effective and sustainable competition, unless alternative and more innovative investment models are used which could mean lower cost and lower access charges (e.g.: bottom up model)²⁰.

Therefore, a Managing Authority should plan an investment with a view to

²⁰

The majority of costs are associated with deploying the passive infrastructure. Under a *passive access model*, the access seeker needs to deploy its own active electronic equipment relatively close to the end user, in order to connect with the passive infrastructure. Although this cost is small when compared to the passive investment, it may still be enough to create an unviable business case in very sparsely populated areas. The alternative is an *active access model*, which allows the access seeker to interconnect via active electronics from a more centralised location, which provides lower control, but requires less upfront investment.

ensuring that any new network infrastructure is opened at as many levels as possible, thus allowing all market players to operate in a level playing field. Also, by investing in infrastructure rather than directly in services, a Managing Authority will help to ensure that it does not distort the market, which could be detrimental to end users.

These considerations will encourage effective and sustainable competition, which will help to create an environment that stimulates the availability of innovative services at low prices, offered by a range of retail providers to consumers and businesses.

2 Introduction

2.1 Background

The *Digital Agenda for Europe* is one of the flagship initiatives of the EC's *Europe 2020 Strategy* for a smart and sustainable economy. The agenda provides a framework for Member States to achieve the 2020 strategy's objectives for broadband deployment: that is, broadband access for all in Europe by 2013 and at least 30Mbit/s connections for all by 2020²¹.

The EC recognises that significant funding will be required in order to achieve these objectives, and all Member States have, or are developing, broadband plans to deliver the required connection speeds to their population. However, only around half of the broadband plans that include roll-out of superfast broadband networks set out the specific measures that will need to be implemented to realise the targets for broadband access.

Due to rapid developments in technologies and business models for broadband services, there is a risk that rural areas will get left behind as commercial operators focus on urban areas that are more cost effective to serve. In order to limit the emergence of a 'digital divide' between urban and rural areas, it is essential that local and regional authorities are able to use public funding effectively to support the roll-out of new broadband networks.

The EC has also recognised that the sharing of best practice in terms of broadband investment has played a key role in improving the outcome of ICT investment programmes in some regions.

The EC considers this guide a particularly important resource for Member States who have the facility to utilise EU funds from the current programming period (2007-13) to assist in the deployment of new broadband infrastructure. Those Member States are urged to use this guide to develop an action plan that will ensure the DAE targets are met.

2.2 Aims of this document

In order to promote the sharing of best practice in implementing broadband investment, this document aims to provide reliable and independent guidance on planning a broadband investment. Overall, the aims of the guide are as follows:

- To help ensure that the Digital Agenda for Europe (DAE) targets are met
- To support the aims of EU's regional policy for affordable high-quality broadband for all
- To support the aims of EU's rural development policy for better quality of life and improved provision of basic services in rural areas;

²¹ These are the coverage objectives. There is also a take-up objective (for at least 50% of households to use services of at least 100Mbit/s).

- To help some Member States exploit EU funds more effectively
- To learn from other projects which have been implemented and spread best practice.

The guide has been prepared on the basis of research into publicly available information, interviews held with stakeholders from several example projects which have already been implemented, and feedback gathered from an online consultation and from a workshop at the Digital Agenda Assembly in Brussels.

The guide is aimed at Managing Authorities (and other implementing agencies) with responsibility for preparing projects to fund broadband, including calls for public procurement. The guide therefore examines a range of possible investment models and other issues that Managing Authorities need to consider in order to successfully leverage public funds for broadband investment.

Structure of the document

This guide has seven sections, addressing each of the stages that a Managing Authority needs to go through when planning a broadband investment. The seven stages are shown in Figure 2.1 below.

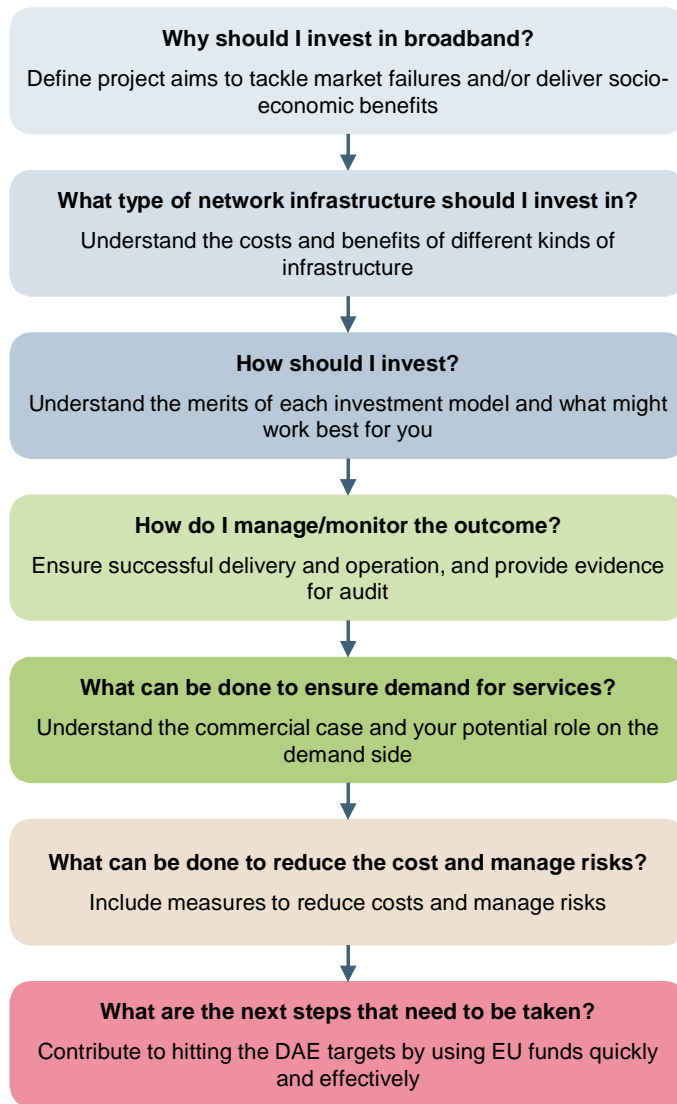


Figure 2.1: The seven stages of planning a broadband investment
[Source: Analysys Mason]

The content of each of the seven sections is summarised below.

- Why should I invest in broadband?** This section looks at the drivers for investing in broadband networks and how public funds can, if used effectively, help to deliver socio-economic benefits. It is essential that Managing Authorities define their aims at the start of the investment planning process. This section also considers the aims of past broadband projects, and how successfully they were achieved, as well as including some of the unexpected benefits that have arisen from these projects.
- What type of network infrastructure should I invest in?** This section looks at the choices available to a Managing Authority with regard to different parts of a broadband network (e.g. access vs. transport/backhaul networks), and the ways in which various elements of the network support different aims of broadband investment. Additionally, although the majority of the example broadband projects considered specify requirements that are technologically neutral, this section aims to explain the reasons for the particular technology choices, and

assess their appropriateness for meeting various goals. A Managing Authority must consider the pros and cons of each available technology, in order to choose the option that meets its aims in the most cost-effective manner.

- **How should I invest?** Managing Authorities must choose the right investment model for their particular circumstances. This section gives details of five different models of investment that a Managing Authority could follow. It considers the advantages and disadvantages of each model, and their suitability for different types of network investment. More detail on these investment models is given below.
- **How do I manage/monitor the outcome?** It is essential for Managing Authorities to manage/monitor the outcome of the investment to ensure that funding is being used appropriately. This section looks at various methods that a Managing Authority can use to monitor the implementation of projects and the appropriateness of each method for different circumstances. It is important for a Managing Authority to consider these issues as part of the planning process, as any public or private partners in the investment project will need to commit to managing and monitoring provisions upfront.
- **What can be done to ensure demand for services?** This section considers the relationship between demand for services and the overall impact of the Managing Authority's network investment, based on insights from the research into example projects.
- **What can be done to reduce the cost and manage risks?** This section considers the measures that can reduce the cost of a broadband deployment (e.g. re-using existing infrastructure) and manage risks (e.g. through detailed planning).
- **What are the next steps that need to be taken?** In this section we consider the three parallel activity streams that need to be initiated following the investment planning process: funding, procurement and delivery, and State aid.

Focus of the guide: broadband investment models

The main focus of the guide is to consider five high-level investment models for broadband, all of which are available to Managing Authorities for funding broadband network deployment. The models below represent a spectrum of increasing involvement and commitment from the Managing Authority:

- **Bottom up** – a group of end users (frequently organised as a 'co-operative') decide to invest in the deployment of a network. Public involvement is usually limited to issuing grants or guaranteeing loans, and/or facilitating access to publicly owned infrastructure such as ducts.
- **Private design, build and operate** – a private company receives funds (often in the form of a grant) from the public sector to assist in network deployment, but the private company retains full ownership.

- **Public outsourcing** – a public sector body outsources network build and operation to the private sector under a long-term agreement, but the public sector body retains ownership of the network.
- **Joint venture** – public and private sector bodies both retain a stake in the network.
- **Public design, build and operate** – the public sector constructs and operates the network itself, retaining full control and offering services on a retail or wholesale basis.

In addition, we are aware that (as part of preliminary analyses) some Managing Authorities have considered other models, such as public-private partnership (PPP) models of the kind used for other major infrastructure projects, where availability payments are made over a long period. However, we have not yet identified any broadband projects that have used this model for a real deployment, and this model is not considered in detail in this guide.

2.3 Approach used to compile the guide

In order to provide comprehensive information to support each section of the document, and therefore create a useful guide for Managing Authorities, we conducted detailed research into existing broadband investment projects around Europe. As a result, we have built up an evidence base of case studies from previous successful projects to deploy next-generation broadband (which can be found in Annex A). Figure 2.2 provides a summary of the example projects on which we have conducted detailed research.

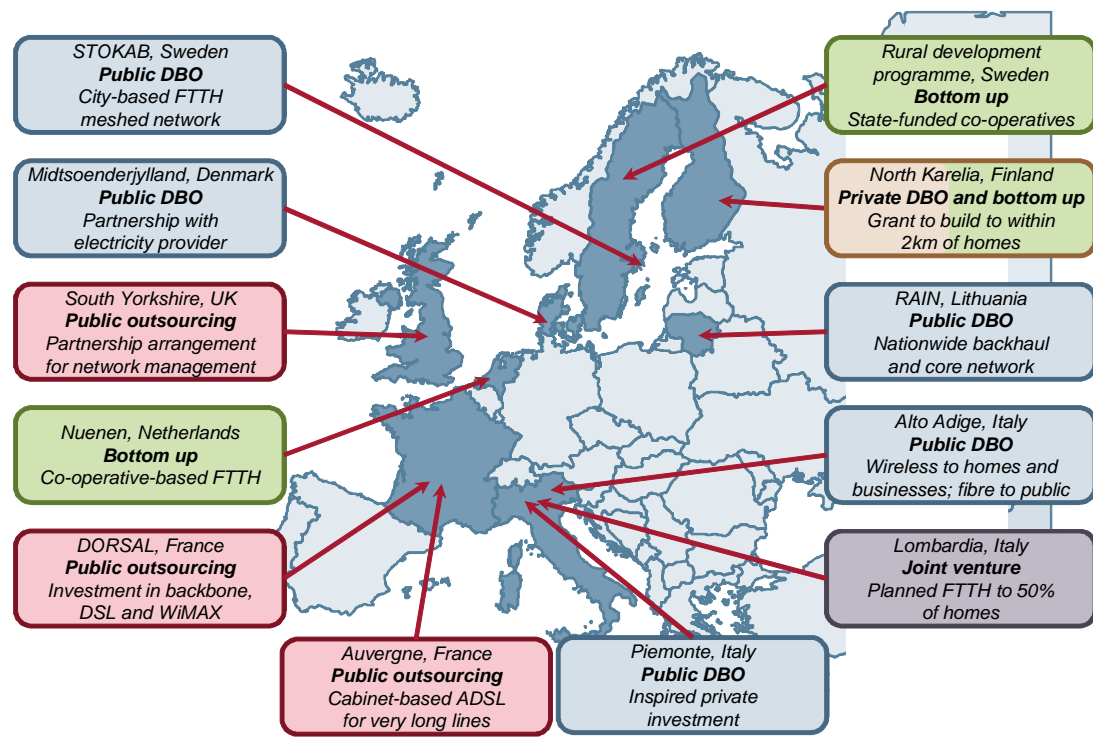


Figure 2.2: Summary of example projects [Source: Analysys Mason]

In addition to this detailed research, the guide includes insights from the following sources:

- feedback from the eris@ annual conference regarding the proposed financial models
- *Models for efficient and effective public-sector interventions in next-generation broadband access networks*, Analysys Mason report for the Broadband Stakeholder Group, 9 June 2008²²
- a blogosphere consultation co-ordinated by eris@
- feedback from the first Digital Agenda Assembly held in Brussels on 16 and 17 June 2011.

When selecting projects for detailed analysis, we aimed to collect a range of examples, including (where possible): various examples of each investment model, and examples of a number of types of infrastructure deployment. Where possible we have identified the outcomes of each project, in terms of supporting competitive broadband provision and delivering socio-economic benefit. Figure 2.3 provides a summary of the examples considered in detail for the guide.

²² Available at http://www.broadbanduk.org/component/option,com_docman/task,doc_view/gid,1008/Itemid,63/

Figure 2.3: Summary of example projects [Source: Analysys Mason]

Project	Managing Authority	Summary of investment	Investment value	Infrastructure					Investment model				
				FTTH	FTTC	Wire-less & satellite	ADSL	Core & back-haul	Bottom-up	Private DBO	Public out-sourcing	Joint venture (partnering)**	Public DBO
Piemonte, Italy	Public ICT administration organisation	Multiple infrastructure to inspire private investment	EUR 21 million from ERDF; EUR 7 million from provincial funds; EUR 7 million from national funds; EUR 15 million from regional funds			✓	✓	✓				(✓)	✓
OnsNet, Nuenen, Netherlands	Close the gap (private company)	Co-operative-based investment in FTTH with some backhaul	Public investment of EUR 6 million and private investment of EUR 8 million Public funding from national government	✓				✓		✓			
Rural Development Programme, Sweden	Swedish Board of Agriculture	National funding made available to local co-operatives for FTTH	Public investment of SEK173.0 million and private investment of SEK23.3 million and EUR 21 million from the European Economic Recovery Package (EERP).	✓						✓			

Project	Managing Authority	Summary of investment	Investment value	Infrastructure					Investment model				
				FTTH	FTTC	Wire-less & satellite	ADSL	Core & back-haul	Bottom-up	Private DBO	Public out-sourcing	Joint venture (partnering)**	Public DBO
Midtsoenderjy Iland, Denmark	Vejen Municipality	Investment in fibre connection between city halls; partnership with electricity company for FTTH	Total investment of EUR 83, 6 million. Out of which private investment of EUR 81.6 million and public investment of EUR 2 million which includes EUR 143300 ERDF support.	✓				✓				(✓)	✓
DORSAL, Limousin, France	Collective of local authorities	Investment in backbone, DSL and WiMAX services	Public investment of EUR38 million and private investment of EUR30 million European funding of EUR13 million			✓	✓	✓				✓	
North Karelia*, Finland	Regional council	Grant to local telco to build backbone to within 2km of household; bottom-up model for final drop	Public investment of EUR6.2 million (including European Regional Development Fund (ERDF) funding) and private investment of EUR3.1 million Successor project included EUR66 million from government, and EUR25 million from the EERP funds.	✓				✓	✓	✓			

Project	Managing Authority	Summary of investment	Investment value	Infrastructure					Investment model					
				FTTH	FTTC	Wire-less & satellite	ADSL	Core & back-haul	Bottom-up	Private DBO	Public out-sourcing	Joint venture (partnering)**	Public DBO	
Digital Region, South Yorkshire, UK	Local authorities, regional development agency	Public investment in FTTC network, with partnership arrangement for network management	Total investment of EUR 101,9 million, out of which ERDF support is: EUR 37,6 million EUR		✓							✓	(✓)	
Auvergne, France	Local authority (Auvergne EU office)	Deployment of cabinet-based DSL services to reduce line lengths and provide basic broadband	Public investment of EUR38,5 million out of which: EUR 10 million ERDF support, EUR 4.8 million in national authority funding and EUR 23,7 million in local and regional authorities funding.		✓		✓					✓		
RAIN, Lithuania	Non-profit public enterprise	Nationwide backhaul/core network	Total investment of EUR 50,1 million, out of which ERDF support is EUR 42,6 million.					✓						✓
STOKAB, Sweden	Municipality owned	City-based FTTH meshed network	Total investment of EUR 450 million	✓				✓						✓
Lombardia, Italy	Regione Lombardia	Planned FTTH investment to 50% of homes	Total investment of EUR 58,5 million, out of which ERDF support is: EUR 7,9 million.	✓									✓	

Project	Managing Authority	Summary of investment	Investment value	Infrastructure					Investment model					
				FTTH	FTTC	Wire-less & satellite	ADSL	Core & back-haul	Bottom-up	Private DBO	Public out-sourcing	Joint venture (partnering)**	Public DBO	
Alto Adige, Italy	Bolzano Local Council	Wireless connections to homes; fibre connections to public sector and businesses	Total investment of EUR 6 million, out of which ERDF contribution is: EUR 2.1 million.			✓		✓						✓

* The interview also considered the successor project to the North Karelia investment, *Broadband for all in Eastern and Northern Finland*.

** A number of individual projects were undertaken as part the programme on a similar basis. Individual projects were not discussed separately, instead, the overall approach was analysed.

*** (✓) refers to examples of partnering that do not fit the strict definition of a Joint Venture, but were felt to align with the philosophy of this investment model.

3 Why should I invest in broadband?

Define project aims to tackle market failures and/or deliver socio-economic benefits



3.1 Introduction

As a first stage in the investment planning process, it is essential for a Managing Authority to define the aims of the broadband investment project. These aims will include *what* the project needs to achieve, and *why*. Once a clear set of aims have been defined these will guide the rest of the project (and influence decisions throughout the planning process). A Managing Authority should consider the appointment of a ‘champion’ to drive the project aims forward.

This section looks at a selection of reasons why a Managing Authority may decide to make broadband investments, primarily associated with delivering socio-economic benefits (creating stronger community relationships, supporting regional development, promoting competition and attracting/retaining investment). A Managing Authority may also derive benefit from using the network for its own services (including playing the role of *anchor tenant*, which could help to support the business case).

Above all, it is important for a Managing Authority to be aware that access to affordable broadband has a positive effect in terms of meeting the most basic needs of the individuals, communities and businesses in a territory. It is important for a Managing Authority to keep these goals in mind, and prioritise the long-term benefit of individuals over short-term gain for private entities.

The majority of the example projects which were studied for this guide were considered to be a success by the stakeholders who were interviewed. However, several interviewees, including those for North Karelia (Finland) and the Digital Region (UK) project, commented that it was too early to objectively measure the impact of the broadband project on the region’s economy, and also highlighted that it was difficult to exclude the effects of the recent economic crisis on such a measurement.

The aims of the example broadband projects, and how successfully they were achieved, are set out in Annex C (which also highlights some of the unexpected benefits that have arisen from these projects).

3.2 Overview of the regional benefits that broadband can provide

The key regional benefits of broadband investment that were identified through our interviews and further research are: supporting economic development, minimising the digital divide and improving social cohesion, as discussed below.

Supporting economic development

Throughout our analysis, three main project aims relating to economic development were identified:

- **Contribution of broadband to GDP growth and productivity gains.** This has been shown in academic work for the World Bank by Christine Qiang²³ (2009), who demonstrated that a 10% increase in basic broadband penetration enlarged GDP growth by an additional 1.21% when looking at 66 high-income countries; and by 1.38% in the remaining 120 low- and middle-income countries. In some cases, the aim is to prevent a decline in GDP. For example, the DORSAL project in France “*was motivated by regional enterprises threatening to leave their local premises and move to another region, where telecommunications services would be cheaper and have higher quality*”.
- **The creation of new jobs or businesses,** which may be directly linked to the telecoms sector or may be from other sectors using the infrastructure that the programme has put in place. A direct example of this was seen in the Piemonte project in Italy where a development programme was run by the exchange created through the project. The programme consists of around 100 participating enterprises, which are given hardware and resources (such as bandwidth) at a discount, with the successful enterprises being spun off as new independent businesses.
- **An increase in consumer surplus,** or the amount that consumers pay for a service, compared to the value they feel they receive from the service outcomes. In the case of broadband, service outcomes can range from quick access to large amounts of information (e.g. learning and health services), to access to the world’s largest portal for social and entertainment services. While none of the interviewed projects has measured this gain directly, a paper by Shane Greenstein and Ryan McDevitt²⁴ (2009) showed that the consumer surplus gain generated by broadband adoption in the USA between 1999 and 2006 was approximately USD7.5 billion.

In some projects, specific reports were issued that analysed the individual region and linked the possibility of economic advancement of the region to an increase in broadband capabilities. For example, in the Digital Region project in South Yorkshire, UK, a report produced at the start of the project helped to generate initial interest and buy-in from all the project stakeholders.

Minimising the digital divide

One of the more crucial aims of broadband investment projects for rural areas is to minimise the ‘digital divide’, a distributional objective²⁵ to ensure that all regions within a country enjoy similar

²³ Qiang, C. Z. and Rossotto, C. M., *Economic Impacts of Broadband, Information and Communications for Development: Extending Reach and Increasing Impact*, World Bank (Washington, DC, 2009), pp. 35–50.

²⁴ Greenstein, S. & McDevitt, R. (2009), *The Broadband Bonus: Accounting for Broadband Internet’s Impact on US GDP* (NBER Working Paper 14758).

²⁵ A distributional objective in this context is the attempt to promote equality of welfare between regions (with a comparison either nationally or internationally), frequently through wealth distribution.

levels of digital connectivity. Minimising the digital divide is one of the main targets that the EC's Directorate General for Regional Policy (DG REGIO) tries to promote through the distribution of its available funds. Given the rate of development of broadband in urban areas throughout Europe, these divides are becoming more marked.

Below we consider some of the specific situations that can cause a digital divide, and hence the areas where public investment in broadband networks will have the most impact. The situations described below will make a commercial business plan more challenging, and so discourage investment in the area by commercial operators.

- **Difficult geographical characteristics.** Broadband network development can be restricted by challenging geographical characteristics, such as the mountainous terrain of an area (as highlighted in the Piemonte and DORSAL projects) or the sparsity of population (as highlighted in the South Yorkshire project). These factors greatly increase the cost and financial risk of developing broadband services in an area, especially fibre solutions, and so discourage commercial investment.
- **Low affluence of an area.** A low level of disposable income in a region is likely to reduce the demand for more expensive (newer) services, and so reduce the potential return on investment. There may be various reasons why a region has a lower affluence level, such as historical economic factors. For example, in South Yorkshire where the Digital Region project is situated, the area suffered from the loss of the two core industries of the region (coal and steel), and is now classified as an 'Objective 1' area by the EU²⁶.
- **Investment inertia.** This occurs in regions that are able to provide some financial return, but are often overlooked by a commercial operator in favour of the more obvious investment opportunities, or lower-risk opportunities available in other regions. This was demonstrated in the Piemonte region of Italy: the region was suffering from investment inertia and required a public investment catalyst to inspire confidence, and highlight the potential of the area. The public sector invested in a new core network, a new Internet exchange and new services, and this attracted investment from the incumbent to upgrade local exchanges.

If a Managing Authority can use an innovative investment model to fund the deployment of infrastructure, so that commercial operators only have to develop a business case for providing services, then the effects of a digital divide can be minimised. Furthermore, broadband projects can act as catalysts either to demonstrate demand for broadband in the region (as in the Rural Development Programme in Sweden), or to stimulate a reaction from the market in the region (as was seen in both Piemonte and the Digital Region projects).

²⁶ An EU Objective 1 region is a region debilitated from any of: low level of investment; higher than average unemployment rate; lack of services for businesses and individuals; and poor basic infrastructure.

Improving social cohesion

Our research highlighted a number of projects whose aims included strong social drivers. These projects aimed to achieve a range of benefits from the social impact of broadband. A report by University of Siegen (2010) report on the social impact of ICT classified the benefits as follows:

- **Provision of e-health services.** The ability to access information on healthcare is often listed as a major reason for obtaining access to the Internet. The availability of better health-related information has led to an improvement in the perception of healthcare in both the USA and Canada. In the Nuenen project in the Netherlands, the initial concept for the project was driven by a local housing company's wish to install e-health services, including video communications, in new-build homes for the elderly and disabled.
- **Improved contact with community and family.** A number of social researchers have concluded that the Internet promotes contact with friends and family, and allows people to maintain contact with people who share similar interests. Indeed in the OnsNet example, recent research demonstrated that the project had helped to promote social cohesion among members of the co-operative.
- **Remote working.** Access to ICT enables flexible working practices, in terms of both time and location. This provides benefits for both employers and employees (e.g. parents with young children, who may be unable to work away from home, can now join the workforce). The introduction of remote working is one way in which the Rural Development Programme in Sweden may achieve its objective of promoting entrepreneurship, employment and helping to sustain Sweden's sparse rural population.
- **Education and lifelong learning.** While there is little evidence that e-learning is likely to replace traditional face-to-face interaction between teaching staff and students, increased ICT penetration can provide large sections of the community with the opportunity to engage in long-term, informal learning.
- **Projects can become targets for further research into the effects of broadband on various socio-economic factors,** as occurred in OnsNet and Midtsoenderjylland, and it can be hoped that this research will help to inspire and guide future projects. The existence of strong links with the local university was highlighted as a key success point in the Midtsoenderjylland project, and so by providing universities with access to data for research, a Managing Authority may be able to benefit from similar links in future projects.

4 What type of network infrastructure should I invest in?

Understand the costs and benefits of different kinds of infrastructure



4.1 Introduction

The second stage of the investment planning process is for a Managing Authority to consider the type of network infrastructure in which it is going to invest. Investing in infrastructure, rather than investing directly in services, will help to ensure that a Managing Authority does not distort the market, which could be detrimental to end users.

The Managing Authority must consider the type of infrastructure along three dimensions: the scope of the network, the performance of the network, and the ability of the network to support competition.

4.1.1 Scope of the network

This section looks at the options available for a Managing Authority to invest in different parts of a broadband network, and the various technologies available for each part.

There are two main options for investing in broadband infrastructure:

- **The access network**, which comprises the connection between the end user and the nearest network node (e.g. local exchange or central office). Various options are available for providing broadband connections in the access network, depending on the requirements and available funding (including existing copper lines, new fibre-optic cables and wireless networks).
- **The backhaul and core network**, which provides links between network nodes to allow connectivity over large distances (e.g. between towns and cities). Because traffic from a large number of end users is aggregated as it passes through the backhaul and core networks, fibre-optic cable is often the technology of choice due to its high capacity. High-capacity wireless microwave links are also used.

The extent of the access and backhaul/core portions of the network is shown in Figure 4.1 for three example NGA technologies.

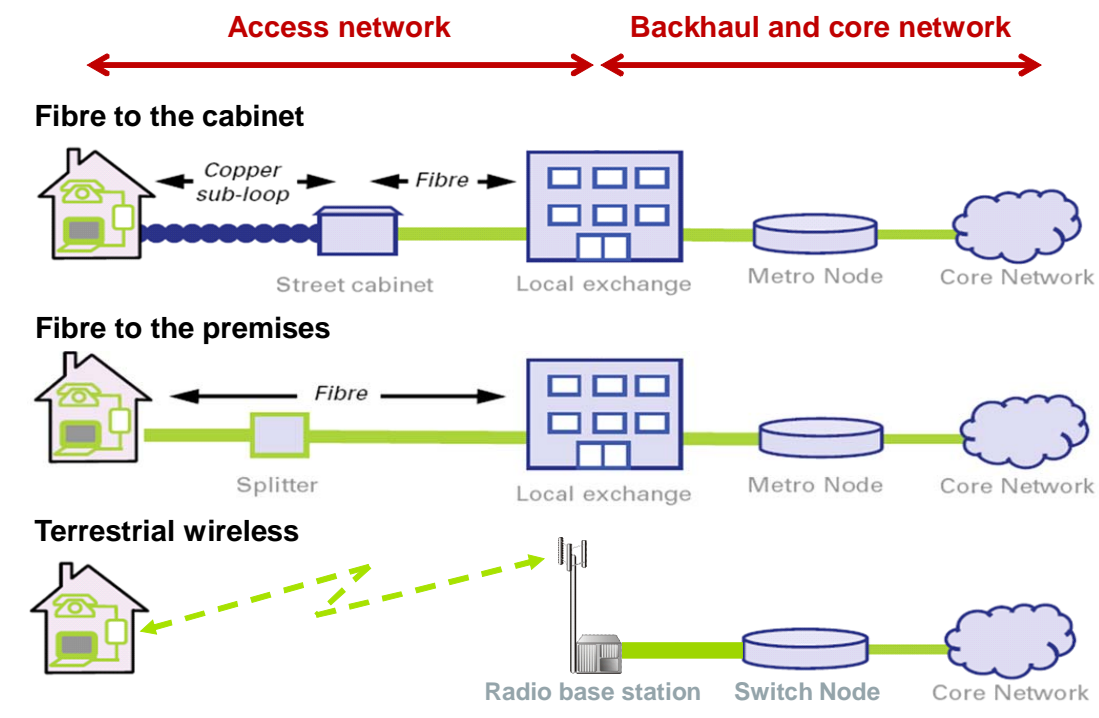


Figure 4.1: Extent of access and core/backhaul networks for some NGA technologies [Source: Analysys Mason]

Sections 4.2 and 4.3 examine which of these network components and technologies have been used in the example projects, to identify different circumstances which lend themselves to a particular choice.

4.1.2 Performance of the network

It is essential that a Managing Authority has at least a broad understanding of the candidate technologies and architectures that can be used to meet its requirements, so that it has an appreciation of the trade-off between cost and performance. Analysys Mason has conducted studies which are available in the public domain on the cost and capabilities of both wireline²⁷ and wireless²⁸ technologies.

However, EU State aid rules mean that a Managing Authority must specify its network requirements in a technology-neutral way. For example, a Managing Authority may specify that a broadband network must provide connections at a certain speed, and be able to be upgraded to some higher speed over time, but it must not specify which technology is used to deliver that speed.

²⁷ Available at http://www.broadbanduk.org/component/option,com_docman/task,doc_details/gid,1036/

²⁸ Available at http://www.broadbanduk.org/component/option,com_docman/task,doc_view/gid,1246/Itemid,63/

It should be noted that a complementary *mix* of technologies may be appropriate in a particular region. While fibre-optic cable usually delivers the highest connection speed, it is expensive to deploy over wide areas, and wireless and satellite technologies are likely to have a role to play in providing cost-effective wide area coverage.

4.1.3 The ability of the network to support competition

Another important consideration is the impact that technology will have on competition.

A condition for granting State aid is the obligation for the aid recipient to provide open wholesale access, regardless of the presence of significant market power. It is generally accepted that if an operator has access to the passive infrastructure (e.g. copper, dark fibre or underground ducts), it will have more freedom to develop innovative services, and therefore compete with other operators and hopefully deliver lower prices to consumers.

Under State aid guidelines²⁹, the access obligations imposed on the infrastructure operator must include access to both passive and active infrastructure level for at least seven years without prejudice to any similar regulatory obligations that may be imposed by the national regulatory authority (NRA). The subsidised network has to be designed in a way that guarantees that several alternative operators can have access to the subsidised infrastructure at all levels: the supported infrastructure will have to offer sufficient place in the ducts, shall have sufficient dark fibre capacity, place in the cabinets, and capacity on active access equipment. In the case of NGA networks, an argument may be put forward that in low-density areas access to the passive level will not result in additional competition since it may be not economically feasible to create an alternative network. Therefore the State aid guidelines for broadband require that the new network should be opened at as many levels as possible, thus allowing market forces to decide which access products suit them best.

It is also essential to ensure that the infrastructure access (at which ever point it is offered) is open and non-discriminatory. This will require the Managing Authority to design wholesale requirements which ensure that operators can compete effectively, regardless of who actually owns and operates the network. The design of wholesale requirements is discussed in more detail in Section 9.3.1.

Competition considerations will influence the choice between the two main options for providing fibre to the home. A 'point-to-point' network provides a dedicated fibre connection to each home. This means that an operator can easily access an end user by connecting to the relevant fibre. An alternative network is a 'GPON' architecture, whereby some of the access network is shared like a cable network, but each customer has their own connection into their premises. A GPON network may involve lower costs than a point-to-point network, but the options for competition are less

²⁹ *State aid to broadband: primer and best practices*, Filomena Chirico / Norbert Gaál, Directorate-General for Competition, forthcoming

straightforward as access to different customers must be managed electronically by the network operator³⁰.

4.2 Access network

4.2.1 Fibre to the home (FTTH)

Fibre to the home (FTTH) involves laying a fibre-optic cable all the way from the central office / local exchange (or suitable local access node, such as a public sector building) to the home. FTTH is the technology with the highest capacity, and therefore provides the highest degree of future proofing. However, due to the long distances involved in deploying a connection all the way to the home, the deployment costs of FTTH can be very high. To date, commercial deployments of FTTH have been limited due to this high cost.

There are two main options for an FTTH architecture: GPON and point to point (P2P).

GPON networks may require less capital expenditure (CAPEX) to be deployed (in particular in less densely populated, rural areas). Previous studies have shown that the cost of deploying a PTP architecture is on average between 10-20% more than an equivalent GPON architecture³¹. The cost difference is higher in rural (less dense) areas than in urban (more dense) areas.

However, as discussed above, the benefit of point-to-point networks is that they allow all operators to have full use of a fibre between the local exchange and the end user, hence allow full unbundling, thus they tend to be viewed more favourably from a competition point of view. State aid policy (see section 9.4) also emphasizes that pro-competitive broadband architectures will result in "lower prices and higher level of services for end user" which in turn can help to deliver better penetration rates in areas affected by cohesion problems.

In contrast, the primary method of competition on GPON networks is via an electronic interface, which may restrict the level of control that an alternative service provider has over its services. The use of wavelength unbundling on PON networks may in the future offer a similar level of control as a dedicated fibre on a P2P network, but at the time of writing of this guide, this technology was still being standardised.

Point-to-point networks may also be better suited to providing symmetric services and are able to provide higher capacities to the end-users hence they are considered to be more future proof solutions, particularly taking in the prospect of both households and businesses moving gradually towards cloud-computing.

³⁰ It is often stated that point to point readily allows for passive (infrastructure-level) access whereas GPON readily allows for active (service-level) access. As GPON technology evolves over time this distinction is likely to become less clear as access to individual wavelengths becomes viable.

³¹ Please see http://www.broadbanduk.org/component/option,com_docman/task,doc_view/gid,1036/, and http://www.vodafone.com/content/dam/vodafone/about/public_policy/position_papers/vodafone_report_final_wkcons ult.pdf.

It should be strongly emphasized that, in the case of both architectures, the cost of deployment to the managing authority is much more dependent on the ability to re-use existing infrastructure and the model of investment than on the choice of technology. This issue is discussed in more detail in Section 8. Furthermore, the sustainability of the project (and therefore the ability to deliver long term socio-economic benefits) is more dependent on the choice of business model and the expertise of project partners, than the choice of technology.

In terms of the projects reviewed in the development of the guide, those projects which have already deployed FTTH infrastructure have used PTP architecture. Project interviewees gave a variety of reasons for choosing PTP infrastructure, including the ability to support high speed connections, the ability to provide symmetric services, the more future proof nature of PTP and the ability to more easily support competition from multiple service providers. One project (which was still in the planning phase) was considering the use of GPON, due to this technology being the favoured technology of the incumbent, who was involved in the project.

A number of the example public projects researched for this guide have featured investments in FTTH in the access network. The example projects which deployed FTTH were as follows:

- **OnsNet, Nuenen, Netherlands:** for delivery of new video-based e-health services
- **Rural Development Programme, Sweden:** to help meet a national target to provide 100Mbit/s broadband to 90% of homes
- **Midtsoenderjylland, Denmark:** FTTH infrastructure was deemed important for economic development
- **eRegio, North Karelia, Finland:** to help meet a national target to provide 100Mbit/s connectivity
- **STOKAB, Sweden:** FTTH was chosen as the most future-proof technology
- **Lombardia, Italy:** different FTTH architectures will be deployed (GPON and P2P), influenced by the preferences of both the incumbent and alternative operators.

Further details of these examples of FTTH deployment can be found in Annex D.

4.2.2 Fibre to the cabinet (FTTC)

Fibre to the cabinet (FTTC) involves laying fibre from the central office (or local exchange) to a street cabinet or basement of an apartment block. Because the fibre is only laid for some portion of the distance to the home, significant cost savings can be realised relative to FTTH. However, as the copper network is used for the last part of the connection to the home, the speeds available on an FTTC network are also significantly lower than with FTTH (around 80% in terms of the cost to connect a home). As with FTTH technologies, the cost is strongly affected by the ability to reuse existing infrastructure.

We observed two examples of projects that featured FTTC infrastructure:

- **Digital Region, South Yorkshire, UK:** FTTC infrastructure was chosen for its ability to deliver significant increases in connection speeds, without the high cost of FTTH
- **Auvergne, France:** FTTC infrastructure was used to provide basic broadband, as there were still a number of houses that were some distance from the cabinet.

Further details of these projects can be found in Annex D.

4.2.3 Terrestrial wireless and satellite

Terrestrial wireless technologies provide a link between the home and the nearest network node without the need for a physical wireline connection. Terrestrial wireless networks are complementary to fixed networks, and can be advantageous in areas where the installation of a wireline network is difficult and/or expensive (e.g. in mountainous terrain). However, because several users access the network via the same last-mile link (i.e. the wireless link), the *contention*³² for services can be much higher than on wireline networks, and the realised speed may be much lower than the maximum speed quoted by the service provider. In order to ensure an end user receives an *assured* level of service more base stations will have to be added, which will increase costs. It should also be noted that demand for high-speed rates from a large number of users on a wireless network tend to require additional investment in the fixed infrastructure that supports the wireless network.

Satellite networks offer a useful solution for areas that are not covered by terrestrial networks (either wireline or wireless), e.g. where the existing networks have left ‘not-spots’. Satellite technologies can contribute to reaching the Digital Agenda’s target of 100% coverage by 2013. As with terrestrial wireless technologies, many users are accessing the same node (i.e. the satellite transponder) and so the effects of contention may have a greater impact than on fibre networks.

Wireless technologies which could provide effective next-generation broadband services include terrestrial wireless broadband technologies such as the 3GPP LTE-advanced or IEEE 802.16m WiMAX standards, and high-capacity satellites, using Ka-band multi-spotbeam technology.

The costs of terrestrial wireless technologies vary according to a number of factors, including the terrain over which they are deployed, the data rate that must be delivered at the furthest point from the base station and the overall traffic demand. Indeed, for both terrestrial wireless and satellite access technologies, the cost of deployment depends very heavily on the traffic demand to be supported. This is in contrast to the fibre technologies, for which costs do not vary as strongly with traffic demand.

Three of the example projects included wireless and satellite networks to complement the fixed infrastructure. In these projects, terrestrial networks were used to cover most of the more rural

³² Network contention is a measure of the number of users that are served by a single network node (e.g. a local exchange or a terrestrial wireless base station). The capacity available to each end user at any point in time is dependent on the capacity supplied to the node, divided by the number of users on that node that are *currently* using services.

areas, with satellite playing an important role in covering hard-to-reach areas. The example projects which featured wireless and satellite technologies were:

- **DORSAL, France:** a WIMAX network has been deployed in the mountainous region, and satellite serves those premises which are unable to obtain a terrestrial connection
- **Piemonte, Italy:** initial investment was in public-only wireless services. Once regulations were changed, however, private operators were able to follow with their own investment.
- **Alto Adige, Italy:** wireless services have been used to cover mountainous areas.

Further details of these example projects can be found in Annex D.

4.2.4 DSL (copper-based) broadband technologies

Basic broadband services are most often delivered over the existing copper network, using DSL technology. DSL technology has the advantage that it makes use of the existing access infrastructure and is therefore relatively cheap to deploy. However, the nature of the technology means that download speeds are heavily affected by the distance between the local exchange (central office) and the home, and in many cases are limited to below around 10Mbit/s.

Two of the example projects involved investment in current-generation broadband (i.e. ADSL). In both cases, this was because the original investment was initiated some time ago (more than five years ago), and at the time this technology was considered to be sufficient to meet market needs. It was recognised by one of the example projects that an upgrade to FTTH would be very costly, while the other project maintains that there is no demonstrable demand for FTTH and so no upgrade is required.

Further details of the example projects that deployed DSL (copper-based) technologies can be found in Annex D.

4.3 The backhaul and core network

A large number of the example projects featured investment in backhaul and core networks. A fit-for-purpose backhaul network is essential for providing effective broadband services. Due to the way that a backhaul/core network connects large areas, this is a cost-effective way of providing coverage to a large number of end users. However, investments in backhaul/core networks rely on the existing access network (or a new access network deployed through a separate investment) to deliver services to end users. Backhaul/core investment can be effective at delivering services to end users where access infrastructure is already sufficient for broadband (e.g. basic broadband over copper lines) or where the investment provides a catalyst for investment to upgrade the access network. It is important for a Managing Authority to ensure that the new backhaul/core network is built using established technical standards, to allow effective competition in the access network.

The example projects which included investment in the backhaul and core network were:

- **OnsNet, Nuenen, Netherlands:** included a backhaul connection for the FTTH network to a nearby university
- **DORSAL, France:** included a 1200km fibre-optic backbone to support the investment in the access network
- **Midtsoenderjylland, Denmark:** included a fibre ring between four city halls (this was subsequently used by a co-operative electricity company to connect to FTTH)
- **eRegio, North Karelia, Finland:** built a backhaul network to within 2km of each home
- **Piemonte, Italy:** included the deployment of a new core network, and a new Internet exchange
- **RAIN project, Lithuania:** deployed a nationwide backhaul and core network to provide improved connectivity to existing access infrastructure.

Further details of these example projects can be found in Annex D.

4.4 Other factors to consider when assessing possible network architectures

There are a number of other factors which it is important for a Managing Authority to consider when choosing network architecture.

Technical expertise Technical experts should be involved early in the design process.

- In the Midtsoenderjylland project in Denmark, the municipalities made their first “fibre master plan”, designed by the Centre for Network Planning at Aalborg University, freely available. This master plan was a design of an optimal fibre network for the region, and where the fibre should be laid, with estimated savings of up to 25% compared to what had previously been planned. The fact that the municipalities made the plan and the methods from Aalborg University available to the electricity companies was seen as an important catalyst in the success of this project.

However, problems can occur when expertise is not used effectively:

- In the DORSAL project in France, the network operator had to install more wireless transmitters than planned. The Managing Authority was protected from the additional cost as the network operator had agreed to bear such risks.

*Technology
obsolescence*

Technology obsolescence is a common issue in telecoms, as technologies are constantly evolving.

- In terms of the **choice between copper- and fibre-based technologies**, the DORSAL project has already implemented one upgrade and any future project would potentially require substantial funds, and probably funding from the EU.
- In terms of the **choice between fibre technologies (FTTC vs. FTTH)**: it is difficult to know which solution is appropriate, as even operators in well developed markets like the USA have adopted different strategies (e.g. Verizon is pursuing an FTTH strategy, while AT&T is deploying FTTC).

*Minimising
adoption barriers*

Public broadband investments should be structured to minimise the barriers to adoption for both end users and service providers – to ensure that services are available and people actually use them. For service providers it is important to define operational areas of an appropriate size: if there are too many small areas this may impose a large burden on service providers that tender for all of the projects; conversely, too few large areas may make it difficult for an operator to create a viable business if those areas include large proportions of low-density users. Barriers for end users can include the cost and accessibility of services. Deploying the right infrastructure and promoting effective competition can help to minimise cost, while developing new services that (for example) do not require the use of a PC can ensure that services are accessible.

5 How should I invest?

Understand the merits of each investment model and what might work best for you



In this section we present five investment models which we believe have potential for use for broadband projects in Europe. The models are shown in Figure 5.1.

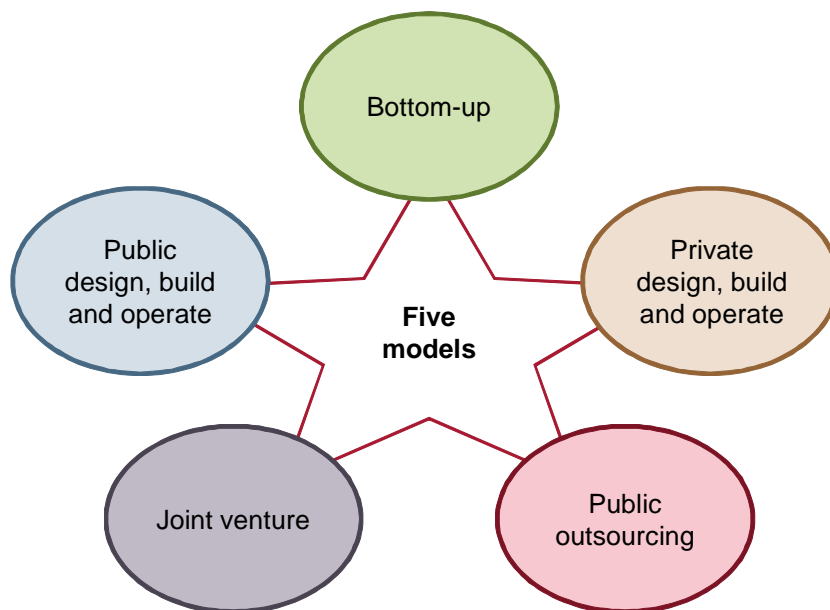


Figure 5.1: Summary of available investment models [Source: Analysys Mason]

There is no single model that suits every situation, and a Managing Authority must consider the pros and cons of each model and how it might fit the Authority’s current situation. This guide therefore presents the merits of each model to enable an Authority to make an informed choice.

Due to the large investment required in deploying broadband networks, public investment of some kind will often be required (and this is more likely in rural areas). However, as discussed in Section 3.1, the long-term needs of individuals must be prioritised over the commercial aims of private partners. For this reason, a Managing Authority might favour those models which allow a higher degree of control over the operations of the project to ensure those long-term needs are met.

However, working with the private sector can bring a number of advantages, including invaluable expertise, and commercial discipline that can ensure that the project is delivered efficiently. A Managing Authority must consider private investment from both within and outside the telecoms sector, including operators, institutional investors, utilities, end users, content providers and

equipment providers. Furthermore, the involvement of large-scale private telecoms operators can help to ensure the sustainability of the project, as their expertise and experience will prove invaluable in adapting to changes in the market or embracing technological developments.

Therefore it is essential for a Managing Authority to engage with potential private partners at an early stage of the procurement planning process to gauge their appetite for different investment models.

5.1 Bottom-up model

The bottom-up, or local community, model involves a group of end users (comprising local residents and/or businesses) organising themselves into a jointly owned and democratically controlled organisational group (frequently a co-operative) capable of overseeing the contract to build their own local network. In this model it is likely that the public sector has no role in owning or running the project, but rather passes the funding to the group itself to oversee the investment project. Given the composition of the local group it is likely that the day-to-day running of the network will be outsourced to a telecoms operator with the necessary expertise.

We have identified example projects which have implemented bottom-up models from both a local point of view, and also as part of larger-scale (regional) initiatives. Bottom-up funded projects tend to be of a smaller scale than projects that use the other funding models outlined below.

Advantages of bottom-up model

- As the investment is generally undertaken by non-profit organisations comprising end users, it is usually considered on a long-term basis and so high-bandwidth infrastructure (such as fibre to the home) can be deployed which provides the highest level of future-proofing.
- Co-operative organisations have the effect of generating and aggregating demand in an area, which ensures that maximum social benefit is derived from the investment, even if only a small amount of funding is available.

Disadvantages of bottom-up model

- This approach may not be suited to providing widespread coverage, as individual projects can be very localised. This may mean that some areas are missed out and those networks that are built have differing technical standards, which may mean that competition from other operators is limited.
- The co-operative/partnership organisations are unlikely to have specific telecoms network expertise, and so high-cost 'turnkey' solutions may be required.

- If the funding is to come from the end users themselves, then producing this funding upfront may create a barrier. In this case, the public sector can help by guaranteeing or underwriting loans.

Overall, the bottom-up model should be used for targeting localised areas and for gaining the most benefit from small amounts of funding.

Below we provide illustrations of how the bottom-up model has been used by some of the example projects.

- **OnsNet, Nuenen, Netherlands:** the bottom-up approach included a six-week demand aggregation scheme and free services for the first year
- **Rural Development Programme, Sweden:** end users provided investment (either financial or 'in kind') to attract additional bottom-up investment
- **eRegio, North Karelia, Finland:** end users provided the investment, and demand often did not materialise until the network deployment reached their premises.

Further details of these example projects can be found in Annex E.

5.2 Private design, build and operate (DBO) model

The private design, build and operate (DBO) model involves a private sector organisation receiving some level of public funding (often a grant) to assist in its deployment of a new network offering open wholesale access. Critically, in this model, the public sector has no specific role in the ownership or running of the network, but it may impose obligations relating to either of these in return for the funding.

Advantages of private DBO model

- It is more suitable for funding widespread deployments than the bottom-up model, as the public funding (grant) can be given to an established commercial operator to deploy and operate the network.
- It imposes only a limited burden on the public sector, which is not involved in running the network. This in turn can lead to faster deployments than other funding models.
- It has a number of advantages for the private operator, particularly because ownership of the network assets is likely to prove valuable in the long term.

Disadvantages of private DBO model

- It is essential that the available funding is sufficient to attract interest from private operators, as significant funding may be required to make a viable business case for deployment, especially in rural areas.

- As the Managing Authority has limited on-going control, the social benefit that the public sector is looking to create may be restricted if the private operator has little interest in delivering social benefit and instead focuses on generating a financial return (although this can be offset by the terms of the agreement).

The private operator will be exposed to more risk in this model; in other models (where the public sector continues to have more of a stake), the private entity continues to share some portion of financial exposure with the public sector throughout the project. An additional risk premium will be included by potential private partners when they determine the funding requirements for the project.

Overall, the private DBO model should be used for larger-scale investments than the bottom-up model, where sufficient funding is available to attract interest from operators to work in rural areas, and where the operations (and risk) of the network can be effectively transferred to an operator with little on-going control from the Managing Authority.

The private DBO model has been used by one of the example projects:

- **eRegio, North Karelia, Finland** (and its successor **Broadband for all in Eastern and Northern Finland**): a grant was used to fund the backhaul and core network serving the FTTH network built using a bottom-up model. The grant provided for the eRegio project was only sufficient to attract interest from a single local operator.

Further details of this project can be found in Annex E.

5.3 Public outsourcing

Under a public outsourcing model a single contract is awarded to a private sector organisation, covering all aspects of the design or construction of the network. The major characteristic of this model is that the network is built and operated by the private sector, but the public sector retains ownership and some control of the network.

Advantages of public outsourcing model

- It is able to leverage the stability of the Managing Authority, and the commercial and technical acumen of the private sector on an on-going basis.
- The public sector retains ownership of, and a large degree of control over, the network infrastructure.

Disadvantages of public outsourcing model

- Next-generation broadband networks can typically take 10 to 15 years or more to achieve a return on investment, and the fact that public network outsourcing agreements typically revert

to public operational control after 10 or 20 years (or at least must be outsourced again under a new contract) could reduce the incentive for some private companies to invest.

- The outsourcing relationship can create an added layer of bureaucracy between the private operator and the Managing Authority.
- Depending on whether the public outsourcing arrangement is facilitated by a legal framework, the provisions of that framework may impose unfavourable constraints on the operation of the project (e.g. constraining investment in the future).

Overall, the public outsourcing model should be used for widespread deployments where the Managing Authority requires a high level of control over the network, and where the private operator prefers the risk profile of greater financial stability but a lower potential return than that offered by the private DBO model.

Three of the example projects featured the public outsourcing model:

- **DORSAL, France:** undertook the investment within a legal framework which facilitated outsourcing of the network build and operations to a single operator by a collective of local authorities. While the legal framework was effective in allowing the separate organisations to procure together (and so realise economies of scale) it also includes provisions which can be restrictive (for example, limiting the amount that can be reinvested to provide capacity upgrades)
- **Auvergne, France:** chose the public outsourcing model to address a market failure, leverage the technical expertise of the private operator, and make effective use of public funds to provide services to commercially unviable sparsely populated areas
- **Digital Region, South Yorkshire, UK:** included a slight variation on this model. The network build was entirely publicly funded (due to a lack of commercial interest), but the operating company is a joint undertaking between the local Managing Authorities and the private consortium that built and operates the network. A revenue share arrangement is in place for any returns from the network.

Further details of these projects can be found in Annex E.

5.4 Joint venture

A joint venture is any agreement where ownership of the network is split between the public and private sector. Construction and operational functions are likely to be undertaken by a private sector organisation.

Advantages of joint venture model

- A joint venture has a number of advantages over a public outsourcing arrangement (as described in Section 5.3 above), as both parties are able to maintain a long-term financial stake in the network. Some Managing Authorities may be reluctant to relinquish full ownership of the network as they may see long-term strategic value in owning the assets.
- The joint venture model offers the ability to broadly balance the interests of the public and private sectors and also balance the sharing of risk. Indeed some forms of joint venture have required the private partner to increase its stake in the project when certain key performance indicators are achieved (such as take-up), which represents a form of risk-sharing arrangement.
- This model often features the creation of special-purpose vehicles (SPVs). These SPVs can be of almost any size, which makes the model very scalable (i.e. from local communities to sub-national regions). The SPV mechanism also allows investment to be gathered from comparatively innovative sources, such as institutional investors.

Disadvantages of joint venture model

- With two stakeholders in the network each with different interests, it may be difficult to align those interests and set up and/or continue the operation of the joint venture.

Overall, the joint venture model should be used only where the interests of the public and private sectors can be closely aligned. Indeed, in our review of the example projects, we were unable to identify any existing formal joint venture arrangements. The Lombardia project in Italy is proposing an innovative model of sharing ownership between the Managing Authority, institutional investor and other public and private partners, but the project has not yet been implemented.

However, there are some examples where particular elements of a project were undertaken in a collaborative sense. These examples of partnering are summarised below, as they reflect the spirit of the joint venture model.

The partnering ideas below may be useful for attracting investment from other industries – for example, from utilities for investment in access infrastructure, or from media and technology companies for investment in services.

- **Lombardia, Italy:** although not yet in deployment, this project is proposing an innovative structure involving SPVs, whereby investment can be sought from a number of sources
- **Midtsoenderjylland, Denmark:** included an agreement between the Managing Authority and a local co-operative electricity company to deploy the network
- **Piemonte, Italy:** included an agreement between the Managing Authority and the incumbent to deploy new infrastructure in return for investment in new services. The project also

included a public–private partnership arrangement for the operation of a new Internet exchange

- **Digital Region, South Yorkshire, UK:** includes a profit sharing arrangement between the Managing Authority and the network operator.

Further details of these example projects can be found in Annex E.

5.5 Public design, build and operate (DBO) model

A public DBO model involves the Managing Authority operating without any private sector intervention, except at a service provider level (involving either wholesale or retail service providers). All aspects of network deployment and operation are managed by the public sector. A network company is formed by the Managing Authority and typically offers wholesale services, with the potential to offer retail services (although this is not common).

Advantages of public DBO model

- This model allows the Managing Authority to retain control of the network and may have benefits such as: ensuring that social capital targets are given a high priority, ensuring that there are no conflicts of interest in achieving effective competition, and enforcing common technical standards.
- This model is also suitable when the Managing Authority does not have confidence in the available legal mechanisms (e.g. competition regulations) for ensuring effective competition.

Disadvantages of public DBO model

- Sole ownership of the network by the Managing Authority increases its exposure to the risk of a failed venture. Organisations set up in this manner may struggle to meet targets (e.g. for coverage and take-up), which may be due to a lack of commercial and technical expertise (which few public sector organisations possess). The public will be aware that its money is being spent, and if any failings receive substantial publicity this could result in a loss of confidence in the project.
- Networks deployed under this model may be limited in size and scope due to the finite amount of expertise held within the Managing Authority. Therefore the ability for investment under this model to provide widespread network coverage may be reliant upon the network providing a catalyst for other investments.
- The model may potentially exclude certain aspects of private sector expertise, which could be valuable in ensuring the efficient deployment and operation of the network. More broadly, this model does not exploit the economies of scale and scope that private sector operators can bring.

Overall, the public DBO model should be used where a Managing Authority needs to have absolute control over the operations of the network (perhaps to ensure competition), or where the Managing Authority is confident that a targeted public DBO investment will inspire investment from other sources.

Although examples of the public DBO investment model can be found across Europe, its primary use appears to be for relatively small-scale deployments (e.g. those confined to a single city or to provide core/backhaul connections between different towns).

Five of the example projects featured the public DBO model:

- **Midtsoenderjylland, Denmark:** to connect four city halls together (although this network was used by an electricity company to backhaul a fibre-based access network)
- **Piemonte, Italy:** to invest in a variety of small broadband projects, including a new Internet exchange, a regional backbone, some dark fibre, a public-only wireless network and new services
- **RAIN project, Lithuania:** to ensure absolute control of (and therefore promote effective competition on) a new national backhaul and core network
- **STOKAB, Sweden:** to provide dark fibre on an equal basis to any customer, through a management company set up by the city. The company uses framework contracts to procure services on an on-going basis
- **Alto Adige, Italy:** the local authority is fully funding a project which will use a combination of wireless and wireline networks to link local homes and businesses.

Further details of all of these projects can be found in Annex E.

6 How do I manage/monitor the outcome?

**Ensure successful delivery and operation,
and provide evidence for audit**



This section looks at various methods by which a Managing Authority can monitor/manage public broadband projects and their appropriateness for different situations. Where possible, the information presented below is based on how various levels of monitoring and governance mechanisms have been used in practice.

6.1 Why are period monitoring and management so important?

It is essential for a Managing Authority to implement effective governance mechanisms. 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 to Member States, so that funding continues to be provided for this type of activity.

6.2 What are the characteristics of the monitoring undertaken by different organisations?

Periodic monitoring can be undertaken by public organisations with varying remits, as discussed below. The monitoring is usually conducted by the Managing Authority undertaking the project (whoever that may be). This section is not intended to guide the Managing Authority in making a choice between the options below, but rather to provide an overview of the constraints that it may experience, depending on its management remit.

Monitoring by the local group (or co-operative)

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. However, a small monitoring organisation may not have the financial or political strength to maintain effective monitoring of the project, as illustrated by the Nuenen example below.

OnsNet, Nuenen, Netherlands

95% of the network is owned by the co-operative and 5% by the construction company (but the construction company has full voting control). This ownership split was not originally planned but occurred due to financial complications during the project.

Overall oversight of the project was intended to be undertaken by the board of the co-operative. Now, however, due to the ownership structure of the co-operative, the board has limited oversight of the project. No monitoring is done by the government or municipalities, and there has been no government involvement in the project beyond the initial money given.

Monitoring by regional municipalities (or a syndicate group on their behalf)

Monitoring by regional or municipal public bodies can bring greater financial or political strength to the monitoring activity. However, as the public body is further removed from the project, there is likely to be a need for a formal process whereby the operating organisation reports to the regional municipality on a regular basis, as illustrated by the DORSAL example below.

DORSAL, France

In order to ensure compliance with the two-year construction timetable, a technical committee was created to oversee the progress of the project. In addition, a representative from Axion/Sogetrel would provide monthly updates on the state of the project to representatives from the local authorities which make up the DORSAL collective. DORSAL publishes an annual report which captures all the activity on the project, specifies the use of funds and provides additional insight. A third party audited the project to ensure that funds were used appropriately.

Monitoring by a central government body

Finally, a project may be monitored by a central government body. This situation has the advantage that the monitoring body has a greater awareness of the high-level objectives of any national broadband policy, and may also have strong links to the market-specific expertise of the regulator. However, despite a central government body having responsibility for all broadband operations in the country, its formal monitoring remit is likely to be limited to those projects which have benefited from public sector investment.

Rural Development Programme, Sweden

The majority of investments are monitored at the county level. Investment has to be used as specified in the application for a period of five years following the project (this is monitored by the Board of Agriculture). There is also a condition of open access imposed on all the projects. Approximately 5% of projects are being monitored/controlled by the Board of Agriculture to ensure the above conditions, as this is the proportion of broadband projects which have received public sector investment.

For all monitoring organisations, monitoring requirements could be set out in the contract with the network supplier, with obligations possibly linked to the payment of public money (e.g. roll-out milestones, 'ready for service' (RFS) dates, Internet service providers (ISPs) signed up, customers connected).

A government body (likely to be the Managing Authority) could hold such a contract, but we are not aware of any examples of a regulator being party to a contract like this. It should be noted that any measures that a regulator may apply (such as penalties and remedies) are separate and determined by the regulator itself, and so do not need to be duplicated in any contract with a network supplier. In other words, the investment contract provides ‘project-specific’ monitoring, while the regulator provides ‘market’ monitoring.

6.3 What commercial aspects need to be monitored?

There are a number of options for monitoring the commercial aspects of a broadband investment project, as outlined below.

Milestone and deployment controls

Milestone bonuses and penalty payments are a form of control over network deployment. Payments are linked to specific deliverables or achievement of a roll-out plan or wholesale take-up by ISPs or take-up by end users. Another link to milestones is widespread publication of RFS dates. Public relations announcements of this type could be stipulated as part of a deployment contract.

It may be necessary to include payment profiles (i.e. schedules for paying the organisations responsible for building the network) as part of this type of monitoring, which set out how the bonuses and penalties should adapt to changing market conditions during roll-out. For example, if Supplier A is awarded public funding, but partway through the project Supplier B decides to extend its roll-out to areas targeted for public funding, the payment profile may need to be adjusted (because Supplier A is less likely to reach the take-up levels it expected at the start of the project).

It is good practice for Managing Authorities to use milestones and deployment controls to ensure that the roll-out goes according to plan.

Price benchmarking and clawback mechanisms

The *Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks*³³ set out two important commercial considerations for Managing Authorities to ensure State aid compliance. With respect to a *benchmarking pricing exercise*, the Guidelines state:

³³ Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:235:0007:0025:EN:PDF>

In order to ensure effective wholesale access and to minimise potential distortion of competition, it is crucial to avoid excessive wholesale prices or, by contrast, predatory pricing or price squeezes by the selected bidder. Access wholesale prices should be based on the average published (regulated) wholesale prices that prevail in other comparable, more competitive areas of the country or the Community or, in the absence of such published prices, on prices already set or approved by the NRA for the markets and services concerned. Thus, where ex ante regulation is already in place (i.e., in a grey area) wholesale prices for access to a subsidised infrastructure should not be lower than the access price set by the NRA for the same area. Benchmarking is an important safeguard since it enables Member States to avoid having to set in advance detailed retail or wholesale access prices, as well as to ensure that the aid granted will serve to replicate market conditions like those prevailing in other competitive broadband markets. The benchmarking criteria should be clearly indicated in the tender documents.

With respect to a *clawback mechanism to avoid over-compensation*, the following text is included in the Guidelines:

To ensure that the selected bidder is not over-compensated if demand for broadband in the target area grows beyond anticipated levels, Member States should include a reverse payment mechanism into the contract with the successful bidder. The provision of such a mechanism can minimise ex post and retroactively the amount of aid deemed initially to have been necessary.

Further guidance on the issues surrounding tender documents and selecting bidders can be found in Section 9.

6.4 What non-commercial aspects need to be monitored?

There are also non-commercial aspects of a project that should be monitored that a Managing Authority must monitor, as outlined below.

Ensuring that open-access principles are maintained

It is a key principle of State aid guidelines that publicly funded broadband projects must use an open-access model. This model helps to promote 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.

The majority of example projects involving public funding included requirements for mandatory non-discriminatory wholesale open access. For example, in the Midtsoenderjylland project “*The agreement to rent the dark fibres had to be priced at the accepted market level as it was against Danish law to disturb the market by subsidising FTTH, or preferring one company to another*”,

and in the Swedish Rural Development Programme “*There is also a condition of open access imposed on all the projects. Approximately 5% of projects are monitored/controlled by the Board of Agriculture*”.

Monitoring of operational metrics

The metrics below represent some of the operational aspects that a Managing Authority should consider monitoring on at least an annual basis, to ensure that wholesale and retail users are receiving a service which is fit for purpose, and overall usage of the network is progressing according to plan. The metrics below are based on the annual report that is issued by the network operator to the Managing Authority on the DORSAL project.

<i>Operational readiness</i>	The Managing 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.
<i>Fault occurrence</i>	The Managing 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.
<i>Maintenance</i>	The Managing 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 preventative maintenance, the Managing Authority should look to ensure that this is done at a time when it will cause least disruption to customers.
<i>Network take-up</i>	The Managing 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 Managing Authority should also separately monitor that these activities are taking place (in addition to monitoring the resultant take-up).
<i>Network performance</i>	The Managing 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.

6.5 What governance mechanisms are available?

From the example projects, we have observed a broad spectrum of options for a Managing Authority to influence the decision making on a project, as discussed below. The choice of governance mechanism will tend to be guided by the choice of investment model, but a Managing Authority needs to be aware of the different options.

Full ownership and control by a public body

If the network infrastructure is fully owned and operated by the Managing Authority, then the Authority has full control over any decision making. However, this approach may require a separate public organisation to be set up that has the appropriate network operating skills. In addition, on larger projects, the lack of involvement from commercial operators may make it difficult to align operation of the broadband network with the needs of the market.

Midtsoenderjylland, Denmark

The backbone network was owned and operated by the municipality – with a repair contract taken out with an external company. The fibre used by the public network is seen as part of the municipalities' ICT networks and so is looked after by the municipalities' ICT administrators, to ensure they have control over how it is used.

RAIN, Lithuania

A 'Joint Activity Partnership Agreement' was made between the Ministry of Transport and Communications (MTC) and PEPI. The MTC agreed to undertake the project application, collection of funds, and participation in the Supervisory Committee (SC).

The SC supervises implementation of the project, work timeliness, achievement of planned results, assesses the project's long-term impact and encourages the distribution of the project's results. The SC gives guidance on the project's activities and implementation. The SC was created by the minister of Transport and Communications and consists of representatives of ministries, local governance authorities, educational establishments, etc. The Supervisory Committee meets at least once a quarter.

A public-only board or small SPV which oversees all decision making

An alternative approach is to have a board of public body stakeholders or a small special-purpose vehicle (SPV) 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. However, caution must be exercised with this approach, to avoid a situation where too many layers of bureaucracy cause project delays.

Digital Region, South Yorkshire, UK

Originally a management team sat underneath the board, to oversee contact with the network operator, Thales, who in turn managed any sub-contractors. Now Digital Region and Thales form a joint team at management level. This collaborative approach has speeded processes up by removing a layer of bureaucracy.

A mixed ownership model with the public sector maintaining a majority stake

A variant of the public-only board is to have a mixed board of public and private stakeholders. In this way, the public sector has the opportunity to maintain control with a majority stake (e.g. 51%) but the private sector can exert significant influence on the running of the project.

Piemonte, Italy

In Piemonte, the public body invited the private sector to control 49% of the newly built Internet exchange, allowing the private sector to help manage the project (while keeping ultimate control in the public sector) and thus give the impression of working with, rather than against, the market.

Alternative methods of influence

Finally, governance can be exercised through alternative methods of influence. This approach may be necessary when no formal governance arrangement is possible between the Managing Authority and the network operating organisation. However, even in these circumstances the Managing Authority is still able to monitor activity on the project, and refer any undesirable activity to another enforcing body (e.g. the regulator).

North Karelia, Finland

The telecoms company that wins each project has to guarantee 30 years of service on the network. One of the Regional Council's jobs is to check that the network is running in accordance with the agreement, though it has no specific tools to use in this task. The majority of monitoring comes through customer feedback. When problems are highlighted, a flag is raised with the Finnish regulator (FICORA) to apply penalties.

7 What can be done to ensure demand for services?

Understand the commercial case and your potential role on the demand side



This section considers the importance of the demand for services in the context of network investment by a Managing Authority. We look at two key issues – *understanding* demand and *encouraging* demand to reach the levels needed to make an investment deliver the required socio-economic benefits.

Details of the initiatives to foster demand from the example projects can be found in Annex F.

7.1 How do I understand the level of demand?

Understanding the current level of demand for broadband technology and services within an area should be a fundamental consideration when a Managing Authority is planning a broadband network investment.

One critical success factor for completion of a broadband project is that the project must be initiated at a time that is appropriate, given the prevailing balance of supply and demand.

Our research has shown that investments involving demand-side initiatives tend to reach break-even relatively quickly (the OnsNet, Nuenen project in the Netherlands providing a good example of this). Many of the project interviews highlighted the importance of the current understanding of demand held by the private telecoms operators. Given that most of the investment models involve some level of interaction with operators, this is also an issue for the Managing Authority. It is possible that if the telecoms operator has a good understanding of the demand, it may be willing to accept a transfer of risk from the public body (as is the case, for example, in French DSP agreements³⁴).

Having established the importance of understanding demand, some example projects also identified various difficulties associated with its measurement. For example, the stakeholders in the Rural Development Programme in Sweden were not fully aware of the true demand at the start of the project, and North Karelia's new project is having measurement difficulties due to variability of the price estimates used to gauge interest from end users. In many cases, new demand is also created once a new network has been built and it is demonstrated that services are of interest to end users. This effect was seen in the North Karelia project, for example.

³⁴ Délégation de Service Public (a model set by French law under which a private actor is granted the opportunity to manage public services by a public body).

Even projects which undertook demand analysis before they began have been affected by the fact that demand changes over time, especially given the rapid pace of developments in the telecoms industry. An example of this evolution of demand is provided by the DORSAL project in France, which reported that users were soon demanding higher speeds and capacities.

In some of the example projects both the Managing Authorities and the telecoms operators perceived there to be a low level of demand initially. Indeed, this perception of low demand was one reason why private investors had previously shown little interest in the areas concerned (and hence created the need for an intervention). However, it is possible that the initial assessment of demand may not have reflected the real demand, due to one of the following factors:

- Managing Authorities may not have asked the right questions (e.g. if people with low levels of IT literacy are asked about their interest in technologies they do not understand, they may not be able to indicate their true level of demand as they have not actually seen the technologies in operation)
- The initial demand may be truly latent, and so not even be apparent to the population itself until it is stimulated through a development such as the introduction of a new service.

If the real level of demand is low, projects can benefit from demand aggregation or stimulation, as discussed in the next section.

7.2 How can I ensure that the required level of demand is reached?

Demand aggregation and stimulation schemes are likely to be important in ensuring the success of a broadband investment project, and so must be considered by a Managing Authority. The schemes should ideally be structured to include an element of commitment from users, since this helps to give the Managing Authority and operator(s) confidence that benefits can be derived from the significant investments required for a new network. Furthermore, once the investment has been made, it may act as a catalyst in revealing latent demand or generating additional investment. These issues are discussed below.

Demand registration and aggregation

With first-generation broadband, demand registration schemes were rather like an ‘expression of interest’ with no firm commitment. In contrast, the demand registration schemes seen to date for next-generation broadband have all involved consumers making a contractual commitment to take a service several months before that service becomes available.

The aggregation of commitment (and demand) from urban and rural areas allows costs to be shared across both, which can help to ensure a feasible business case for investment in rural areas that would otherwise be impossible to achieve. In this case the urban areas are effectively subsidising the rural, as was the case in the OnsNet project in Nuenen.

Demand stimulation

In order to stimulate the greatest possible increase in demand, a Managing Authority must consider two interlinked factors.

- **Creation of new services requiring broadband.** A Managing Authority can create demand by producing useful services that people will use, especially where the technology is used to achieve goals that would not have been possible over previous networks. A good example of this was the creation of alternative customer premises equipment in the Piemonte project, so that elderly people could use services without knowing how to use a PC. While this adds complexity to a project, it should be viewed as providing very useful additional value to a broadband investment project. Furthermore, a Managing Authority may have good contacts with other organisations that can assist in the development of new services. For example, a public body can work with local universities to develop e-teaching services, or can work with local hospitals to develop e-health services (again as demonstrated in the Piemonte project, where the incumbent offered to upgrade multiple exchanges in return for a similar value of service product creation).
- **Marketing of the uses of broadband.** As well as making services available, it is also essential to advertise them to the local people, to ensure that they are aware of their existence. One of the main points of feedback from the OnsNet (Nuenen) project, which undertook a successful marketing campaign, is that a project should not try to sell its advanced *technology* but rather advertise itself as a *service* – especially when dealing with elderly members of the population.

In addition, demand stimulation should be timed so that it coincides with an increase in supply, whether from the private sector or from any form of supply stimulation. A Managing Authority should also recognise the impact that a strong community-based dimension can have on a localised intervention. Local interest can also be increased through local demand stimulation initiatives; for example, the OnsNet (Nuenen) project provided a one-year free period for users who signed up to the project. Of course such a promotion will have an inevitable short-term financial impact on the project.

Catalyst effects

One of the key outcomes from many of the example projects is that the investment project itself can act as a catalyst that stimulates demand. This can happen in one of two ways:

- **A project's technology or services may inspire latent demand.** This is especially true where the initial demand has been underestimated due to latent demand that only emerges once people see their friends and family using the technology and services. Although this could mean inspiring demand at the beginning of the project (as in the North Karelia example), it is also possible to inspire demand for *future* projects (as was the case in the Rural Development Programme in Sweden).

- **Public infrastructure development may overcome private investment inertia.** As discussed earlier (see page 26 above), a new infrastructure project can frequently act as a catalyst in dispelling investment inertia, helping to attract private sector investment as the project develops. As a result, either the cost of the project to the public can fall or the scope of the project can be expanded. Examples of this are provided by the Piemonte project in Italy (where the incumbent changed its investment attitude towards the region), and the Midtsoenderjylland project in Denmark (where initial public investment helped to stimulate the local electricity company into undertaking a large investment).

8 What can be done to reduce the cost and manage risks?

Include measures to reduce costs and manage risks



8.1 Introduction

Deploying broadband infrastructure is an inherently expensive undertaking, and any measures to reduce the cost of the deployment can help to make public funds go further, make business cases more attractive to private operators, and generally maximise the social and economic impact of the investment.

8.2 Measures to reduce costs

A key source of cost savings measure is the re-use of existing infrastructure. For example, if existing ducts can be re-used this avoids the hugely expensive activity of digging new trenches when installing fibre infrastructure. Some of the example projects were able to use existing ducts to avoid digging new trenches (e.g. the DORSAL and Midtsoenderjylland projects used the duct of existing utility providers to deploy new fibre connections). However, in the case of Nuenen, the use of existing duct was discounted due to the time and effort it would have required to negotiate access.

In such circumstances, the Managing Authority can play a role in facilitating access to ducts, especially if there are other public organisations with duct holdings that could be persuaded to support the Authority's broad socio-economic aims. For example, in the STOKAB example project the Managing Authority sought to co-ordinate its network installation with other civil works by other utilities. The State aid guidelines³⁵ recommend that if a Managing Authority decides to undertake some civil works (such as the construction of new ducts) in order to enable and accelerate the deployment of infrastructure by operators, then such civil works should not be "industry or sector specific". In principle, the civil works should be open to all potential users and not just electronic communications operators (i.e. also open to electricity, gas and water utilities, etc.).

The Broadband Communication from DG INFSO³⁶ also includes a number of other measures to reduce the costs of broadband deployment:

³⁵ Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks, available at <http://www.broadband-europe.eu/Pages/DocumentDetail.aspx?ItemID=72>

³⁶ Broadband Communication from DG INFSO, available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0472:FIN:EN:PDF>

- Making the installation of new passive infrastructure and in-building wiring a requirement for planning authorisations.
- Encouraging local authorities and regulators to use their powers to require the disclosure of the existence and condition of local access infrastructure from operators, with the aim of stimulating competition. In particular, national regulators should use their powers under Directive 2002/21/EC to obtain all relevant information on the location, capacity and availability of ducts and other local loop facilities, to give alternative operators the opportunity to deploy their fibre networks at the same time as incumbents, and share the costs of civil engineering works.
- Co-ordinating civil works (such as digging and the construction of ducts) to enable and streamline the deployment of network elements.
- Provision of general powers for the acquisition of rights of way by streamlining laws and regulations concerning civil works, town planning, environment, public health and general administration to simplify and accelerate procedures (e.g. for granting rights of way or mast planning), if necessary by establishing a one-stop shop for these purposes.
- Planning authorities could also reduce the investment cost for the roll-out of wireless broadband, by removing administrative obstacles (e.g. difficulties in obtaining permission for new base stations or in renewing contracts for existing ones).

An arrangement whereby a Managing Authority can facilitate discussions with planning authorities to enable the smooth deployment of the network was observed on the Digital Region project in South Yorkshire, UK. This was also seen on a more localised basis in the Midtsoenderjylland, Denmark project, whereby the co-operative based funding model facilitated access to end users' property for network deployment.

8.3 Measures to manage risks

When designing public broadband investments, careful consideration should be given to potential market developments that may lead to the infrastructure being superseded by other technologies. For this reason, contracts should be structured so that they can react to significant changes in take-up, pricing or wholesale product requirements. It is also important for a Managing Authority to arrange for thorough due diligence to be conducted as part of a project, to ensure that its plan is credible and will not be subject to significant delays, cost increases or other potential difficulties. A Managing Authority should ensure that it has access to the necessary skills, either internally or externally, to design interventions and identify any risks that could emerge in future.

An example of a project for which planning aimed to reduce costs and manage risks is the RAIN project in Lithuania:

RAIN, Lithuania

The following principles were followed in the planning of the network:

- 1 Cables only to be laid to areas where no other cables existed, with information on planned routes being provided to operators, allowing them to highlight any doubling of lines.
- 2 Ensure coverage of 98% of Lithuania and to knowledge centres (schools, libraries, Internet cafes, etc.).
- 3 Install fibre connection points in all settlements the line passes, allowing future connections to network
- 4 Fibre lines to terminate at locations agreed by the municipalities and the operators
- 5 Minimise the total distance of cable, while considering how to avoid natural obstacles (lakes etc.) and use protective zones such as those under roads.

A simultaneous network access project entitled “Creation of a Broadband Data Transmission Network in Lazdijai Region and Alytus Region Municipalities” (PDPT) and the infrastructure created during its implementation, were also taken into account when selecting fibre routes for the RAIN network. The towers built during the implementation of the PDPT project were connected to the RAIN network. In addition, the remaining unconnected infrastructure assets of other operators as well as establishments and organisations throughout the region were also connected to the RAIN network.

Operators provided PEPI³⁷ with information about the communications infrastructure that they managed to aid in planning of the fibre routes. In return, PEPI provides information about planned fibre routes to any interested parties, with precise information about planned lines (i.e. with co-ordinates) provided to parties who enter into a confidentiality agreement. Planned fibre routes are adjusted through working procedures upon receipt of operators’ comments on their future plans, including changes in the use of their infrastructure and other comments.

³⁷ Public Enterprise Plačiajuostis Internetas (PEPI), a state-founded non-profit public enterprise.

9 What are the next steps that need to be taken?

Contribute to hitting the DAE targets by using EU funds quickly and effectively



Figure 9.1 summarises the three key activity flows that follow preparation and planning of a broadband investment: EU funding application, procurement and delivery, and compliance with State aid regulations.

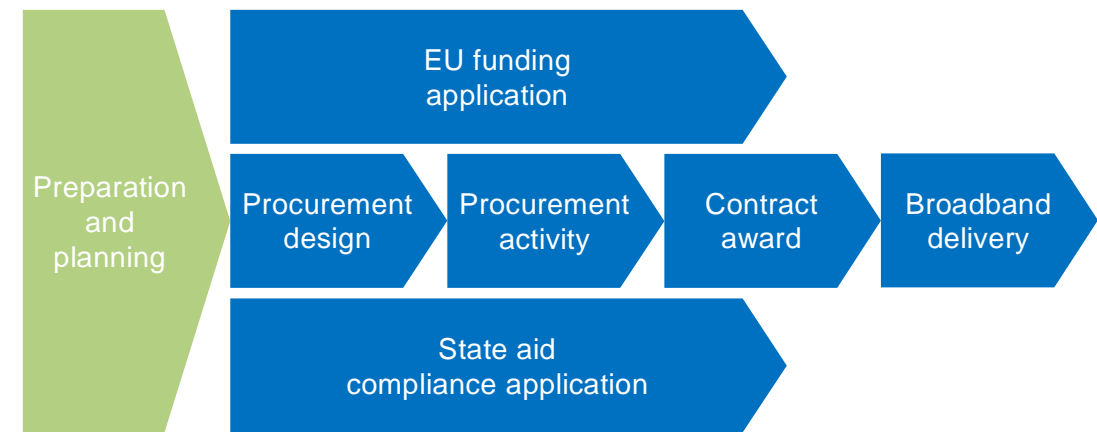


Figure 9.1: Next step activities [Source: Analysys Mason]

These three activity flows are carried out broadly in parallel. A summary description of each activity is provided below.

9.1 EU funding application

To complete an EU funding application, or any other relevant funding application, a Managing Authority will need to assess the funding application guidelines and application form(s), and ideally check there is a common understanding of the funding application requirements through meetings and dialogue with the funding body. For example, a constructive dialogue with the European Commission services, when necessary and before submitting the application, could prove useful.

9.1.1 Preparing the application

As guidance for preparing funding applications, there are two specific aspects to consider.

- **The application form is likely to require the completion of relevant, evidence-based quantitative and qualitative analysis** such as a cost–benefit analysis and a socio-economic analysis, to demonstrate the project will provide benefits, that project risks will be managed and the project will be sustainable.
- **It may be necessary to re-position the aims of the project so that it satisfies the funding body’s objectives.** For example, a project may be designed such that the outcome is delivery of broadband to residential and business premises, proposed by bidding suppliers to achieve market efficiencies and minimise intervention funding. However, the objectives of the ERDF stipulate that only businesses are eligible for funding. In this case, the funding application may need to demonstrate how State aid is designated for businesses only, even though the broadband roll-out includes delivery to residential premises. One approach could be to include a contractual mechanism that withholds release of State aid funding to the supplier until obligations associated with broadband delivery to businesses have been satisfied.

9.1.2 Timing of the application

Activities to prepare funding applications should begin in parallel with the procurement process, but the actual funding application, along with supporting details such as a cost–benefit analysis, cannot be fully developed and completed until the details of the solution and costs are available, which is only possible once the winning bidder(s) have been identified at the end of the procurement process. Only after the funding application has been approved is the Authority in a position to award the contract to the winning bidder(s).

9.1.3 Sources of EU funding

EU funding is distributed through a range of policies and financial instruments designed to satisfy the various objectives of the EU. A number of these are applicable to broadband projects, as summarised in Figure 9.2 below.

Broadband projects will often be funded using a variety of sources, and many of the financial instruments below can be used in combination. EU funding can also be combined with national or local sources of public sector funding, and should also aim to leverage private sector financing where possible, as discussed in Section 5.

The financial instruments summarised in Figure 9.2 are potential funding sources that were available at the time of writing, but this availability is subject to change and up-to-date information on EU funding should be sought at the time of application.

No.	Name	Description
1	European Regional Development Fund (ERDF)	<p>This fund has been made available by EC to strengthen economic and social cohesion in the EU by correcting imbalances between its regions. The ERDF can intervene in three objectives of regional policy:</p> <ul style="list-style-type: none"> • <i>Convergence</i> – focuses its intervention on modernising and diversifying economic structures, and safeguarding and creating sustainable jobs • <i>Regional competitiveness and employment</i> – prioritises innovation and the knowledge-based economy, environment and risk prevention, and access to transport and telecoms services • <i>European territorial co-operation</i> – focuses on development of economic and social cross-border activities, establishment and development of trans-national co-operation, and increasing the efficiency of regional policy through inter-regional promotion and co-operation <p>ERDF money is used for co-financing of project costs; therefore it should be supplemented by other funding sources, which may be from European, national or local government, or from the private sector.</p>
2	European Agricultural Fund for Rural Development (EAFRD)	<p>The EAFRD is designed to contribute to improving:</p> <ul style="list-style-type: none"> ▪ the competitiveness of agriculture and forestry; ▪ the environment and the countryside; and ▪ the quality of life and the management of economic activity in rural areas. <p>As part of this remit, a key objective is to encourage ICT development in rural areas. EAFRD money can be used for infrastructure investment, but also in development of services and IT businesses in rural areas, demand stimulation measures, and vocational training in ICT.</p> <p>EAFRD funding must be supplemented with other funding sources, which may be from national or local government, or from the private sector.</p> <p>Under the European Economic Recovery Plan, which was endorsed by the Council at its meeting on 11-12 December 2008, in total EUR 1.02 billion were made available for broadband in rural areas and new challenges as defined under the Common Agricultural Policy (CAP). This money was injected in the EAFRD. The programming that followed by Member States for injection of these funds into their total budgets, led to the provision of EUR 360 million solely for broadband investments in rural areas.</p>
3	European Social Fund (ESF)	<p>The ESF was set up to reduce differences in prosperity and living standards across Member States and regions, and thereby promote economic and social cohesion. The ESF is devoted to promoting employment in the EU, and helps Member States make Europe's workforce and companies better equipped to face new, global challenges. It contributes to projects that provide training, and helps businesses, communities and individuals to make the most of broadband and IT.</p>
4	Joint European Support for Sustainable Investment in City Areas (JESSICA)	<p>JESSICA is a joint initiative for financing sustainable urban development, operated by the EC in co-operation with the European Investment Bank (EIB) and the Council of Europe Development Bank (CEB). JESSICA aims to co-ordinate the approach of these bodies with the objective of providing financing for urban renewal and development actions as well as for social housing, using a combination of grants and loans. Under the new procedures, Member States have the option of using some of their EU grant funding to make repayable investments in projects that form part of an integrated plan for sustainable urban development. The investments can be equity, loans and/or guarantees, and are delivered to projects via Urban Development Funds and, if necessary, Holding Funds. The JESSICA initiative allows Managing Authorities the possibility of providing funding for public-private partnership or other urban development projects that are</p>

No.	Name	Description
		capable of repaying in the long term. JESSICA is also expected to attract contributions from international financial institutions, banks and the private sector, thereby achieving greater leverage from scarce grant resources.

Figure 9.2: *EU initiatives and financial instruments applicable to broadband projects [Source: Analysys Mason]*

Managing Authorities from Member States in Central and Eastern Europe should note that support is available to help them apply for and invest EU funds. JASPERS (Joint Assistance to Support Projects in European Regions) assists the 12 Central and Eastern EU Member States to prepare applications for grant financing for major projects, under the Structural and Cohesion Funds.

The aim is to increase the quantity and quality of projects that are sent for approval to the EC. JASPERS' assistance, which is provided free of charge, is geared towards accelerating absorption of the available funds³⁸.

9.2 State aid compliance

The key activities for achieving State aid compliance are associated with justifying the need for public intervention.

9.2.1 The need for State aid compliance

State aid compliance is not always required. The section below outlines the circumstances under which State aid compliance is and is not required.

No need for an individual State aid notification

There are four situations under which State aid is *not* required:

Project is viable on market terms If public funding is invested in a broadband project on terms that are in line with the market (i.e. in line with the market economy investor principle, MEIP), there is no need for State aid clearance.

The following conditions must be met:

- The investment of the Managing Authority shall be made under the same terms and conditions as the private investor
- The private operator shall have a significant share in the project
- The public investment is pursued on the basis of a commercially viable business plan.

If these conditions are met, the Managing Authority should implement the

³⁸ See <http://www.jaspers-europa-info.org/> for more information.

project in line with the EC's Amsterdam precedent decision (C53/2006).

Low level of aid If the aid amount is very low (less than EUR200 000), the aid will most likely fall under the *de minimis* threshold. However, discussion with national State aid authorities will be required to confirm this.

Public only network The broadband project will not constitute State aid if the network to be constructed will only serve the needs of public bodies (like libraries, police, cultural centres, etc.), and will not be open for exploitation by commercial operators.

However, if spare capacity on the network will be offered to third-party operators, State aid clearance will be needed.

Implementation under a national framework scheme If the broadband project is to be implemented under a national framework scheme that has already received State aid clearance, then no separate clearance is needed, even though State aid is being used.

The Managing Authority needs to ensure that the project is implemented according to the conditions of the relevant framework scheme.

A State aid notification is required

If none of the above conditions is met, an individual State aid notification will be required to the EC. It is advisable for all granting authorities to begin by submitting a State aid pre-notification paper.

9.2.2 Achieving State aid compliance

A Managing Authority should, ideally, prepare a State aid pre-notification paper in consultation with the relevant government department.

In addition to describing the project objectives and approach in the State aid pre-notification paper the Authority will need to gather evidence about the broadband demand and supply situation in the localities of interest for the project:

- An Authority can prepare evidence of demand for broadband by conducting local surveys and referencing other surveys conducted on a larger (e.g. national) scale.
- For the supply-side perspective, an Authority will need to prepare *maps of current infrastructure* and a *coverage forecast analysis* of the likely broadband supply situation for a minimum of three years into the future.

With respect to *detailed mapping and coverage analysis* for the supply side, the State aid guidelines for broadband include the following³⁹:

Member States should clearly identify which geographic areas will be covered by the support measure in question. By conducting in parallel an analysis of the competitive conditions and structure prevailing in the given area and consulting with all stakeholders affected by the relevant measure, Member States minimise distortions of competition with existing providers and with those who already have investment plans for the near future and enable these investors to plan their activities. A detailed mapping exercise and a thorough consultation exercise ensure accordingly not only a high degree of transparency but serve also as an essential tool for defining the existence of “white”, “grey” and “black” zones⁴⁰.

The results of the mapping must be validated via a public consultation in which the project plans are published on a suitable webpage. The Managing Authority must leave sufficient time (a minimum of one month) to allow commercial operators to comment on whether they have credible investment plans in the area concerned.

Mapping of both current infrastructure and future investment in infrastructure provides important information for the broadband investment. However, it should be noted that the Managing Authority must also map the service requirement of the target area or territory. The requirements for the broadband investment will be defined by the gap between:

- What is currently available from the commercial sector (or will become available within a short timeframe, currently defined as three years), and
- The needs of users seen from a mid-/long-term perspective, taking into account both the need to ensure that the investment is future proof and EU and national objectives.

Beyond the mapping requirement, other inputs used to prepare the State aid pre-notification and formal notification papers are derived from the project design, the procurement requirements specifications and the responses from bidders during the procurement process. In particular, the requirements specifications and questions posed during the procurement should be developed to help satisfy the EC’s State aid broadband guidelines.

When the requirements specification for a broadband project is being developed and refined, the Authority must also consult the relevant National Regulatory Authority. This is to ensure that the requirements specifications and outcomes expected from the procurement process will be compliant with current regulations and legislation and are aligned, as far as is practically possible, with future potential regulation and legislation. The consultation can also be useful for seeking

³⁹ Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks, available at <http://www.broadband-europe.eu/Pages/DocumentDetail.aspx?ItemID=72>

⁴⁰ The EC makes a distinction between areas where no broadband infrastructure exists or is unlikely to be developed in the near term (white areas), areas where only one broadband network operator is present (grey areas) and areas where at least two or more broadband network providers are present (black areas).

views about bidders' approaches to solutions, and the issues bidders raise that may relate to market regulation rather than the project itself.

9.2.3 Timing of the State aid application

The activities associated with achieving State aid compliance could begin and theoretically be completed through to an approval decision before the procurement process begins. In many instances, however, details about the likely solution and the costs of meeting coverage objectives may not be clear until suppliers have had the opportunity to propose solutions during, or near the end of, a procurement process. Therefore, as a minimum, if State aid approval cannot be achieved before the procurement process begins, the State aid application should be developed in parallel with the procurement process. In previous State aid decisions, the final State aid notification assessment has not been completed until the details of the technical solution and costs have been investigated thoroughly by EC clarifications of the winning bidder(s) proposal at the end of the procurement process.

The detailed coverage analysis and mapping, along with an open market consultation, should also ideally occur before the procurement process begins, and the Authority should request suppliers to continue providing updates to the Authority after the initial consultation has ended, so that the mapping can be kept up to date.

9.2.4 Additional recommendations on State aid applications

We have included below several recommendations from an article⁴¹ on best practice in State aid applications for broadband projects. It should be noted that although the article was written by representatives from DG COMP, the recommendations below are based on private and personal opinion of the authors and do not represent the official position of the EC. Managing Authorities should continue to use the Broadband Guidelines⁴² or State aid Commission decisions⁴³ as a reference.

The recommendations outline the factors which can lead to successful broadband projects and are as follows:

-
- *A State aid measure is more effective when it is part of a more comprehensive (national) broadband strategy, containing not only a vision on how to develop the infrastructures, but also a clear action plan on the complementary demand and supply side measures, administrative, regulatory and simplification initiatives with the common objective to increase broadband penetration and coverage and to support competition.*
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⁴¹ Chirico, F. and Gaál, N., *State aid to broadband: primer and best practices*, EC Directorate-General for Competition, unpublished at the time of writing.

⁴² Available at <http://www.broadband-europe.eu/Pages/DocumentDetail.aspx?ItemID=72>

⁴³ Summary available at http://ec.europa.eu/competition/sectors/telecommunications/broadband_decisions.pdf

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- *Full transparency as regards the aid measure together with the active involvement of all stakeholders (commercial operators, the NRA, local authorities, etc.) in the design of the projects is crucial to find the right balance between commercial incentives and the public interest.*
 - *The availability of adequate fibre backhaul networks in each region is a fundamental prerequisite for any broadband development.*
 - *In the vast majority of cases and given the economics of networks, widespread (or even universal) broadband coverage can only be achieved via the use of a mix of technologies.*
 - *Aid limited only to passive infrastructure elements could support the NGA roll-out of several operators.*
 - *Public ownership limited to passive infrastructure elements only could be a good way to benefit all market operators in a non-discriminatory way. At the same time, the distortion of competition arising from such intervention could be limited, since public companies do not compete directly in the core activities of the telecommunication operators (wholesale and retail service provision).*
 - *To create a competitive market for broadband, with lower prices and higher level of services for end user, granting authorities should support crucial pro-competitive features, in particular: full and effective wholesale access to the subsidised networks and network architectures conducive to long term competition (such as multiple fibre deployment, point to point infrastructures).*
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9.3 Procurement and delivery

9.3.1 Procurement design

The procurement design is shaped by a number of factors and options that should be assessed methodically and developed into a coherent, agreed procurement strategy. These are summarised in Figure 9.3 and Figure 9.4 below and are also influenced by the commercial model chosen for the project (which is discussed in detail in Section 5). The decisions and definitions set out in the procurement strategy should enable Managing Authority to create a procurement contract notice if OJEU is the selected procurement route.

Due to the wide range of factors associated with procurement design, it is likely that many Authorities will need specialist procurement and technical support to ensure the procurement is appropriately designed to satisfy their objectives, and complies with procurement legislation and State aid guidelines.

<i>Area of interest</i>	<i>Options</i>
<p>Procurement route: There are risks that some of the listed options would not satisfy the State aid guidelines for an Open Tender Process</p>	<ul style="list-style-type: none"> • Single source (framework or existing contract options) • Competitive open tender (e.g. on Authority website) • Private tender (e.g. only to invited suppliers) • Mini-competition using a framework contract • OJEU procedures – further explored in Figure 9.4
<p>Contractual structure <i>(Depends on governance and legal structure between parties, scope of requirements and operational considerations)</i></p>	<ul style="list-style-type: none"> • Single contract • Multiple contracts • Framework contract • Interfaces / relationships / contracts between parties
Operational models	<ul style="list-style-type: none"> • Contractual responsibility for management of supplier • Infrastructure management – with the public sector or part of the supplier's obligations
Beneficiaries	Define the scope of the expected beneficiaries in terms of who receives funding and services
<p>Form of contract <i>(The contract needs to satisfy the State aid guidelines (e.g. by including a reverse payment mechanism))</i></p>	<ul style="list-style-type: none"> • Funding body • Bespoke • Authority's own • Standards or procurement body • Hybrid of the above
Contract term	<ul style="list-style-type: none"> • Number of years – minimum State aid requirement is seven years • Extension options • Termination flexibility
Specification	<ul style="list-style-type: none"> • Technical • Services • Outcome based • Hybrids of above
<p>Technology <i>(State aid requires the principle of technology neutrality to be applied, but the specifications should aim to satisfy the State aid guidelines)</i></p>	<p>Specify:</p> <ul style="list-style-type: none"> • Supplier choice • Refresh options • Hybrid of above
<p>Suppliers / market segments <i>(Market is not segmented 'cleanly', so it is sensible to name likely suppliers to get a feel for likely match-up. A list of probable suppliers influences the choice of procurement route)</i></p>	<ul style="list-style-type: none"> • Network operators • Network service providers (use network operator infrastructure) • Systems integrators • Equipment vendors • Others, including consortia

Figure 9.3: Factors relevant to the design of a procurement [Source: Analysys Mason]

<i>OJEU procedure options</i>	<i>Considerations</i>
Open (no pre-qualification) or Restricted (pre-qualification)	<ul style="list-style-type: none"> • Certainty of requirements • No dialogue after OJEU notice issue • No negotiation throughout the process, only clarification • Ability to recourse to negotiated process • 'Open' has no ability to pre-qualify so number of tender responses is unlimited
Competitive Dialogue	<ul style="list-style-type: none"> • Uncertainty of requirements or high degree of complexity (must justify why the option is chosen) • Pre-qualification to select appropriate bidders • Ability to discuss requirements (dialogue) against potential supplier solutions pre-Tender • No recourse to negotiated process • No negotiation following submission of Tender, only clarification provided this does not distort competition • Recommended route ahead of 'negotiated'
Negotiated	<ul style="list-style-type: none"> • Uncertainty of requirements or high degree of complexity • Pre-qualification to select appropriate bidders • No ability to discuss requirements against potential supplier solutions pre-Tender • Ability to negotiate post-Tender

Figure 9.4: Considerations relevant to selection of procurement procedure [Source: Analysys Mason]

Two of the most important aspects of procurement design include designing wholesale obligations and using lots. These aspects are discussed in more detail below.

Designing wholesale obligations in broadband procurement

Wholesale obligations will need to be detailed in the requirements specification document used in the procurement. Through consultation with the NRA, requirements should be specified so they do not contradict the wholesale obligations stipulated by the NRA, and assurances should also be sought regarding future wholesale obligations that the NRA might advise of. New networks should be operated on a transparent and non-discriminatory basis to allow for fair competition between retail service providers and wholesale access should be provided at both the passive infrastructure and active levels.

It may be justifiable to allow a single provider to operate the passive layer in certain localities (e.g. areas of low population density where costs are excessive) in order to increase the revenue opportunity for bidders and hence maximise levels of private investment. However, if wholesale access is not provided at the passive layer, bidders must be required to explain how sufficient competition will be delivered at different active levels, and potentially the supplier should be obliged to comply with wholesale access at the passive level at a later date. If multiple wholesale models are being considered, the procurement should be designed in such a way as to include an assessment of actual cost impact and effect on competition of multiple models before the final tender.

Bidders responsible for wholesale provision should be asked to explain how they will attract take-up of services by retail service providers and ultimately take-up by end users; this could include details of the proposed service propositions and pricing, and an explanation of the expected penetration rate. The contract could include take-up targets that should be delivered during the contract, potentially with appropriate penalty and reward mechanisms linked to achieving the take-up targets.

Using lots in broadband procurement

The scope of procurement for a broadband intervention project could be split into multiple lots. The method of determining how to choose lots will depend on the project situation and objectives, and an assessment of the advantages and disadvantages of creating multiple lots should be undertaken. Procurement with multiple lots would typically be based on dividing infrastructure requirements or geography, but it could be a combination of both of these aspects of the project, as appropriate. However, any decision to use multiple lots should consider the following implications:

- The attractiveness of multiple lots to different suppliers (e.g. smaller lots may allow smaller bidders to apply and increase bid competition)
- Risks may be introduced by dividing up delivery responsibility
- The level of management required for multiple contracts and suppliers may be higher than a single lot
- Multiple lots may bring a decrease in economies of scale and/or increase in costs compared to doing a procurement using a single lot.

Using network requirements as one example, the civil works and broadband network implementation could be divided to create two lots. This would allow bidders to tender for a single lot (such as the requirements for civil works) or for both lots, according to their capabilities. In this example it might increase the likelihood of a bid from companies specialising in civil works.

Alternatively, the lots could divide up the backhaul and access networks (outlined in Section 4). In general it is advisable to invest in the backhaul network first and then monitor the reaction of the market to see whether this initial investment encourages investment in the access network to provide services. If this does not happen within a reasonable time then a second wave of procurement on selected areas will be required to provide the access network.

In some cases, the mapping exercise may already have identified those areas where the market will not invest to provide the access network (as discussed in Section 9.2.2). In these situations, the procurement for both the backhaul and access networks may take place at the same time, but it would still be advisable to split these portions of the network into different lots to allow for greater technological neutrality.

Using geography as another example, multiple lots could be created based on local authority boundaries, or based on different categories of geography, e.g. a lot for rural areas and a lot for extremely remote areas. Dividing the procurement into multiple lots may also be helpful if the different areas being targeted are small and isolated, and geographically separated from each other. Having lots defined by small geographical areas might encourage smaller companies to bid, however this should be balanced against the loss of economies-of-scale, and the greater complication in managing delivery.

If procurement is split into lots that result in a number of small networks being deployed by different suppliers, it may be appropriate to consider aggregating service delivery using one market-facing wholesale operator. Having one wholesale market-facing entity serving all retail service providers should make it easier for retail service providers to offer services over all of the small networks and benefit from the combined scale.

9.3.2 Procurement activity

Procurement activity covers a range of sub-activities, some of which are dependent on the chosen procurement route. A summary of the main activities is included in Figure 9.5, assuming use of the OJEU Competitive Dialogue procedure (which is a likely procurement route). The activities described are based on practical experience and provide general guidance; however, it is recommended that a Managing Authority seeks up-to-date specialist internal, or external, legal advice, given the dynamic nature of procurement legislation and case law.

<i>Step</i>	<i>Procurement activity</i>	<i>Sub-activities</i>
1	Market awareness	Preparation of project materials to encourage private sector participation in the procurement process, e.g.: <ul style="list-style-type: none"> • supplier day(s) • OJEU Prior Information Notice • proof of concept workshop(s).
2	Pre-qualification questionnaire (PQQ)	Preparation of a detailed questionnaire to pre-qualify, or select, a limited number of suppliers that demonstrate they should have the capability and capacity to meet the project's objectives. Detailed evaluation criteria need to be set out in the PQQ and the method of selection defined. Evaluation of supplier responses to the PQQ needs to be conducted by appropriately qualified resources. Selected and non-selected suppliers should be given an evaluation de-brief explaining the outcome of the selection process and the results of their individual evaluation.

<i>Step</i>	<i>Procurement activity</i>	<i>Sub-activities</i>
3	Invitation to participate in dialogue (ITPD) including initial requirements specification, draft contract and evaluation criteria	Preparation of a document set as the basis for inviting the selected suppliers from the previous pre-qualification stage to participate in dialogue. The ITPD will comprise a set of instructions that explain the dialogue process in detail and outline expectations of the suppliers as bidders, a requirements specification, a draft contract, and the evaluation criteria for determining the winning bidder using the principle of the 'Most Economically Advantageous Tender'. Typically, an ITPD will request outline proposals from bidders and a shortlisting of bidders may take place by conducting an evaluation of outline proposals. All suppliers should be given a de-brief of the evaluation.
4	Dialogue process	The dialogue process usually consists of a series of formal meetings, and accompanying written clarifications, between the Managing Authority and each bidder. The purpose of the meetings is to explore proposed broadband solutions and for the Authority to refine the requirements specification and contract terms that will be used in the invitation to submit final bid (ITSFB) or invitation to tender (ITT). During the dialogue a further shortlisting of bidders may take place. The dialogue process should also include consultation with the NRA to ensure requirements are appropriate, particularly in terms of wholesale access obligations (as discussed in Section 9.2.1).
5	Invitation to submit final bid (ITSFB) / invitation to tender (ITT) including final requirements specification, evaluation criteria and contract	Preparation of the ITSFB or ITT that invites bidders to submit their final proposal, comprising a set of instructions for bidding, the final requirements specification, the final contract, and the final evaluation criteria for determining the winning bidder using the principle of the Most Economically Advantageous Tender. The evaluation of bidder responses to the ITSFB or ITT will identify the winning bidder that will be awarded a contract, subject to State aid approval and confirmation of funding. All bidders should be given a debrief of the evaluation.
6	Standstill period and contract award	See Section 9.3.3 below.

Figure 9.5: *Main procurement activities [Source: Analysys Mason]*

9.3.3 Contract award

After completing the main activities in the procurement process, as outlined in Section 9.3.2, the Managing Authority may award the contract to the winning bidder, provided that the key dependencies of State aid approval and funding confirmation have been achieved and any final bid clarifications have been resolved. When the Authority is ready to sign the contract it must initiate a formal standstill period by notifying all suppliers that submitted a PQQ response of the Authority's intention to award the contract to the winning bidder. Providing no complaints are received during the standstill period, the Authority may sign the contract.

9.3.4 Broadband delivery

The broadband delivery stage is a complex undertaking and presents the contracting Authority with a variety of challenges. Many of the issues presented during delivery should be typical of those routinely faced by a supplier when rolling out broadband services, whose financial motivators (such as cashflow and profit targets) will themselves act as a self-controlling / motivational function. Nevertheless, many areas will require close monitoring and management (as discussed in Section 6), as even experienced suppliers may be delivering completely new network infrastructure and services.

Key issues that should be addressed include:

- Establishing that coverage and any agreed technology mix satisfies contractual obligations, using robust technical definitions for coverage and technology compliance, including assessment of potential coverage overspill
- Checking that supplier's costs and take-up revenues are in line with its proposed business plan and, if necessary, ensuring mitigation plans are put in place to keep the business plan sustainable
- Analysing network performance and ensuring that network improvements are initiated if performance is below contractual targets
- Using benchmark data to confirm tariffs are consistent, remain competitive in the market and do not distort the market
- Validating that proposed changes by the supplier are technically and commercially justified, potentially using independent expert advice
- Ensuring that data provided by the supplier is timely and accurate and allows for appropriate payment of State aid at agreed milestones.

10 Further work by the EC

In this section we describe two areas of further work for the EC following initial publication of this guide: keeping the guide up to date (Section 10.1) and carrying out other actions that arise from the broader feedback gathered through development of the guide (Section 10.2).

10.1 Keeping the guide up to date

This guide has been developed by examining 12 example projects in detail, and the recommendations and insights are derived primarily from this evidence base. Additional guidance on the implementation of each of the models will be developed by the European Broadband Portal⁴⁴.

Over time, however, the guidance material will need to be updated under the following circumstances:

- As new projects are successfully implemented, these should be included to broaden the evidence base of best-practice examples. In particular, any examples of a successful joint venture investment should be included in future versions of the guide.
- As the recommendations in the guide are implemented, feedback from stakeholders may mean that some recommendations in the document should be strengthened, while others are given lower prominence.

10.2 Other actions from broader feedback

Through the various feedback mechanisms used to influence the content of the guide (including an online consultation and a workshop at the Digital Agenda Assembly), we have received feedback on a number of issues. Suggested actions that could be taken in response to this feedback are given below.

⁴⁴ See: <http://www.broadband-europe.eu/Pages/Home.aspx>

Removing barriers to acquiring funding We received feedback that raising finance for projects has been identified as a key concern, and there is uncertainty regarding the process for accessing EU funds.

The on-going consultation on the revision of the State aid guidelines on public funding to broadband networks is welcome, but the EC should undertake the following additional actions:

- Co-ordinate and channel funding applications from several small projects to allow the applicants to gain scale and reduce the overhead associated with their individual application
- Set up clear points of contact to provide guidance and support in accessing finance, including EU funds.

Clarification of the DAE aims The EC should provide more guidance as to what the 30Mbit/s target actually means (i.e. whether this figure is a peak speed or an assured speed), as this can have a significant impact on the requirements for (and costs of) broadband networks.

Further stimulation of demand The focus of this guide is on funding models to deploy infrastructure. We received a lot of feedback that demand for services is an essential ingredient in the deployment of infrastructure, as it ensures that funds are requested and commercial partners are sought.

We have included guidance in this document on stimulating demand, and the EC should explore a complementary initiative to promote the value of the *services* that run over broadband infrastructure, rather than the value of the infrastructure itself. Those services could include:

- Private sector services (e.g. triple play, banking, retail and other e-commerce)
- Public sector services (e.g. education, health, local and national services).

Supporting standardisation Standardisation of technology is essential in achieving economies of scale and so reducing costs and lowering prices that consumers will pay.

Technology standardisation is especially important in small-scale deployments, as the use of non-standard technologies would create a barrier to large-scale operators offering services and reduce the prospects for competition.

Annex A Glossary of terms

<i>Access network</i>	The portion of a telecoms network between the central office (also known as a local exchange) and the end-user premises
<i>Active</i>	The portion of the infrastructure which includes <i>active</i> electronics (as opposed to <i>passive</i> infrastructure such as fibre and underground ducts)
<i>ADSL</i>	Asymmetrical Digital Subscriber Line
<i>ADSL2</i>	Asymmetrical Digital Subscriber Line 2 (ITU-T G.992.3 and G.992.4)
<i>ARCEP</i>	Autorité de Régulation des Communications Électroniques et des Postes (French telecoms regulator)
<i>Backbone</i>	The portion of the telecoms network that links towns and cities across the country (also known as the core network)
<i>Backhaul</i>	The portion of the telecoms network that connects the central office (local exchange) to the core/backbone network. Also used to refer to any portion of the network that connects into the centre of the network
<i>Bitstream</i>	A method of infrastructure access whereby an operator connects via active electronics
<i>Broadband</i>	Network or circuit capacity of 256kbit/s or more
<i>BST</i>	British Summer Time
<i>BT</i>	British Telecom
<i>Cabinet</i>	A piece of passive infrastructure that houses active electronics close to the end-user premises
<i>Cloud computing</i>	The concept of accessing data and applications from remote servers via the Internet, rather than from local storage
<i>Core network</i>	The portion of the telecoms network that links towns and cities across the country (also known as the backbone network)
<i>CSI</i>	Organisation that operates the public administrative ICT systems in Piemonte, Italy

<i>DAE</i>	Digital Agenda for Europe
<i>Dark fibre</i>	Fibre-optic cable which has not yet been connected to active electronics and carries no data
<i>DBO</i>	Design, Build and Operate (an investment model)
<i>Digital divide</i>	A socio-economic effect whereby one area of a country (usually rural areas) falls behind another area (usually urban areas) in the availability of digital services such as broadband
<i>DSL</i>	Digital Subscriber Line
<i>DSLAM</i>	Digital Subscriber Line Access Multiplexer
<i>DSP</i>	Délégation de Service Public (a model set by French law under which a private actor is granted the opportunity to manage public services by a public body)
<i>Duct</i>	An underground tube used to house telecoms cabling (including copper and fibre-optic cable)
<i>EC</i>	European Commission
<i>ERDF</i>	European Regional Development Fund
<i>Ethernet</i>	A widely used networking protocol
<i>EU</i>	European Union
<i>EUR</i>	Euros
<i>Exchange</i>	A network node that serves anywhere between about 2000 to 20 000 lines (also called a central office)
<i>Fibre</i>	A type of cable whereby information is transmitted as light waves through a thin filament of glass
<i>FTTB</i>	Fibre To The Building
<i>FTTC</i>	Fibre To The Cabinet
<i>FTTH</i>	Fibre To The Home
<i>GDP</i>	Gross Domestic Product
<i>GPON</i>	Gigabit Passive Optical Network

<i>GVA</i>	Gross Value Added
<i>ICT</i>	Information and Communication Technology
<i>ID</i>	Identification
<i>Incumbent</i>	The telecoms operator in each country that is or used to be owned by the government. Passive infrastructure such as ducts and copper cable is usually owned by the incumbent.
<i>ISP</i>	Internet Service Provider
<i>JV</i>	Joint Venture (an investment model)
<i>Last-mile</i>	Another name for the access network
<i>LLU</i>	Local Loop Unbundling
<i>Managing Authority</i>	A public authority with responsibility for supporting the deployment of broadband networks with respect to EU Structural and Rural Development funds. In the context of this guide, Managing Authority also refers to an agency (e.g. an intermediate body such as a regional/rural development agency) delegated to provide public support to these networks
<i>Meshed</i>	A network configuration where each node must be able to act as relay for data from any other node, in addition to its own
<i>MoU</i>	Memorandum of Understanding
<i>MPLS</i>	Multi-Protocol Label Switching
<i>MTC</i>	Ministry of Transport and Communications (Lithuania)
<i>Narrowband</i>	Network or circuit capacity of less than 256kbit/s
<i>NBS</i>	National Broadband Strategy
<i>NGA</i>	Next-Generation Access
<i>NGN</i>	Next-Generation Network
<i>Node</i>	A point of aggregation in a telecoms network, whereby data from several users is collated to be sent through the network
<i>NRA</i>	National Regulatory Authority
<i>OLO</i>	Other Licensed Operator

<i>Outsourcing</i>	A business model whereby a third party is contracted to undertake a business process or service (e.g. building and operating a network)
<i>Overlay</i>	The concept of deploying new broadband infrastructure without removing the existing infrastructure
<i>P2P</i>	Point to Point
<i>Passive</i>	Referring to the portion of the infrastructure which includes <i>passive</i> infrastructure, e.g. fibre and underground ducts (as opposed to <i>active</i> electronics)
<i>PC</i>	Personal Computer
<i>PDPT</i>	A project in Lithuania for the creation of a broadband data transmission network in the Lazdijai region and the municipalities of Alytus region
<i>Penetration</i>	The amount of take-up of a service within an area
<i>PEPI</i>	Public Enterprise Plačiajuostis Internetas (a not-for-profit public enterprise established in Lithuania to implement the RAIN project and manage the new infrastructure)
<i>POP</i>	Point of Presence
<i>PPP</i>	Public-Private Partnership (an investment model)
<i>PTS</i>	Post-och Telestyrelsen (Swedish postal and telecoms regulator)
<i>RDA</i>	Regional Development Agency
<i>RFP</i>	Request for Proposals
<i>RFS</i>	Ready For Service
<i>Ring</i>	A network topology which provides redundancy whereby all nodes are connected on ring. If a section is cut or damages, the other portion of the ring can continue to provide services
<i>SaaS</i>	Software as a Service
<i>SEK</i>	Swedish Krone
<i>SME</i>	Small and Medium-sized Enterprise
<i>SMP</i>	Significant Market Power

<i>SPV</i>	Special-Purpose Vehicle
<i>Switch</i>	A portion of telecoms network equipment that directs traffic from one point to another
<i>Telco</i>	Telecoms operator
<i>TI</i>	Telecom Italia
<i>TPST</i>	Très Petit Site Technique ('a very little technical site', between the Main Distribution Frames and the end users)
<i>Triple-play</i>	A broadband service proposition which includes TV, Internet and voice
<i>TV</i>	Television
<i>UK</i>	United Kingdom
<i>USA</i>	United States of America
<i>USD</i>	US Dollars
<i>USO</i>	Universal Service Obligation
<i>WDM</i>	Wavelength Division Multiplexing
<i>WiMAX</i>	Worldwide Interoperability for Microwave Access
<i>Wireless</i>	Any telecoms connection that is made using radio waves (e.g. mobile technologies, satellite)
<i>Wireline</i>	Any telecoms connection that is made with a cable, e.g. copper or optical fibre

Annex B Bibliographic and other references

B.1 Bibliographic references

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Annex C Aims and results of example projects

This annex includes extracts from interviews with example project stakeholders, which describe the aims and results of example projects.

OnsNet, Nuenen, Netherlands

Aims: The initial aims of the investment stemmed from a local housing company's wish to install e-health style services, including video communications, in new-build homes for the elderly and disabled. The prices quoted by the incumbent for the services, however, were prohibitively expensive, leading to considerations of creating its own network. Also, the area had previously had ADSL and cable service available: the maximum speed was estimated to have been less than 10Mbit/s, and connections were viewed as expensive and with poor quality of service.

The key aim behind the funding given by the Ministry of Affairs was to achieve economic development as well as acting as a test of different technology and practices.

Results: The project is seen as a major success, with take-up of 85% in Nuenen and churn being almost non-existent. While there was no formal measure of increased gross value added (GVA), there was anecdotal evidence of increased entrepreneurship and a growing number of knowledge workers and high-tech industry entering the region due to the high level of connectivity.

Recent research⁴⁵ has been undertaken showing how the project has helped aid social cohesion among members of the co-operative.

Rural Development Programme, Sweden

Aims: This project fits into the aims of both Sweden's Rural Development Programme, as well as its National Broadband Strategy (NBS). The main objective of both of these programmes is to promote entrepreneurship, employment and help sustain Sweden's sparse rural population (with as few as two people per km² in some areas). Also broadband is seen as a basic service that all people should have access to.

Before the Rural Development Programme there was no real broadband investment in Sweden's rural areas, and although most areas had DSL quality was seen as a major issue. There was no market interest in the areas covered by the scheme, due both to lack of demand as well as the high cost of infrastructure given the terrain covered.

Results: Overall the project is seen as a success, with the number of applications for the grant money being much higher than anticipated. Following the project the government has redistributed an additional EUR15 million from the county administrative boards towards broadband projects. The counties have also applied to the government for more funding to try to meet the significant unfulfilled demand.

⁴⁵ Sadowski, B., Matzat, U. and Kwaaitaal, J., *Towards an integral vision on broadband in Eindhoven* (2008).

DORSAL, France

Aims: The aims of the investment were to tackle a market failure. Limousin (the second most rural region in France) was considered unattractive for telecoms services operators, and it was difficult for the region's only operator, France Telecom, to justify further investment. Prior to the deployment of the DORSAL network, prices in the region's main cities (e.g. Limoges) were much higher than in cities like Paris and Lyon, and services could only be provided to around 30% of end users. Also, certain enterprises were threatening to leave their local premises and move to another region, where telecoms services would be cheaper and have higher quality.

Results: Since the launch of the network, prices have fallen significantly (equivalent to levels in Paris), while quality has improved dramatically. Customers are now able to choose from a variety of operators. Individual end users now have access to triple-play services, and those who cannot be reached by ADSL can rely on WiMAX or satellite connectivity.

The investment had a positive impact on the local economy and job creation, as local telecoms operators have started offering retail services. Some local operators have expanded to other regions, while operators from other regions have also launched in Limousin.

Piemonte, Italy

Aims: The main aim of the investment was to increase broadband utilisation and availability throughout the region of Piemonte. In 2003/4, low broadband penetration was seen as a major problem with only 30% of the territory covered, equivalent to around 80% of the population. The incumbent had no commercial interest in the area, due to the mountainous and rural nature of the region.

Results: There is now 60% Internet penetration with only 2% of the population using narrowband services. The fact that 40% of the population is not using the Internet is attributed to the large elderly population, a fact which has led to the development of 'black-box solutions', especially for areas such as e-health, so that end users do not need to interact with PCs.

The project was seen as successful in working as a catalyst for investment by the incumbent, causing it to upgrade many of the exchanges. The Internet network is currently used by a range of vendors, telecoms operators and public organisations. The project was successful in involving the private sector early in the process, and so is viewed as helping the market rather than fighting it.

Midtsoenderjylland, Denmark

Aims: The goals of this investment were to create a 'networked community', to support public sector ICT services and start momentum behind the vision of 'fibre to all'. FTTH is seen as an important piece of infrastructure for economic and social development. Smaller towns had basic cable services, but most rural areas had almost no connectivity, and received only two airborne TV channels⁴⁶. The municipalities asked the incumbent to consider deploying FTTH to rural areas of the region, but the incumbent concluded that there was no business case.

⁴⁶

Note: The most important driver for the investment was the very slow connections or lack of Internet access. There was no access to cable TV in rural areas, but the two airborne TV channels could be supplemented by satellite-based channels.

Results: In 2002, 90% of the population had access to broadband via copper but now 100% of the region has FTTH access, and around 50% of the population takes services. In rural areas this take-up increases to 80% due to lack of alternative ways to access TV content. The project has led to increased business development, including the creation of an 'Innovation House' which is home to 15 new companies. Since 2004 more than 50 new companies have been established and supported by the 'Innovation House'.

Syd Energi, the co-operative electricity company which rolled out much of the access network, has made calculations based on its investments and experience to date, and it expects to make a return on its investment (which provides FTTH connections to each of its 250 000 customers in the region) within 20 years.

North Karelia and "Broadband for all in Eastern and Northern Finland", Finland

Aims: The aims of both projects are to create increased economic value in a rural area of Finland. The projects aim to provide equal opportunities for rural and urban areas throughout Finland. The end goal is to increase the vitality of the countryside – with broadband seen as a key factor in the health of the region, especially given the connectivity requirements of both agriculture businesses and tourism.

The investment was further motivated by the lack of interest in these regions among telecoms operators. Prior to the North Karelia eRegio project, in 2008, 98% of the population had access to connectivity but in rural areas this mostly took the form of wireless connectivity (which was seen as slow and unreliable).

These projects also form part of the implementation of Finland's National Broadband Strategy (NBS).

Results: The original eRegio project increased the connection availability from 74% to 98% within the region; however, actual take-up was significantly lower. Although not complete, the new project has been very successful to date, with completed areas reporting take-up of around 60%.

It was felt too soon to have conclusive information on the creation of new businesses from the two projects. It was expected that the overall result will be a decline in businesses leaving the region (rather than getting new businesses to move to a rural region, which is quite difficult).

Digital Region, South Yorkshire, UK

Aims: Prior to the project the region had patchy ADSL coverage from local loop unbundling (LLU). The aim of the project was to provide FTTC connections to 80% of South Yorkshire and then use the revenues generated from to extend the scheme to provide 97% coverage. The Digital Region project included public investors with different aims: the regional development agency (Yorkshire Forward) was interested in the economic benefits that would arise from the project, while the Local Authorities had a greater focus on the social improvements, and the resulting transformation of the infrastructure available for public services. The commercial partner undertook the project to derive a financial return.

First-generation broadband was already available in most of the area, but the project aimed to bring a step change into the region to kick start the local economy. At the start of the project the view from commercial operators was that there was no commercial case for next-generation broadband in the region.

Results: Network build is ongoing, having started in 2009. Project planning started in 2004, and there was a long time prebuild period due to procurement difficulties, and a change of partnership structure that required additional due diligence before the project could start. Because of this time delay, BT has deployed an FTTC network in similar locations to those covered by the Digital Region infrastructure.

To date, Digital Region has struggled with customer acquisition, especially following competition from other infrastructure operators. The network is slowly picking up new customers but currently lacks the major providers, as they are able to integrate into BT's competing network much more easily.

RAIN project, Lithuania

Aims: An advanced broadband network is seen as necessary for Lithuania's population to use ICT and access content, and to allow businesses to develop and become more competitive. Currently rural areas (32% penetration) are far behind urban areas (99% penetration) in network connectivity. The rural areas have received little private investment in the last five years due to their commercial unattractiveness (due to low subscriber density), creating a digital divide.

The RAIN project aims to provide opportunities for residents, public institutions and businesses to use broadband in the country's rural areas. It has three socio-economic goals:

1. Reduction of Lithuania's digital divide by creating favourable broadband infrastructure conditions throughout the whole country, including areas that are unattractive to businesses.
2. Promotion of competition in the broadband sector. An open-access policy will directly contribute to competition and development of new business opportunities, and contribute to making infrastructure more economically efficient.
3. Acceleration of the development of an information society in Lithuania. The creation of advanced infrastructure in areas that currently do not have it will help to provide access to broadband networks for public institutions.

The infrastructure built helps in meeting the goals of both the Lithuanian Broadband Communications Infrastructure Development Strategy for 2005–2010 and the Information Society for All component of the Economic Growth Action Programme. Once the project is finished, it is hoped that favourable conditions will have been created in rural areas of the country for:

1. People to use e-services and access content, as well as work and study on distance programmes; giving the opportunity for Lithuanians to acquire knowledge, skills and qualifications to adapt to rapidly changing living and working conditions.
2. Businesses to use ICT in their operations, thus a creating a positive environment for IT businesses as well as increasing the level of productiveness by creating favourable conditions for innovation and SMEs.
3. Public institutions to modernise their activities and provide e-services, contributing to developing the use of IT to increase the efficiency of the decisions taken by public institutions.

<i>Indicator (unit of assessment)</i>	<i>Current level</i>	<i>Goals for 2015</i>
Increase broadband network service users penetration	72% (2005)	+23%
Connected towns and villages to the created broadband network	430 (2005)	770

Figure C.1: Summary of RAIN project goals [Source: information from stakeholder]

Results: Project implementation is ongoing (it is planned to finish by March 2013). The progress of the project is being monitored and all project activities so far have been done on time.

Auvergne, France

Aims: The overall aim of the network was to guarantee that 100% of households have access to high-speed broadband (with a minimum speed of 512kbit/s). It aims to cover the white areas⁴⁷ (4% of the territory and 353 communes) in which affordable and efficient Internet access (minimum 512kbit/s) was unavailable.

High-speed broadband access constitutes a decisive factor in the competitiveness of territories. The network aimed to deliver a number of economic, social and territorial goals:

- build up an innovative knowledge society and strengthen economic competitiveness
- attract new residents and businesses (newcomers check ADSL broadband eligibility before their installation), maintain the presence of those already settled
- avoid the digital divide between rural and metropolitan areas by bringing high-speed broadband access in the rural areas and preserve the coherence between territories
- bringing new services for leisure, family life, and professional use.

In those areas which are sparsely populated, private operators in telecommunications are not ready to invest. The deployment and operation of infrastructure, and the commercialisation of High-Speed broadband services would not be profitable for them.

Results: The impacts of the project are:

- *Development of the broadband market:* 99.6% of the 14 000 lines targeted benefited from an increased speed beyond the minimum 512kbit/s. Beyond the 14 000 lines targeted, 35 000 lines benefited from an increased speed. One month after the deployment of these new facilities, around 30% of the households that previously did not have a high-speed broadband Internet access, subscribed to a contract
 - *Development of new service offers and economic impact:* small businesses can start more easily; agricultural holdings are connected and can improve their organisation and use the online declaration for Common Agricultural Policy subsidies; the work of independent nurses is facilitated through the use of online services; 103 interactive terminals of Visio-Public Points device (PVPs) are spread across rural areas to facilitate access to public services; Numeric Spaces of Work (ENTs) are developed in schools and can improve relationships between parents, pupils and teachers.
-

STOKAB, Sweden

Aims: The company STOKAB was started in 1994 following deregulation of the telecoms market. The company was started when no operator showed any interest in dark fibre in Stockholm, but the municipality felt there was a commercial need for it. The city wanted good IT infrastructure to help contribute to growth, and so formed STOKAB, a company 100% owned by the municipality. It was felt important that the broadband infrastructure and services were split in order to fully promote competition.

Results: One indication of success is the price of Internet access throughout Stockholm. A recent publication, "Computer Sweden" marked the price of 100Mbit/s broadband in Stockholm at EUR550 (compared to an average of EUR950 for the rest of Sweden). This is helped by the 90+ service providers in Stockholm, which is much more than in most other cities in the EU.

⁴⁷ The EC makes a distinction between areas where no broadband infrastructure exists or is unlikely to be developed in the near term (white areas), areas where only one broadband network operator is present (grey areas), and areas where at least two or more broadband network providers are present (black areas).

In total STOKAB has over 800 business customers. The first of these customers came from banks and finance houses who wished to control their own networks.

One of the key success factors was that STOKAB did not try to compete with its customers. STOKAB maintained this role to promote stability for its customers.

Between 1994 and 2008 the total investment amounted to approximately EUR300 million, but between 2009 and 2012 the rate of investment has increased to EUR150 million per annum. This has mostly been driven by the move to FTTH, which has higher costs. So far, 250 000 households have been connected (which will rise to 400 000 by 2012) and 100% of business premises.

Lombardia, Italy

Aims: The main aims of Progetto BUL (Banda Ultra Larga, meaning 'ultra-broadband') Lombardia (Progetto Lombardia) are linked to the offering of new services to homes and businesses through a more capable network. The services which are of interest to the Lombardia region include:

- services related to digital public administration and "digital democracy"
- digital healthcare and telemedicine
- digital school and professional education through e-learning
- digital justice and safety
- intelligent transportation systems and digital logistics
- teleworking and digital collaboration
- software as a service (SaaS) services and cloud computing for enterprises
- smart grid and energy efficiencies
- tourism.

Regarding infrastructure targets, the project aims to bring FTTH to 50% of population of Lombardia. The Milan municipality is excluded (as it has already been passed).

Expected results: Results in terms of penetration will depend on the treatment of the existing copper network. The following figures are based on estimates from the Lombardia region:

- if there is a complete total switch-off of the copper network, penetration of the new infrastructure should reach about 100% of the population in the 167 served municipalities
- if the copper network is left in situ (an overlay scenario), the new infrastructure should have a population penetration of about 60% in the 167 served municipalities.

Implementation is expected to begin by mid-2012 and to be completed by 2015 (the Expo year in Milan).

Alto Adige, Italy

Aims: Deployment of the fibre network is in response to requests made to the public administration by several businesses and end users that are seeking broadband connectivity in the region. Regarding business entities, there are very many hotels in the area have been considered as business entities due to the high level of employment they provide and their importance for tourism in the region.

The broadband project defined coverage targets, including: all businesses employing three or more people, 95% of those with fewer than three employees and 90% of the population. Its objective is also to cover all the 116 local municipalities in the Alto Adige sub-region. Initially each city hall is being connected (primary network), and then the main public institutions will be connected (secondary network) (i.e. schools, libraries, hospitals, sites for transmission of signals, etc.).

Before 2004, broadband coverage in the Alto Adige sub-region was the responsibility of the single telecoms operator providing services in that area. This meant that broadband coverage in a certain area was influenced by the return on investment that the operator sought for that specific investment. Thus the Alto Adige sub-region had fibre solutions provided by the Italian incumbent operator and other local telephone operators only in the Bolzano city (the 'capital' of the sub-region). All other local municipalities were not covered by the high-speed fibre broadband connectivity.

Results: Both the wireless and wireline aspects of the project are considered to have been a success and have met all of their targets.

The local Council could have invested slightly more and earlier in order to avoid having to work to an even tighter deadline than the one originally set (i.e. 2013).

Annex D Infrastructure choices from example projects

This annex includes extracts from interviews with project stakeholders, which describe the infrastructure choices from example projects.

D.1 FTTH

OnsNet, Nuenen, Netherlands

For the OnsNet project, FTTH was chosen, with two fibres laid to each house (one delivering Internet and the other TV). FTTH was considered to be the ideal choice to deliver e-health style services, including video communications, in new-build homes for the elderly and disabled.

Although FTTC was estimated as EUR200 cheaper per house than FTTH, the co-operative was described as wanting the 'best of the best', in terms of service, rather than focusing on cost.

Rural Development Programme, Sweden

The project requirements were technologically neutral but the choice of fibre is indirectly driven by the 2020 broadband aims of the Digital Agenda for Europe. Sweden's broadband goals include two key aims: by 2020, 90% of Sweden is to have 100Mbit/s broadband; and by 2020, the whole population is to have at least basic broadband access. The choice of fibre is seen as the only way to achieve the first of these goals.

Due to being primarily awarded to local co-operatives, the money given tended to fund access networks rather than core network projects, although this was not specified as a formal criterion. This was mainly because local groups tend to be more interested in projects that have an immediate and direct effect on end users.

Midtsoenderjylland, Denmark

A consultant was commissioned to analyse the difference between installing a WiMAX network and a fibre network in a rural area (65km, 500 termination points). The conclusion of this work was that the WiMAX would initially be cheaper, but that there was an eight-year breakeven point for the fibre network, given the extra revenue for operators due to opportunities to sell services such as TV.

In addition to supporting public sector ICT services, another aim of this project was to start momentum behind the vision of 'fibre to all'. FTTH is seen as an important aspect of infrastructure for development. In the smaller towns there were basic cable services, but most rural areas had almost no connectivity (for example, receiving only two airborne TV channels). At the start of the project the municipalities were also advised by Aalborg University that symmetrical connections would be more useful in the future than asymmetrical.

Following the installation of a core ring between several city halls, discussions were held with Syd Energi, which felt that if it could supply electricity to rural areas it could just as easily supply FTTH. A large storm in 1999 had destroyed a large portion of Denmark's overground electricity network, meaning that local electricity companies were slowly migrating much of their electricity network underground. This gave Syd Energi a good opportunity to install FTTH at the same time as it installed the new electricity cables. To operate this network it agreed to rent the backbone of its network from the municipalities.

A point-to-point network was installed, inspired by projects in Sweden, as GPON was felt to limit different service providers, and the benefits of point to point were felt to outweigh the additional costs.

eRegio, North Karelia, Finland

Following the eRegio project which looked at basic broadband provision (2005–2008), a new project has been started with a greater focus on providing high-speed broadband, "Broadband for all in Eastern and Northern Finland".

Both of these projects form part of the implementation of Finland's National Broadband Strategy (NBS). The NBS has two key parts: since summer 2010 Finland has had a universal broadband service obligation (1Mbit/s) in place (supported by the eRegio project, and similar projects in other regions); the second part consists of a high-speed broadband strategy (the key driver of the new project), which requires 100Mbit/s by 2015 for all the population. To date all implementations have included fibre in the access network despite the projects being technologically neutral, due to the 100Mbit/s requirement in the NBS.

STOKAB, Sweden

STOKAB was set up in 1994, well before fibre had become a mainstream access network method. The decision to go with fibre was influenced by the presence in Stockholm of Ericsson (one of the world's main fibre developers at the time). The city also wanted to minimise digging in the future, and felt that fibre was future proof.

One of the main lessons that had been learned was the difficulty of starting out at such an early stage of a new technology. It was also felt that it was important to install a sufficient number of fibres. STOKAB started out installing 48 fibres (a number that most people felt was too high at the time), but is now having to upgrade some areas to as many as 684 fibres.

Lombardia, Italy

The network will provide FTTH and will be characterised by a hybrid GPON and P2P infrastructure: this actually reflects operators' implicit preferences regarding network infrastructure, as the incumbent (Telecom Italia) prefers the GPON architecture while other OLOs show a preference for the P2P architecture.

Two different scenarios have been developed for the precise make-up of the network architecture:

- *base case*: whereby GPON is the prevalent access technology, with P2P links only if/where required (i.e. significant businesses)
- *evolutionary case*: whereby a higher number of end users have a dedicated fibre from the local termination point.

In both cases access to the network is provided by the relevant SPV at the request of operators; the SPV maintains access ownership and provides access to operators on a client basis. In fact the two scenarios are not alternatives, but the second one can be seen as an evolution of the first.

Progetto Lombardia also plans to optimise the project by carrying out civil works together with other works conducted by third parties, by using existing infrastructure that is able to host the network (e.g. public lighting, district heating and sewer networks) and by minimising charges from road surface repairs.

D.2 FTTC

Digital Region, South Yorkshire, UK

The Digital Region project features a deployment of FTTC infrastructure to 80% of homes in the region (representing 546 000 homes and 40 000 businesses).

The original tender requirements were technology neutral, but set out requirements for a certain level of speed and quality of service. Research was published about the difference that high-quality, fast broadband would make to South Yorkshire. The original requirement was guaranteed 25Mbit/s service to everyone, but following talks with industry this target was changed to 40Mbit/s.

FTTC was seen as a cost-effective way of delivering the required service level. The Managing Authority did not receive any tenders which proposed an FTTH solution as the cost was considered to be too high.

Auvergne, France

The project includes the deployment of two types of passive infrastructure:

- a “very little technical site” (in French “Très Petit Site Technique”, TPST) between the Main Distribution Frames and the end users. A TPST consist of an existing building, shelter or cabinet connected to the local cabinet and converted in order to accommodate the DSLAM of another operator.
- optical fibre (860km) between the Main Distribution Frames and the “very little technical sites”.

The winning technology was “NRA-ZO” (Subscriber Node for eligibility improvement), which appeared during the competitive dialogue and was chosen as the technically and economically most advantageous technology. This technology has been available since June 2007, when it was approved by the ARCEP. It is a well proven technology, based on commonly known standards and already deployed on a large scale. It will also support further evolution of the network and speed increases thanks to a further fibre deployment.

The infrastructure is open to competition. The Contractor operates and commercialises the infrastructure, and also acts as an Internet access provider. Alternative operators can rent active infrastructure from the Contractor (i.e. use the Contractor’s DSLAM via bitstream access technology), or they can rent passive infrastructure (i.e. space in a “very little technical site” in order to install their own DSLAM). The end user therefore has a choice of Internet provider.

The cabinets have been built to house two DSLAMs: one from the Contractor and one from an alternative operator. This is sufficient to meet current market demand. If further operators want to install their own DSLAM, the Auvergne region will finance an enlargement of the cabinet.

D.3 Wireless and satellite

DORSAL, France

Due to the fact that Limousin is a rather mountainous region, WiMAX is used to provide coverage in locations where no other Internet access was available. Although the current network uses 72 WiMAX transmitters, WiMAX does not provide coverage of the entire region. End users who cannot receive connectivity through the network receive a subsidy for the equipment installation costs to connect to a satellite Internet provider.

Initially 40 transmitters were planned for deployment, but as these did not provide sufficient coverage as specified in the contract terms, the network operator Axion/Sogetrel was obliged to deploy another 32 transmitters, with this extra investment fully financed by the network operator.

For the WiMAX part of the network, Axion/Sogetrel collaborated with mobile operators and public bodies such as the French Defence Ministry which own towers in order to obtain rights of use. Where possible, WiMAX equipment was installed on existing towers. Such collaborations were envisioned in the terms of reference and mentioned by applicants in their proposals. These external relations and collaborations were managed by Axion/Sogetrel as specified by the DSP framework⁴⁸.

Piemonte, Italy

Prior to 2005, strict regulation of wireless networks in Italy did not allow commercial networks to use free frequencies to provide services to the general population. However, the market was stimulated by investment exclusively in public sector services, leading to a change in wireless regulations in late 2005.

Once the regulations changed, many wireless network managers expanded into the private sector through their existing networks and the experience they had gained from the public network. However, the majority of operators are still small and cautious, with the largest having only 10 000 customers and most being in the 500–1000 customer range.

The bands used were mostly 2.4 and 5GHz unlicensed bands, although nowadays 17GHz is also used because of frequency congestion in some areas. Some of the largest wireless operators are using licensed links in the backhaul network to guarantee bandwidth to customers. It should be noted that wireless offers are coming very close to ADSL download speeds (with much more upload bandwidth than ADSL).

Alto Adige, Italy

The broadband project includes a wireless network to provide services to homes, and a fibre network for services to business and public buildings.

⁴⁸ The investment was executed under the framework of *délégation de service public* (DSP), a model set by French law under which a private actor is granted the opportunity to manage public services by a public body. The contract is usually set in a manner which establishes a link between the quality/outcome of management and the remuneration of the actor. This model is commonly used for the management of public services such as transportation, water, electricity and others. The framework enables local collectives to formulate provisional contract, with defined quality/outcome requirements, which serves as basis for negotiations and execute a public tender procedure through which they select a partner.

Wireless services were provided to 90% of the population by 2009. Wireless technology was chosen due to its ability to provide coverage quickly to the sparsely populated areas of mountainous terrain.

D.4 DSL (copper-based) broadband technology

Piemonte, Italy

Between 2004 and 2009 the project received a continuous stream of investment, but some areas are still only at 1Mbit/s. An agreement has been made with Department of Commerce to undertake further upgrades in the future. It is felt that a FTTH network is still not really needed due to a lack of services that would use it; also there is a lack of available public money to fund it.

DORSAL, France

The network choice was determined by DORSAL's ambition to deploy a network which was extensive in terms of coverage, open and attractive to all network operators, and used future-oriented technology. The network needed to be compatible with the technology used by different operators. It combined 1200km of fibre-optic backbone with ADSL used to provide broadband services to end users over the copper infrastructure.

The initial speed needs estimated in 2004, and for which the network was designed, were a minimum of 10Mbit/s symmetrical for enterprises and a minimum 1Mbit/s asymmetrical for end users. However, due to the rapid developments in technology, the speed requirements are now much higher. Following an upgrade, the network currently provides triple-play services with 20Mbit/s over ADSL. Any future upgrade to FTTH is felt to be difficult due to the nature of the DSP framework (see below). Any future project is thought to potentially require substantial funds, including EU grants.

D.5 Core and backhaul

OnsNet Nuenen, Netherlands

Backhaul was laid from Nuenen to an Internet exchange point at the University of Eindhoven just 7km away. The cost was approximately EUR200 000 to build the backhaul and a POP to serve 7000 connections. The project was seen as both a good investment per house and, given the high take-up rate of the Nuenen project, the backhaul investment per house was seen as relatively low.

DORSAL, France

The network choice was determined by DORSAL's ambition to deploy a network which was extensive in terms of coverage, open and attractive to all operators, and used future-oriented technology. The network needed to be compatible with the technology used by different operators.

The choice of network architecture was influenced by the fact that Limousin is a very rural and mountainous area, thus the actual network deployed features from a variety of technologies, all supported by 1200km of fibre-optic backbone.

Midtsoenderjylland, Denmark

In 2003, an opportunity arose when four municipalities (including Vejen) decided to collect their ICT together into a centralised hub. To do this required a fibre connection between the four city halls, but the incumbent quoted a high price to provide this and the municipalities decided to create the network themselves.

In the end a 48-fibre optical ring was designed, linking the four city halls and various other large institutions. The 48 fibres gave extra capacity for the future, and allowed spare dark fibre to be rented out.

The municipalities paid for two rings (the second of which was built in 2006 before the reorganisation of municipalities), which were owned and operated by the municipalities for their own use. Attached to these rings are two FTTH networks, built and owned by two separate electricity companies (across two different regions).

eRegio, North Karelia, Finland

Public funding is provided to a telecoms operator as a grant for it to build the core infrastructure. The backbone it builds has to reach within 2km of each house, with the last-mile access being financed by individual households (in reality the backbone passes within around 100–300m of each household).

Piemonte, Italy

The project featured two major investments in core network infrastructure: a regional backbone was created connecting major cities, and a new Internet exchange was created to be run by a public/private consortium. It was identified that an upgrade to the backbone would be the most effective use of funds in terms of delivering a useful increase in bandwidth to end users. Previously the closest Internet exchange was in Milan, and had to be accessed across multiple telecoms operators (who had no interest in making the access easy).

The backbone is split into two key parts: the public sector part is operated by CSI (the local public ICT administration organisation), while the private sector part is operated by the not-for-profit exchange consortium which included public and private members.

In order to fully distribute the network, nodes were spread across multiple cities – which was felt to be very useful for smaller operators. The project also increased competition by allowing smaller operators to obtain bandwidth on the same terms (price and non-price terms) as larger players.

RAIN project, Lithuania

Across most of Lithuania there is sufficient last-mile infrastructure for broadband, but the necessary core/backhaul network infrastructure and capacity are missing.

The network is to adhere to principles of: open access, technological neutrality and promoting competition. The infrastructure is to be built only in rural areas and where it does not already exist. The technical solutions chosen provide for the relevant needs for no less than ten years.

The goal of the RAIN network is to promote the use of broadband communications in rural areas. Whilst preparing the project, the following alternative techno-economic aspects were analysed:

- I. Transmission medium: fibre-optic cables; copper cables; wireless technologies
- II. Data transfer solutions: MPLS technology to be used in the entire network; MPLS technology to be used on the network distribution levels; Ethernet technology to be used in the entire network
- III. Asset management systems: multiple (up to ten) operators of the RAIN network; one operator of the RAIN network (PEPI); one operator of the RAIN network (a private enterprise).

The following economic alternatives were also analysed: development of the RAIN network not to be implemented; network development to be implemented by creating only the transmission medium; network development to be implemented by creating the transmission medium and installing data transfer solutions.

Due to the wide geographical coverage, the types of service to be provided and the large number of users, high standards of reliability and speed were required. In addition, the infrastructure that is built has to remain in service for a minimum of ten years and be technology-neutral to allow as many technologies as possible to compete in the market. This is to give service providers a free choice of technology while still being able to compete in providing services. It should be noted that the RAIN project did not involve the creation of a whole new network but rather the creation of missing parts of the current networks. Given the ideal of the network allowing everyone to use it who wishes to do so, it is important that the connection capacity is sufficient with the possibility of future expansion, and that there are enough resources for all providers.

Whilst carrying out a survey of the providers about the resources they need, it was determined that the most acceptable solution was fibre. Since not one, but several, providers plan to use the same communications channel at the same time, and they plan to use different technologies, a medium is needed that provides sufficient resources for all the operators and is suitable for any technology. Fibre-optic cable was chosen as the most acceptable solution. Given the number of potential operators it was decided that no fewer than 24 fibre cables were to be used in principal links and no fewer than 12 fibre cables in inputs of network objects.

The infrastructure created during the project did not include the last-mile segment of the network. The infrastructure allowed the connection to the network of last-mile segments using all types of technological solution without modifying the network. The infrastructure aimed to encourage operators to provide broadband to end users, attracting investment of private capital into access infrastructure in rural areas and promoting competition. The infrastructure created during the project gives communications operators the opportunity to provide broadband communications services and allows users to freely choose a service provider in at least 98% of the country's rural areas.

Alto Adige, Italy

The broadband project includes a wireless network to provide services to homes, and a fibre network for services to business and public buildings.

Fibre services are being targeted at all businesses employing three or more people, and 95% of those with fewer than three employees. However, the network is being prioritised to connect city halls first (primary network), and then to connect the main public institutions (secondary network) (i.e. schools, libraries, hospitals, sites for transmission of signals etc.).

There are a significant number of local utility companies (i.e. district heating companies, power stations, etc.) which had previously laid fibre from their local exchange stations to the residential and business premises, therefore allowing the telecoms operators to rent their fibres and easily provide connectivity to their customers. These entities will be valuable to the project, as through the civil works they undergo to renew or extend their infrastructure, they are easing the completion of the entire fibre network roll-out, in terms of both time saved and investment reduced (for instance, when the civil works are used both to meet the needs of these entities and to lay more or new fibre).

Annex E Investment models used in example projects

This annex includes extracts from interviews with project stakeholders, which describe the investment models used in example projects.

E.1 Bottom-up models

OnsNet, Nuenen, Netherlands

The Nuenen project was started through the creation of the Nuenen Internet co-operative, where members were given the opportunity for an FTTH connection. It was considered advantageous for local citizens if the Internet was to be turned into a utility – with ownership falling on either the government or the local population itself.

Following a six-week demand aggregation programme, an independent local co-operative was created to build and own the network, and a business plan submitted to the Ministry of Affairs. By the end of the six-week period around 90% of the area's population had joined the co-operative. The co-operative supplied its members with free triple-play broadband for the first year, followed by a charge of EUR60 per month thereafter. The network was operational after five months and following the first year's free period 80–85% of the citizens continued to use the service. In addition, recent research has shown how this project has helped aid social cohesion throughout the co-operative's members.

Due to the co-operative's lack of expertise it decided to outsource both the building and operation of the network. A turnkey solution was required for building the network, and a construction company was chosen that offered this. For network operation, the co-operative undertook an outsourcing arrangement with Edutel, an existing semi-public telecoms operator affiliated with a number of high schools in the area.

Many of the technological choices were driven by the co-operative's aims of achieving 'the best of the best', and supported by the co-operative investment model being able to take a longer-term view of benefits rather than just focusing on a short-term business case and the reduction of costs.

Rural Development Programme, Sweden

Under the Rural Development Programme in Sweden, a typical local investment project was initiated by residents and enterprises showing interest and forming into co-operatives or economic associations. These organisations applied to the local authority (county board) for support, and contributed either financial support or support in kind (often digging to install new ducts). While the private contribution was non-compulsory, a public grant was more likely to be awarded if interest in local investment was demonstrated. Due to this additional investment, a local model was seen as a good way to scale up the initial investment. The public money given to these projects was made up of 75% EU funding and 25% other public funding.

An advantage of the co-operative structure was that one of the key cost-saving elements came from easier access to private land, due to the local initiative and investment in the project. However, it was agreed that one of the downsides of allowing grant money to be directed through local interests was that less organised or more sparsely populated rural areas may miss out on grants, and that those networks that were built may not have common technical standards. This was not seen as a major problem, however, and it was felt more important to ensure the money was going to an entrepreneurial region with proven demand.

The grants tended to fund access networks rather than core networks, as local groups tended to be interested in projects that offered an appreciable benefit to end users. In the majority of cases the local group owns the resultant infrastructure, but occasionally the local group was allowed to sell the infrastructure to a third party (though specific market mechanisms had to be used to ensure a fair price). The network itself was run by an independent telecoms operator as a condition of the grant being awarded.

Another important part of this project was the partnership between the regulator and a non-telecoms department: the project was the first to involve co-operation between the Board of Agriculture and the Swedish postal and telecoms regulator (PTS), with PTS helping to design the scheme and the Board of Agriculture undertaking marketing and information. This enabled the Board of Agriculture's rural expertise to be complemented by the PTS's expertise in broadband. The actual implementation was done regionally by the County Administrative Boards, who allocated the money to the local co-operatives.

eRegio, North Karelia, Finland

A bottom-up approach features in the composite funding model of this example project. Public funding is given to a telecoms operator as a grant for it to build the core infrastructure (i.e. a private DBO approach, as explained in the next section). However, the backbone that is built has to reach within 2km of each house, with the last-mile access being financed by individual households (i.e. a bottom-up approach, and in reality the distance to the backbone is much less). Each household signs an agreement, and provides payment, at the time of the project initiation so that all the fibre can be laid at the same time. It was highlighted that a key driver of people signing up was being able to see the construction happening outside their houses, and the additional incentive was that while houses are able to buy access after the project has finished it will cost them significantly more.

An improvement to the model has been implemented in the successor project, "Broadband for all in Eastern and Northern Finland". In the new project, surveys are run to check the demand before construction starts in each area. However, as only price estimates can be used to gauge demand, the response may vary from reality given variance of the actual price. The real demand is only realised once the project is underway, with the 'excavators on the ground' effect that was highlighted above.

E.2 Private DBO model

eRegio, North Karelia, and "Broadband for all in Eastern and Northern Finland", Finland

A private DBO approach features in the composite funding model of this example project. Public funding is given to a telecoms operator as a grant for it to build the core infrastructure. However, the backbone that is built has to reach within 2km of each house, with the last-mile access being financed by individual households (i.e. a bottom-up approach, as explained in the previous section).

The ongoing “Broadband for all in Eastern and Northern Finland” project was launched to create demand, and give information and manage/co-ordinate the broadband promotion and operations between neighbouring regions in eastern and northern Finland. This project receives funding for its high-speed broadband investments from the Finnish government and EU agriculture funding. The Finnish government has reserved EUR66 million of State aid, and EUR25 million will be received from the EU (agriculture funding) for the whole of Finland. The basic financing model is that around one third of the funding is State or EU aid, another third comes from a local municipal fund, and the final third is from the telecoms operator that is building the network. Municipalities have to pay 8%, 22% or 33% of the cost of their investments, depending on their financial capacity and according to criteria defined by the government. The predecessor project, eRegio, used the ERDF mechanism for investment projects that were launched while it was underway. In most cases half of the finance came from the municipality and half from the ERDF, although investment was sometimes also received from private telecoms operators. All normal State aid rules were followed, with Finland having to notify the EU of the model being used.

For the “Broadband for all in Eastern and Northern Finland” project, the Regional Council gave the permit for the grant money through a public procurement which followed appropriate EU procurement regulations. The overall project was divided into relatively small lots (1–3 lots per municipality for each of the 14 municipalities under Regional Council of North Karelia). This was due to smaller lots being seen as easier to manage and also a way of keeping the lots relatively inexpensive, to allow smaller operators the chance to bid.

In the case of the eRegio project, 11 lots were offered, but the only bids received were from a single local telecoms operator (a similar situation was seen across the rest of Finland’s projects). The national telecoms operators were not interested in the rural projects despite the available funding, and this led to a lack of competition in the process. It was felt that local telecoms operators are more willing to wait longer for payback (as their focus is on maintaining their reputation among the local population, rather than on meeting the needs of shareholders), so will apply for grants that the national players are not interested in.

Due to the problems with lack of competition, the Regional Council is now looking at the option of awarding grants to local co-operatives (made up of local residents and businesses) to fund the backbone network (and so effectively make the entire project bottom up). The co-operative would build and own the network and make an agreement with a telecoms operator to operate it.

The telecoms company that wins each project has to provide a guaranteed 30 years of service on the network. One of the Regional Council’s jobs, together with the municipalities, is to check that the network is running in accordance with the agreement, though it has no specific tools to use in this task. The majority of monitoring comes through customer feedback. When problems are highlighted, a flag is raised with the Finnish regulator (FICORA) to apply penalties.

E.3 Public outsourcing

DORSAL, France

This project was among the very first of its kind, whereby a group of local authorities formed a territorial collective to invest in deploying a network. In March 2002, the syndicate known as DORSAL was formed, representing a number of French ‘départements’ (regional sub-units) and larger regional cities. Following DORSAL’s initial examination of the prospects for financing and deploying a regional network, several more départements joined the syndicate which then launched the project execution phase.

DORSAL decided to execute the project under a public outsourcing framework called a *délégation de service public* (DSP)⁴⁹. It would then arrange a concession of the public service, enabling it to benefit from private investment, attain greater economic efficiency and benefit from the experience of collaborating with a specialist enterprise. The DSP framework enables local collectives to formulate a provisional contract with defined quality/outcome requirements, which serves as a basis for negotiations, and execute a public tender procedure through which they select a partner. This framework also transfers risk from the collective of public bodies to the private partner.

After three months of discussions, Axion/Sogetrel was unanimously selected to deploy the network and manage the service for a period of 20 years. The DORSAL network was conceived as a wholesale network, with Axion/Sogetrel providing only wholesale, rather than retail, services. The network currently provides connectivity to 20 operators, including France Telecom. Overall, 45% of the investment was made with public funds, with the remaining 55% funded by the partner.

The management and ownership model was decided under the framework of DSP. The concession is given for 20 years during which all revenues from operating the network go to the private partner. The partner has an obligation to maintain the network. At the end of the 20-year period, the network becomes the property of the territorial collectives syndicate. At this point a new procedure to select a partner will be initiated, but the collectives will set the contract so as to receive a share of the revenues. DSP also ensures that DORSAL is updated monthly by Axion/Sogetrel, with DORSAL publishing an annual report which captures all the activity on the project.

One of the key lessons taken from this project was the feeling that having a collective call for proposals facilitated the establishment of economies of scale, as selecting a single candidate to deploy an inter-departmental network reduced the cost for the départements and cities which are part of DORSAL. If each had undertaken the process on its own, it was felt the total cost would have been greater.

In addition, it was felt that the public outsourcing model worked well here given the reliable private partner and local structures capable of organising themselves and representing the collective interest. It was felt that Internet connectivity is a public good and the public should be able to have control over it.

A problem highlighted is that the current contract terms for a DSP framework, as set by French law, do not allow for re-investment of funds which represent more than 20% of the value of the initial capital, over the term of the contract (20 years in this case). For the telecoms sector, which is capital intensive and features rapidly evolving technologies, this amount may well be insufficient. For example, if FTTH is to be rolled out in the future, 20% (EUR17 million) of the initial investment of EUR85 million would be inadequate for any deployment at scale. Any future project is thought to potentially require substantial funds, including EU grants.

Auvergne, France

The chosen model is a public-private partnership between the Auvergne Regional Council and a private operator (the Contractor). The Auvergne Region provides the funding for the required infrastructures (EUR38.5 million from the Region, the départements, the French State and the ERDF) through an income provided to the operator during the ten-year contract period. The operator designs, operates and commercialises the infrastructures on behalf of the Auvergne Regional Council. The Region Auvergne owns all the infrastructure deployed.

A PPP appeared to be the best solution for legal, economic and technological reasons:

⁴⁹ A *délégation de service public* (DSP) is a legal model in French law under which a private actor is granted the opportunity to manage public services by a public body. The contract is usually set in a manner which establishes a link between the quality/outcome of management and the remuneration of the actor. This model is commonly used for the management of public services such as transportation, water, electricity, etc.

- the market failure (lack of private operator's investments in these sparsely populated areas) called for a public intervention
- the Region was unable to define the technical means that could meet its needs, and could not establish the legal and financial parts of the project construction. It fell to the Contractor to recommend a comprehensive technological, economic and financial solution. Thus, the Region would benefit from private sector innovations
- only a PPP would enable both a speedy selection process for the Contractor, and income for the Contractor in zones where the return on investment is too weak (because of low population density)
- the PPP allows a sharing of the risk. The Contractor take on a part of risk and responsibility, especially in terms of technical exploitation.

The timetable for the project was as follows:

- an agreement was signed in December 2005 between the Auvergne Regional Council and the four departments of the territory; a preliminary study concluded that a PPP was the best solution
- a competitive dialogue was led by the Region between January and July 2007
- the PPP contract with the Contractor (France Telecom) was signed in October 2007. The contract transferred the Contracting Authority to the Contractor
- the project was deployed by the Contractor, under the supervisory control of the Region
- the deployment was completed in March 2009.

The State aid regulation did not cause any problems. The French Regulatory Authority for Electronic Communication and Posts (ARCEP) approved the technical solutions.

The Contractor operates the infrastructure for a ten-year period on behalf of the Auvergne Region, both technically and commercially. It receives an income from the Auvergne Regional Council covering its investment and operating costs. Thus, the role of the Contractor is to design, finance, build, technically operate and commercialise the infrastructure. The Contractor also acts as an Internet access provider alongside other potential providers.

The Auvergne Regional Council is the Managing Authority; it defined and published the notice for a competitive public tender and led the competitive dialogue which requested the bidders to make one proposal for several provisions (one lot for several provisions): Design, Financing, and Building; Technical operating; and Commercialisation of electronic communication services on behalf of the Auvergne Region.

A Selection Committee set up by the Auvergne Regional Council evaluated and selected the proposals according to the criteria mentioned in the tender and through several rounds of dialogue.

Digital Region, South Yorkshire, UK

The network is fully publicly owned. The network operating company, Digital Region Limited, is run as a not-for-profit organisation, with the board consisting of the regional development agency (Yorkshire Forward) and members of each of four city councils. The funding model (100% public ownership of the network) was chosen partly due to a view that there was a lack of other viable options, given the lack of market interest in the region.

The project is purely publicly funded and so 100% owned by the local authorities. However, the project also includes a revenue sharing agreement with the company which built and now manages and operates the project (Thales). It should be noted that Thales does not hold any equity in Digital Region Limited.

The public procurement was led by local authorities, and went through the normal processes of securing State aid clearance. A large amount of information was required during a long iterative process – however, this did help to focus on the project aims.

The tender was won by a consortium led by Thales (and including Kingston Communications and Alcatel–Lucent), whose skills and experience were considered the best fit for the project's requirements.

Originally a management team sat underneath the board ,to oversee contact with the network operator, Thales, who in turn managed any sub-contractors. Now Digital Region and Thales form a joint team at management level. This collaborative approach has speeded processes up by removing a layer of bureaucracy.

E.4 Joint venture model (and examples of partnering)

Lombardia, Italy

The structure of the investment has not yet been defined; but based on the currently available public documents, Lombardia region will act as an enabler, mediator and facilitator of investor interests, with a neutral role in intermediation and management.

The project foresees the creation of a holding which manages a number of local SPVs; the mechanisms for participation illustrated in the figure below vary according to how partners decide to participate in the equity (i.e. swapping cash, assets, infrastructure, and/or equipment for equity):

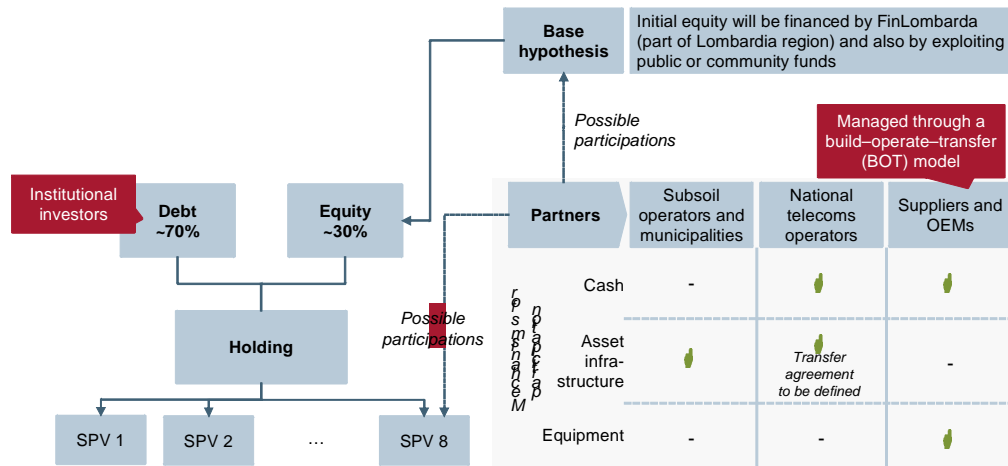


Figure E.1: Ownership and financing structure of Progetto Lombardia [Source: Analysys Mason based on public data]

Institutional investors include all suitable lenders, such as (investment) banks and (pension) funds. Subsoil operators are all organisations which have underground networks for their business (e.g. the tube company, the gas company, the sewer company (if not owned by the municipality)).

The SPVs will have a remit which is primarily defined by geographical area. Every SPV will have ownership of planning, realisation, wholesale commercialisation, provisioning and maintenance activities: this means that it will own all processes related to planning, construction, provision and maintenance of the dark fibre infrastructure (i.e. excluding civil infrastructure).

Total estimated investment is EUR1.0–1.4 billion, with an estimated realisation time of 5 to 7 years.

The philosophy of Progetto Lombardia aligns with the terms of a Memorandum of Understanding (MoU), signed between the Italian government and main Italian telecoms operators. The main principles of the MoU relating to the management and ownership model are:

- use of the public–private partnership (PPP) model to realise the passive infrastructure needed to deploy the next-generation network (NGN)
- the sharing of planning and financing activities for the realisation of passive infrastructure between the central government, telecoms operators, local public authorities (especially Regions) and public and private financial institutions
- the definition and management of local initiatives at the operating level are delegated to Regions, as already happened with Lombardia region for Progetto Lombardia.

Regarding service management, Progetto Lombardia will have an independent infrastructure manager which provides access to dark fibre to operators on an open-access/neutral-net basis. Final decisions and amendments to this general framework are subject to two main issues:

- the role and involvement of the incumbent, Telecom Italia in these projects (which in turn could affect)
- the actual ownership structure of the new holding company.

The participation of Telecom Italia (TI) also affects the evolution of possible scenarios:

- *total replacement*: if TI participates in Progetto Lombardia, the existing copper network will be switched off (which is already planned for the Milan municipality by 2015) and all remaining users will be migrated to the fibre infrastructure
- *overlay*: if TI does not participate in Progetto Lombardia, the existing copper network is likely to continue in operation with only some of the remaining users being migrated to the fibre infrastructure.

Midtsoenderjylland, Denmark

The investment featured the deployment of a fibre ring connecting four local city halls.

Following the installation of the core ring, discussions were held with Syd Energi, which felt that if it could supply electricity to rural areas it could just as easily supply FTTH. A large storm in 1999 had destroyed a large portion of Denmark's overground electricity network, meaning that local electricity companies were slowly migrating much of their electricity network underground. This gave Syd Energi a good opportunity to install the fibre at the same time as it installed the new electricity cables. To operate this network it agreed to rent the backbone of its network from the municipalities, until such time as its own backbone network was ready.

The electricity company and local municipalities had a common interest and so set up a less formal agreement rather than a contract (as it included no details of financial recourse) which allowed the electricity company to use the publicly funded fibre backbone. Denmark has a strong tradition of co-operative companies, so the municipalities were used to working with the organisational structure of the electricity company. Overall this partnership led to the municipalities paying only 1% of the total network costs, with private investment funding the remaining 99%.

Piemonte, Italy

An arrangement was made between the Managing Authority and the incumbent to attract investment to the area. The incumbent committed to upgrading a large number of exchanges at a cost of around EUR50 million, with the region agreeing to provide an equivalent value of resources in kind through developing services: e-health, telemonitoring, etc.

A further partnering arrangement was created for the operation of the newly created Internet exchange, to ensure that management of the exchange is seen as neutral. It was felt to be important that telecoms companies were included, to ensure that companies felt the exchange was run in a way that considered their interests. The exchange is now self-funded through member fees and requires no additional public funding.

In order to maintain control of the consortium the public has the majority stake (51%), and tight governance arrangements are followed.

Digital Region, South Yorkshire, UK

As described in Section 5.3 above, the network operating model for Digital Region represents a form of partnering arrangement.

The network operating company, Digital Region Limited, is run as a not-for-profit organisation, with the board consisting of the regional development agency (Yorkshire Forward) and members of each of four city councils. The project also includes a revenue sharing agreement with Thales (the company which built and now manages and operates the project).

Originally a management team sat underneath the board to oversee contact with the network operator, Thales who in turn managed any sub-contractors. Now Digital Region and Thales form a joint team at management level. This collaborative approach has speeded processes up by removing a layer of bureaucracy.

E.5 Public DBO model

Midtsoenderjylland, Denmark

In 2003, an opportunity arose when four municipalities (including Vejen) decided to collect their ICT together into a centralised hub. To do this required a fibre connection between the four city halls, but the incumbent quoted a very high price to provide this and the municipalities decided to create the network themselves. A standalone business case was developed to link up the ICT of the four municipalities.

The tender for installing the network was offered to seven different companies, with the final offer being judged on both best economic and technical value. It was specified that the tender was for 48 fibres, but few other details were specified, to try and allow for creativity.

Several of the final bids were similar to the winning bid, with one having the same overall price. This bid, however, involved the electricity company owning the fibre and renting it back to the municipality, and was rejected as the municipalities wanted to own the whole ring (to ensure security of price and allow for more flexibility in the future). This turned out to be useful as it allowed additional municipalities to join the project later in 2006, during preparations for reorganisation of the Danish municipalities and regions in 2007.

The municipality now owns and operates the ring – with a repair contract taken out with an external company. Spare fibres are rented out to and operated by external companies, but the fibre used by the public network is seen as part of the cities' ICT networks and so is looked after by the cities' ICT administrators, to ensure they have control over how it is used. The general access network is owned and operated by the electricity co-operative.

The agreement to rent the dark fibres had to be priced at the accepted market level as it was against Danish law (and EU State aid rules) to disturb the market by subsidising FTTH, or to give preference to one company over another. However, given the extra competition created by this project the incumbent's fibre prices dropped to approximately one third of their previous level. In addition, external companies rented shared space within the ducts (which they used to add additional fibres), and they are paying for that access over a ten-year period.

Piemonte, Italy

The Piemonte project included a range of broadband investments, which were primarily publicly funded:

- A new regional Internet exchange, built with public funds. Operations are undertaken by a public/private consortium (with the public owning 51% to maintain control)
- A regional backbone with cloud computing infrastructure at regional nodes, built with public funds. Public traffic is operated by CSI (the organisation that operates Piemonte's public administrative ICT systems); private traffic is operated by the exchange consortium
- 700km of dark fibre primarily to commercial premises (e.g. industrial areas and offices) but also locations of public interest, built with public funds. Access to the dark fibre is managed by a third-party wholesaler, selected through public procurement
- A public-sector-only wireless network, built with public funds. The initial constraint on public-sector-only traffic was due to licensing constraints, but this inspired parallel private investment at a later date
- Public investment in new services (e.g. e-health, tele-monitoring, tele-control), in return for which the incumbent upgraded a number of exchanges in the area to DSL.

Most of the above investment was entirely publicly funded. This was done initially due to a low level of interest in the area among private telcos. This can be seen by comparing the economic value in different areas of Piemonte: for example, Turin accounts for around 90% of the region's economy but only 50% of the population, making it a far more attractive prospect for private companies than the more rural areas. This is reflected in the fact that the Turin exchange currently carries 20Gbit/s of traffic: ten times the average traffic on a regional node of the Piemonte backbone.

However, after a few years the private sector started becoming more involved in the project, though there was still a bias towards the more urban areas. It was felt important by the Managing Authority to make sure the project worked with the market rather than against it.

Overall the public sector funded 60–70% of the overall infrastructure cost, as the incumbent joined the project later on by making a commitment to upgrade a large number of exchanges at a cost of around EUR18 million. This was done in return for the region agreeing to provide an equivalent value of resources in kind by developing services such as e-health, telemonitoring, etc.

The procurements were structured into a series of lots, with the provinces split into roughly balanced values in terms of the potential commercial return. There were two main calls for proposals: one focused on the fibre network and equipment for the backbone linking cities (with an estimated payback period of 15–20 years); the second call focused on laying around 700km of dark fibre, a combination of new fibre (using existing ducts) and existing fibre (15–20%, which came from the incumbent's underused fibre, with ownership transferred to the Piemonte region or CSI). The incumbent was awarded more points for using more existing fibre and won several of the lots.

As the project was initially fully publicly funded, tenders were run using public procurement procedures – and because CSI itself is public owned it was also subject to public procedures.

RAIN project, Lithuania

Across most of Lithuania there is sufficient last-mile infrastructure for broadband, but the necessary core/backhaul network infrastructure and capacity are missing. The investment need is large and it is felt it would be carried out inefficiently if split among providers. It is envisaged that the project will connect public services to rural broadband network hubs and allow private users to connect in rural areas, thus helping to complete the national broadband strategy.

Three management models were considered for the infrastructure:

- 1 A collection of up to ten operators, one from each region, which provides wholesale services
- 2 The creation of a public management company which provides wholesale services, where the introduction of new services and infrastructure maintenance is outsourced
- 3 A private company, which manages and uses the network to provide wholesale services.

Two main problems were identified: the monopoly situation created under the last two models and the difficulty of ensuring that only wholesale services were offered under the first and third models (both of which may increase prices for users). Within Lithuania, the legal basis exists to control the monopoly situation (and would be especially easy under model 2); however, it is very difficult to prevent any private enterprises from providing services to the bulk, individual and vertical service markets at the same time. It was therefore decided to go with the second management model. To this end a non-profit organisation, controlled by the state, was formed to perform the exclusive functions of infrastructure management and control of the provision of services.

The state founded a non-profit public enterprise (Public Enterprise Plačiajuostis Internetas (PEPI)), to implement the project and manage the new infrastructure. All the assets and infrastructure belong to the state. Technology-neutral infrastructure is provided for institutions and end-user service providers to use (open access).

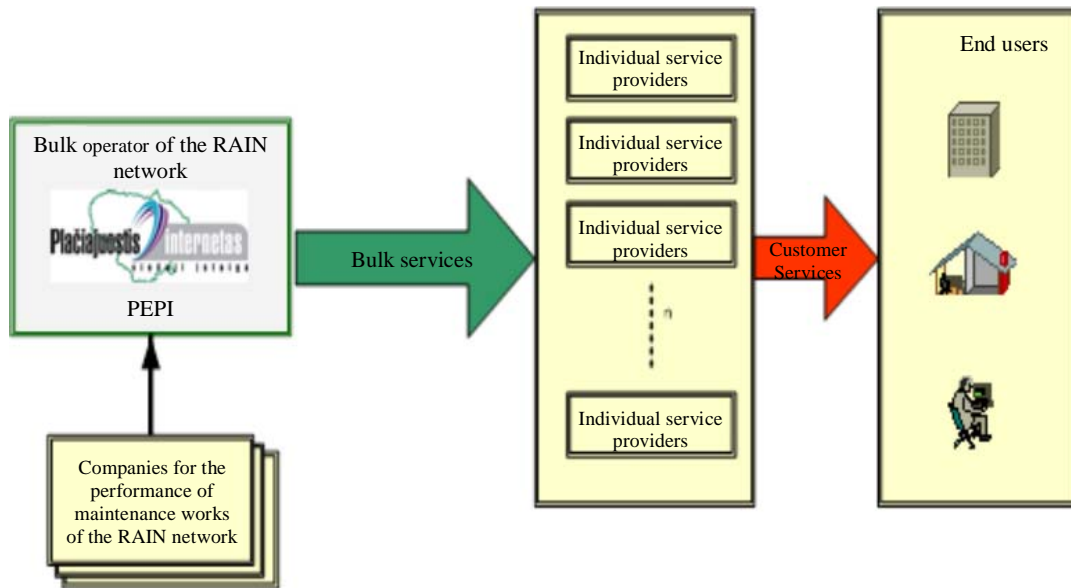


Figure E.2: Service provision diagram [Source: RAIN Project]

In order to avoid market distortions, PEPI controls the network but does not provide services to individual users. It is intended that the infrastructure will encourage providers of broadband services to invest in connecting users in rural territories.

It is important that PEPI is non-profit as it means service charges are based only on costs necessary to maintain the RAIN network. The chosen management model aims to maximise total investment by providers in order to provide the opportunity for users to choose among services, providers and technologies.

Procurement tenders of fibre-optic lines were structured geographically, with one tender for each two administrative regions (ten in all in Lithuania). In total there were five tenders for fibre-optic lines. Tenders for network equipment were structured by equipment type: data transmission equipment, WDM equipment, network management systems and so on.

The tenders were evaluated differently: some by smallest price, others by economical usefulness, depending on the complexity of the tender. The prices that were proposed during the tender were very close to the planned prices in the budget of the project.

STOKAB, Sweden

The city paid the initial set-up fees (EUR5000), but after this there was no public investment in the company. Following its creation, STOKAB applied to a bank for a commercial loan and used this to start the network. The profits from STOKAB's business are reinvested to expand the fibre network, and if STOKAB stops investing the money it is legally required to reduce the price it charges customers for fibre.

The municipality of Stockholm chose this model as it was felt that all other methods would have required a telecoms partner, which may have created conflicts of interest which would stifle competition.

STOKAB runs the backbone and access network (essentially a fibre meshed network) only, and provides no services to end users. Once STOKAB's customers have rented the dark fibre they can use it for any purpose. In addition, all of STOKAB's investment is made in response to demand from customers; so STOKAB knows it will not build dark fibre that will be unused.

Initially STOKAB's main customers were large businesses (for example, banks that required their own secure networks), however it quickly expanded into supplying broadband-intensive businesses, before moving onto SMEs and finally apartment blocks and housing.

To save money there was some re-use of ducts. Several agreements were made: first with a cable company (owned by the city), then with Stockholm's private subway company, and with the local electricity companies. However, it was felt that this re-use was limited due to the different type of network design and infrastructure required for fibre compared to other utility networks.

It was highlighted that STOKAB received no special help from the municipality, and had to pay the same price for digging up the streets as other operators. In addition, because of the hands-off approach taken by the municipality no State aid or competition regulations needed to be considered.

STOKAB has many different types of customer, covering all sizes and businesses. The main operators that work with STOKAB do so under a framework developed over time between them and STOKAB. This framework helps ensure that STOKAB builds in the areas they most need and helps maximise utilisation of the STOKAB network. The smaller customers send STOKAB a request and STOKAB gives them a quote. A key point is that no matter how small an organisation is, it always receives the same contractual terms and price as the larger customers.

STOKAB uses fibre patch panels as the handover points to customers. STOKAB will supply a patch cable into a space owned by the customer. It was explained that STOKAB does not build vertical networks within multi-dwelling buildings. To date, both FTTH and fibre-to-the-building (FTTB) style access have been installed, but the current trend is moving towards FTTH, driven by the city's largest housing company.

In Sweden it is felt that public companies such as STOKAB should aim to do as little as possible that could have been undertaken by the private market. This meant that STOKAB tried to outsource / procure as much as possible, and had to follow the usual procurement rules. The procurement was split into two parts: one tender for the digging and the other for the production of fibre to a particular technical specification.

All of STOKAB's procurement is undertaken under a 'procurement framework' that was created (for both deployment and management of the network). A number of subcontractors are awarded preferred status and then these subcontractors are allowed to bid for each tender. However, it was noted that when STOKAB started, fibre was such a new technology that in certain cases STOKAB had to educate the contractors about how to install it properly.

A building co-ordination procedure exists in Stockholm to try and ensure that building works are synchronised. This allows STOKAB to install fibres at the same time as other companies are digging trenches throughout the city. The city set up this procedure because it thought it would be both cheaper and less disruptive for the city if all digging works were condensed into as short a period as possible.

Alto Adige, Italy

The Alto Adige fibre broadband project is to be fully funded by the public administration of Bolzano, which is the owner and operator of the infrastructure. The administration will then rent part of its capacity to the telecoms operators to provide broadband connections to the local premises and businesses.

The Italian regulator is not directly involved in this project. The only entity which regulates this fibre roll-out project is the Bolzano local Council.

The Bolzano local Council carried out all necessary technical and economic valuations and also took care of the network design and the procurement phase.

In particular, although not directly involved in the execution of civil works, the local municipalities have a role in gathering information and co-ordinating with all other entities that are present in the area to improve the scheduling of future works.

All suppliers involved in this project have been shortlisted and selected through a combination of public tenders (in particular when the amount of work and therefore the investment is significant) and through selection from a sample of pre-qualified suppliers which have previously worked for the local Council on other projects.

The critical success factor which enabled both the previous and the current project to be completed on time and meet all of their targets is the centralisation of the responsibilities, management and co-ordination of the network within a single entity (i.e. the local Council). In fact, this was believed to have been paramount in avoiding duplication of activities (whether paper based or actual civil works).

Annex F Demand activities from example projects

This annex includes extracts from interviews with example project stakeholders, which describe the demand activities from example projects.

OnsNet, Nuenen, Netherlands

Before the project broadband demand was estimated to be in the region of 30%. In order to create demand the project undertook an 'education programme', showing people that fibre is useful, focusing on how it enhances quality of life (especially for the elderly), rather than emphasising the technology. The range of services that FTTH brings was also emphasised, with a key focus on communication, such as video calling relatives, remote attendance at church services and e-health style facilities. On completion of the project around 50% of the people were thought to have bought new wireless routers or new computers.

On creation of the co-operative 85% of the population signed up with a six-week period of demand aggregation, showing that there was real demand once the project was started.

Rural Development Programme, Sweden

When the project was started the Board of Agriculture had almost no picture of the demand and worried that it would be unable to find sufficient demand from local communities to get the grant money working efficiently. However, on initiation of the project it was found that demand from local communities was actually much higher than anticipated: applications became so strong that the initial tranche of funding was allocated within only a year.

Following this initial round of funding, the government has given additional money on a temporary basis, and EUR15 million has been redistributed by the county administrative boards towards broadband projects. The counties have also applied to the government for more funding to try to meet the significant unfulfilled demand.

One of the key lessons learned from the project was the importance (and difficulty) of establishing a clear picture of the actual demand at the outset of a project. Having a clear picture would have allowed a redistribution of funding from other government sources to occur much earlier in the process.

DORSAL, France

Demand was considered as part of the initial study undertaken prior to the project, which sought to determine the needs of individuals and enterprises in the Limousin region in terms of broadband, and how these could be satisfied.

The initial speed requirements estimated in 2004, and for which the network was designed, were a minimum of 10Mbit/s symmetrical for enterprises and a minimum of 1Mbit/s asymmetrical for end users. It is felt that these speeds are no longer sufficient, due to rapid developments in technology. However, the technology used to build the core network is future-proofed as it can cater for higher speeds and allows for upgrades.

Piemonte, Italy

At the beginning there was a lack of visible demand, with broadband penetration at around 25%. Now, however, there is 60% Internet utilisation with only 2% of the population using narrowband. The fact that 40% of the population is not using the Internet is attributed to the large elderly population. This has led to the development of 'black-box solutions', especially in areas such as e-health, so that end users do not need to interact with PCs.

In terms of the new Internet exchange, from the start of the project the exchange was open to everyone, not just telcos, and currently it is used by a range of vendors, telecoms operators and public organisations. A survey is run every year to monitor current demand at the exchange.

Furthermore, the public consortium invested in new services to create demand for Internet connectivity (such as e-health, tele-monitoring and tele-control). In return for this investment, the incumbent committed to invest in the upgrade of a large number of local exchanges.

Midtsoenderjylland, Denmark

There are three examples on the project of how demand had emerged following the fibre network installation:

- Farms which need good ICT infrastructure to store/transfer information on cattle IDs etc. now use the fibre network to back up this information securely.
 - A car wash company that previously had slow ADSL now uses its fast fibre connection to allow the owner to manage the site remotely using video cameras.
 - An architect in a rural area is now able to transmit his digital drawings quickly and efficiently to central offices/clients, and so can sustain his rural practice.
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North Karelia, Finland

It was felt that having knowledge of the demand in a region was a key factor in any telecoms operator decisions, and therefore important to understand before a project is started.

For the eRegio project, the actual demand was not measured, but instead calculated using the estimate that 50% of people would be interested in signing up initially and more would join the project at a later date. With this estimate a demand figure could be calculated just using the Regional Council's population data.

In the new project surveys are run to check the demand before construction starts in each area. However, as only estimates of price can be used to gauge demand, the actual demand realised may vary if the actual price is different from the estimate. The real demand is only seen once the project is underway, with the 'excavators on the ground' effect that was highlighted earlier.

South Yorkshire, UK

The project had a reasonable understanding of demand due to the amount of research undertaken before the project began. This was largely due to the State aid process, which required a large amount of information to be delivered during a long iterative process. It was felt that this process had the added bonus of helping to focus the aims of the project.

The Digital Region project had planned many demand creation projects; however, following the economic downturn and a shift in UK governmental policy, there was a reduction in the budgets of Regional Development Agencies (RDAs) and they were later abolished.

This has meant that many demand-side programmes did not come to fruition as originally planned. The newly created Local Economic Partnerships (LEPs) (which replaced the RDAs) have started looking at demand programmes themselves, but it is still too early for any demand projects to have emerged.

RAIN project, Lithuania

In order to determine the need for broadband in Lithuania's rural areas, a survey was carried out, allowing the municipalities to help estimate the need in all of the country's rural areas. The results of the survey show that there are more than 11 000 organisations in the country's rural areas, which would want to connect to a broadband network. A significant proportion of them (about 19%) were various businesses, including large farms, rural tourism and other types of business. About 15% of the identified organisations in rural areas were educational establishments. A large part, about 13%, were healthcare establishments and another 11% of the identified organisations in rural areas were libraries.

About 1200 libraries in rural areas are participating in the Libraries for Advancement project. The project aims to: make it possible for every resident of Lithuania to use computers and the Internet free of charge in all public libraries; and encourage residents to make active use of this opportunity. The Ministry of Culture has provided a list of libraries where a strong need for broadband communications has been identified.

In order to accurately estimate the demand for, and ensure the provision of, broadband in rural areas, the operators provided a list of infrastructure that could be used to provide services to end users. The operators also agreed to allow third parties (other operators) to place equipment necessary for the provision of the services in objects that will be connected to the infrastructure of the RAIN network.

Auvergne, France

The identification of the lines which were unable to receive broadband Internet was technical, based on data purchased from the incumbent operator. The technical data was compared with the complaints from end users and public officials.

A website was also created to present the project and to inform the inhabitants on deployment progress, commercial opening dates, and the available Internet providers.

STOKAB, Sweden

The majority of demand was driven by the operators. Outside of this, a lot of demand was driven by outsourced ICT networks for business. In addition, the city holds activities to teach IT skills to people who are not used to using the Internet.

STOKAB only builds its networks in areas to which its customers wish to expand, and so a small proportion of the demand risk is shifted to the customers.

Lombardia, Italy

Regione Lombardia plans to stimulate demand for superfast broadband by developing targeted services by demand type (Public Administration (PA), businesses, private users), by creating initiatives to promote digital service use and by making a larger number of PA documents available online.

Investments will also be made to digitalise and centralise services on one regional system. Finally, ICT-producing sectors will be strengthened and collaboration between businesses aimed to improve ICT education will be enhanced.

Alto Adige, Italy

The fibre roll-out has been sized to prioritise the provision of services to remote areas which are not covered by fibre. In particular, the network has been designed to take account of businesses seeking fibre network connectivity first (including touristic areas).
