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Committee of the Regions

Linking the Digital Agenda to rural and sparsely populated areas to boost their growth potential

This report was written by
Rossella Soldi (Progress Consulting S.r.l.), Simona Cavallini,
Julia Friedl, Margherita Volpe (Fondazione FORMIT).

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List of acronyms

ADSL	Asymmetric Digital Subscriber Line
CAPEX	Capital Expenditure
COR	Committee of the Regions
CEF	Connecting Europe Facility
DAE	Digital Agenda for Europe
DBO	Design, Build and Operate
DOCSIS	Data Over Cable Service Interface Specification
DSM	Digital Single Market
EAFRD	European Agricultural Fund for Rural Development
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIB	European Investment Bank
EIF	European Investment Fund
EFSI	European Fund for Strategic Investments
ERDF	European Regional Development Fund
ESIF	European Structural and Investment Funds
EU	European Union
EUR	Euro
FTTH	Fibre to the Home
FTTB	Fibre to the Building
FTTP	Fibre to the Premise (same as FTHH)
FTTx	Fibre to the x
GBER	General Block Exemption Regulation
GBP	Pound sterling
GDP	Gross Domestic Product
HSPA	High Speed Packet Access
ICT	Information and Communication Technologies
ISP	Internet Service Provider
JV	Joint Venture

LTE	Long Term Evolution
LRAs	Local and Regional Authorities
Mbps	Megabit per second
NGA	Next Generation Access
NGN	Next Generation Network
MS	Member States
NUTS	Nomenclature of Territorial Units for Statistics
OPEX	Operating Expense
PPP	Public Private Partnership
RIS3	Research and Innovation Smart Specialization Strategy
ROI	Return on Investment
RRS	Rural, Remote, and Sparsely populated
SPV	Special Purpose Vehicle
USD	US Dollar
VDSL	Very-high bit-rate Digital Subscriber Line
WiMax	Worldwide Interoperability for Microwave Access
2G, 3G, 4G	Second Generation, Third Generation, Fourth Generation

Summary

With a view of achieving the 2020 European Union (EU) broadband targets of coverage and penetration, some EUR 22 billion of EU public funds are potentially available over the 2014–2020 programming period for either upgrading existing broadband infrastructures or deploying new ones. However, to reach these targets, in the most optimistic scenario there is an estimated funding gap of at least EUR 13 billion (EC, 2015a). EU funds are crucial not only for their direct contribution to the financing of broadband infrastructures, but also for the leverage effect they are expected to play in attracting investments from other sources, including private ones.

Characteristics such as rurality, remoteness and low population density contribute to make a territory unattractive for private investment in Information and Communication Technologies (ICT) infrastructure. Compared to urban agglomerates, these areas face common challenges to broadband deployment, such as structurally lower and fragmented demand as well as higher unit (i.e. per end-user) deployment and maintenance costs of the infrastructure. Connectivity demand in particular is a crucial driver of investment for private actors. As a consequence, market players have no economic convenience in areas where population density cannot guarantee a service request that justifies deployment costs. In areas affected by market failure and/or market bias, the public authorities' roles are multiple. Indeed, evidence shows that local and regional authorities (LRAs) across Europe act as financing entities, risk takers, or initiators/facilitators of broadband deployment/upgrading initiatives.

Part 1 of this study reviews the state of the art of broadband deployment in areas considered unprofitable by private operators. Unprofitable areas are assumed to include the 'predominantly rural', 'remote' and 'sparsely populated' (RRS) territories of the EU as defined at NUTS3 level within the rural–urban typology of Eurostat. Data at the end of 2014 provide evidence that a digital divide exists in the EU between urban and rural areas, in particular if fast broadband connection is considered. By focussing on the next targets of the Digital Agenda for Europe (DAE) for fast and ultra-fast broadband, the data also highlight that none of the EU28 countries has so far reached 100% coverage of Next Generation Access (NGA). In addition, several countries have a rural NGA coverage below the EU average of 25% (i.e. Spain, Austria, France, Hungary, Sweden, Croatia, Ireland, Finland, Czech Republic, Slovakia, Bulgaria, Greece and Italy). Overall, data analysis further highlights that the actual uptake of broadband connection (also referred to as broadband access) is much lower than the broadband coverage. This implies that end-users are potentially able to subscribe to the service (i.e. the broadband service is available) but they do not.

Since demand plays a crucial role in driving investments, it is evident that besides broadband coverage, the selection of the most suitable investment and financing models also needs to take into account access levels.

Part 2 of the report focuses first on the discussion of the most common barriers to ICT infrastructure investments in RRS areas. Second, it identifies and classifies the tools and instruments adopted by LRAs for financing the deployment of the infrastructures and/or for attracting external investments. Barriers specific to RRS areas include, for example, a limited market size. Furthermore, compared to urban areas, barriers relate to lower revenue for network operators and service providers, and higher financial risk and/or a longer pay-back period for the investors. Regarding tools and instruments, these are categorised into four main types ranging from contractual arrangements and multi-stakeholders engagements to strategic frameworks and EU funding instruments. The emphasis of the analysis is on contractual arrangements and multi-stakeholders engagements, on their applicability in RRS areas, and on their strengths and weaknesses from the perspective of LRAs. To this end, for example, the public Design, Build and Operate (DBO) approach is found to be highly suitable for RRS areas as it easily allows the inclusion of social benefits considerations in the investment decision. Federation of LRAs is considered another suitable approach for RRS areas as the aggregation of public authorities creates a single point of contact with respect to the market, hence increasing the market size and the potential profitability of private network operators. More generally, approaches characterised by the achievement of a critical mass of actors for demand creation (e.g. community-based initiatives) or fund raising (e.g. equity crowdfunding) are found to be suitable for implementation in RRS areas.

Part 2 concludes with a literature review of the evidence of the territorial impacts of broadband deployment in RRS areas, from the business and the citizens' perspectives. Although evidence is scarce, the multiple and beneficial impact of broadband deployment on socio-economic aspects is unquestionable. While business benefits from a generalised growth potential brought about by the availability of broadband, from the social perspective impact has been noted on several spheres of an individual's life. For example, effects are reported in literature on the level of participation in social life, on the enhancement of personal skills, on the increase of opportunities for cost savings related to the consumption of goods and services, and on better access to basic services such as health care.

Part 3 presents five cases related to the different types of tools outlined in Part 2. The cases are developed on the basis of desk-review of publicly available documents. They are selected according to a number of criteria, including availability of information, level of connectivity and ICT preparedness of the concerned area(s), active role in the infrastructures deployment process played by local and/or regional authorities, use of EU funds, geographical balance across the EU, and impact and sustainability of the initiative. The outlining of cases is complemented by the inclusion throughout the report of several other examples of broadband investment in RRS areas. Empirical evidence and the considerations on the wider territorial impact of broadband investments support the proposition, in Part 4 of the study, of 'new ways' of financing of ICT infrastructures in underserved or unserved areas.

'Novelty' refers to existing approaches which appear to be suitable for financing broadband deployment/upgrade in RRS areas but which are not yet taken up by LRAs. This is the case, for example, of equity crowdfunding, which is recommended as an effective but still not widespread instrument for financing broadband deployment in areas characterised by a good ICT preparedness level. 'Novelty' also refers to the outlining of proposals to improve the effectiveness and efficiency of financing/investment models and/or the use of EU funds by LRAs. To this end, for example, a support scheme for securing financing for ICT infrastructure deployment in RRS areas from the European Fund for Strategic Investments (EFSI) is suggested. Since higher risk is one of the barriers to ICT infrastructures investment in RRS areas and since the EFSI is specifically meant to finance projects with a higher risk profile and in strategic areas of the real economy, the proposed scheme simply aims at matching these two perfectly compatible conditions. Other included suggestions relate to the creation of publicly-sponsored venture capital, to the involvement of non-conventional broadband investors (i.e. utilities' operators) able to exploit economies of scope, and to the maximisation of EU funding contribution within a public DBO approach.

The successful implementation of the Digital Single Market (DSM) and the achievement of the DAE targets for 2020 require the effective and efficient use by the public sector of the funds available for broadband infrastructures deployment and/or upgrade. This, in turn, requires: investment tools and instruments which are appropriate for overcoming both the challenges faced by less connected areas and the barriers which prevent external investment in these areas; and capacities to implement these tools and instruments. An effort to achieve the above two conditions is essential and so is public funding in order to build the critical mass of capital required to attract external investors. The role of LRAs is multiple in this respect, and fully justified by social considerations.

Part 1: Broadband infrastructure: analysis and mapping of the state of the art in rural, remote and sparsely populated areas

1.1 Introduction

The implementation of the Digital Agenda for Europe (DAE) and the completion of the Digital Single Market (DSM) are acknowledged priorities at all policy levels in Europe.[1] The ultimate aim of an enhanced digital society is to make the citizens' life easier, safer, and more efficient (i.e. produce social value) while creating business opportunities, innovative knowledge, and growth (i.e. produce economic value). Connectivity is at the basis of the development of a digital society. In order to accomplish inclusiveness and convergence rather than divide, connectivity networks need to be equally accessible throughout the European Union (EU). The DAE target of 'basic broadband infrastructure coverage for all' was achieved in 2013. The bulk of the coverage (96.1%) was through fixed technologies such as Asymmetric Digital Subscriber Line (ADSL), Very-high bit-rate Digital Subscriber Line (VDSL), cable, fibre, and copper. Wireless connection (2G, 3G, and 4G) contributed by 3.3%, while the rest of the coverage (0.6%) was achieved through satellite technologies (EC, 2013).

De facto, more is needed in terms of connectivity quality, capacity and speed in order to produce social and economic value. To this end, by 2020, the DAE targets are 100% coverage of broadband above 30 Megabit per second (Mbps), and penetration of ultra-fast broadband (i.e. subscriptions above 100 Mbps) in 50% of European households (EC, 2010).[2] These faster conditions are achieved through a 'Next Generation Access' (NGA), i.e. access through networks "*which consist wholly or in part of optical elements and which are capable of delivering broadband access services with enhanced characteristics (such as higher throughput) as compared to those provided over already existing copper*

[1] In 2010, the launch of the DAE (COM(2010) 245) acknowledged Information and Communication Technologies (ICT), and internet accessibility in particular, as fundamental leverages of innovation, economic growth and progress in the EU. The DAE contains 101 actions grouped around seven pillars and sets concrete targets to be achieved by the years 2015 and 2020. A DSM is the first pillar of the DAE. In 2014, its achievement was included among the ten priorities of the Juncker Commission and one year later (May 2015) a DSM strategy (COM(2015) 192 final) was launched outlining a series of interventions by the Commission to boost progress in the different thematic areas relevant to the completion of the DSM.

[2] Within the DAE, three levels of broadband speeds are considered: 2, 30, and 100 Mbps. Access at downstream speeds between 30 and 100 Mbps is considered as 'fast broadband' and at rates higher than 100 Mbps as 'ultra-fast broadband'.

networks" (DAE Broadband Glossary).[3] A Next Generation Network (NGN) is often obtained by upgrading existing copper or co-axial access networks and has a speed between 30 Mbps and 100 Mbps. High speed NGN broadband connections have a speed over 100 Mbps (i.e. ultra-fast) and, more typically, of 1 Gigabyte per second.

The first part of this study focuses on the review of the state of the art of broadband infrastructures deployment in areas generally considered unprofitable for investment by private operators.

1.2 Definition of the areas addressed by the study

Based on the assumption that characteristics such as rurality, remoteness and low population density contribute to make an area unattractive for private investors to get involved in ICT infrastructures deployment, this study focuses on the 'predominantly rural', 'remote' and 'sparsely populated' (RRS) areas of the EU. These areas are defined coherently with the urban–rural typology of Eurostat. This choice allows our work to be framed into an official classification based on territorial administrative units. Definitions of these areas are provided in Table 1.

Table 1. Definition of rural, remote and sparsely populated (RRS) areas

	Definitions (Eurostat, 2014)
Rurality	A NUTS3 is 'predominantly rural' "*if the share of population living in rural areas is higher than 50 %*". It is 'intermediate' "*if the share of population living in rural areas is between 20 % and 50 %*".
Remoteness	The 'remoteness' dimension is considered within the urban–rural typology of Eurostat with respect to 'predominantly rural' and 'intermediate' territorial units. If less than half of the residents of a predominantly rural or intermediate NUTS3 can reach a city of at least 50,000 inhabitants within 45 minutes, the territorial unit is considered to be 'remote'.
Sparsely populated	These areas are defined as having a population density below a given threshold. The threshold is set at 8 inhabitants per km² at NUTS2 level, and at 12.5 inhabitants per km² at NUTS3 level.

[3] NGA includes the following technologies: Fibre to the Home (FTTH), Fibre to the Building (FTTB), Cable Docsis (Data Over Cable Service Interface Specification) 3.0, VDSL and other broadband with at least 30 Mbps download.

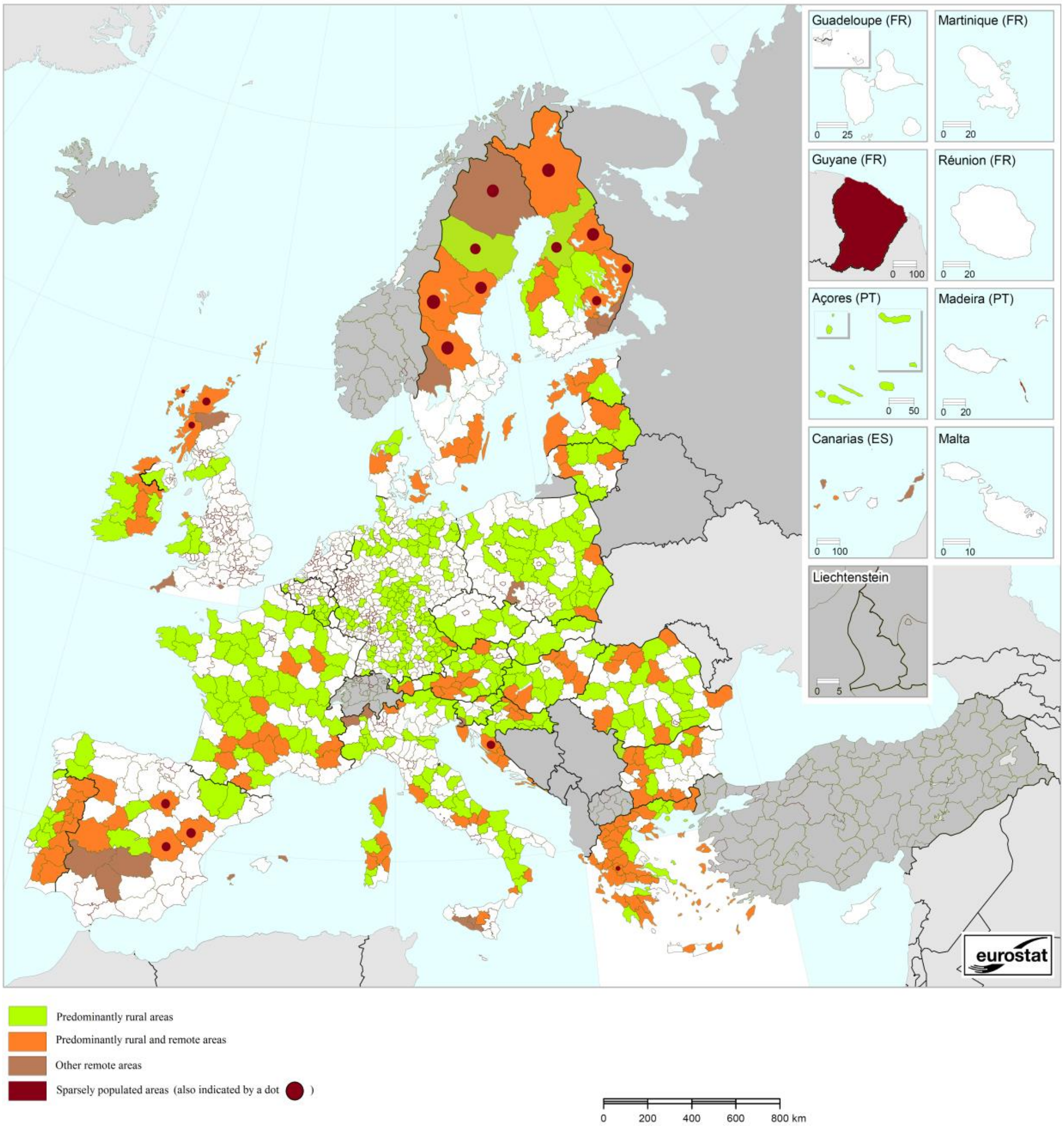
Map 1 shows the area covered by this study at NUTS3 level. As rurality, remoteness and low population density may overlap over an area, the following classes have been distinguished: predominantly rural areas (green), predominantly rural and remote areas (orange), other remote areas (i.e. remote areas which are not rural) (light brown), and sparsely populated areas (purple or purple dot).

1.3 Broadband coverage in RRS areas

1.3.1 The urban-rural digital divide in the EU

Digitalisation of the society is an opportunity for progress and growth but it is also a challenge when it occurs unevenly. The asymmetric access of Europeans to the internet and other digital technologies is referred to as 'digital divide'. Recent data provide evidence that this divide still exists, in particular if fast broadband connection is considered.

Map 1. Rural, remote and sparsely populated areas in the EU

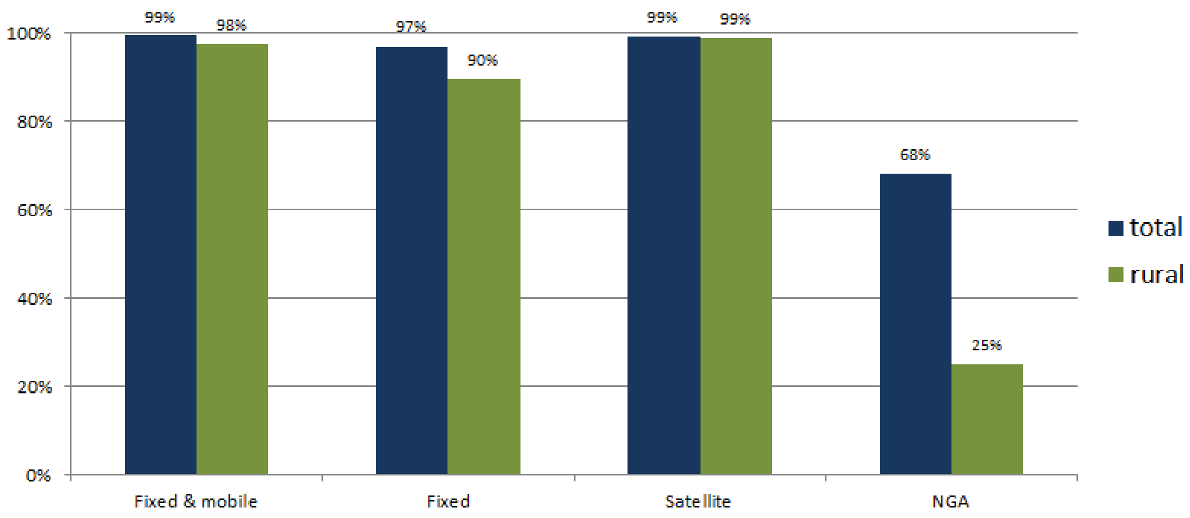


(¹) Based on population grid from 2006 and NUTS 2010.

Notes: Urban-rural typology map at NUTS3 level created with Eurostat Statistical Atlas and then modified by the authors to reflect the distinguished classes.

Figure 1 shows an overview of the EU total and rural coverage of the different broadband technologies at the end of 2014. While basic broadband coverage was achieved throughout urban and rural households, the rural coverage of fixed and, in particular, NGA technologies was limited. Notably, NGA rural coverage increased by 16 percentage points since the end of 2011, with a rather slow pace growth of 5.3 percentage points per year over the period end of 2011–end of 2014.

Figure 1. Broadband coverage at the EU level, total and rural, end of 2014

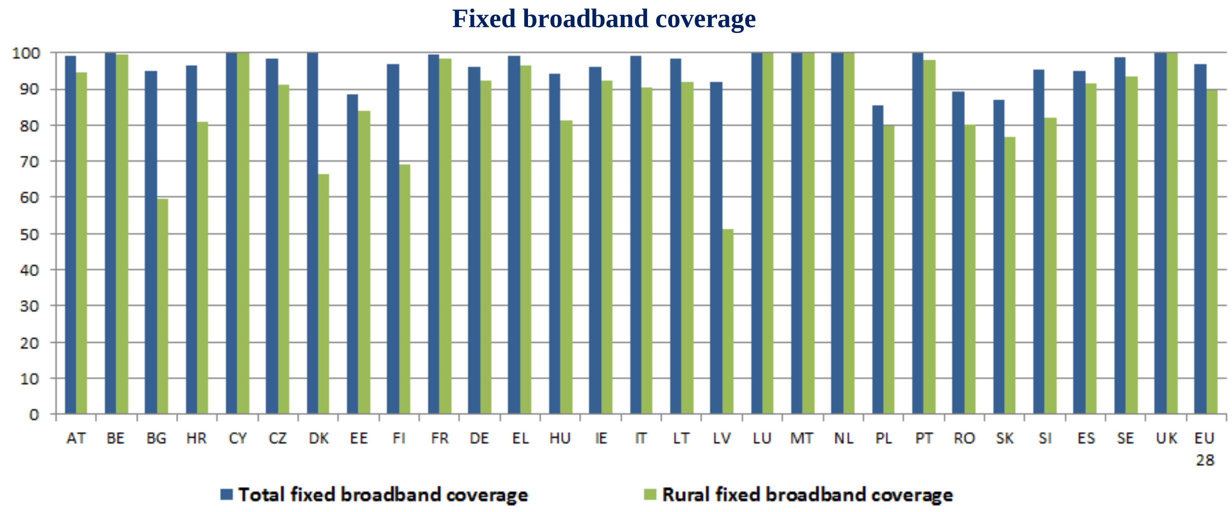


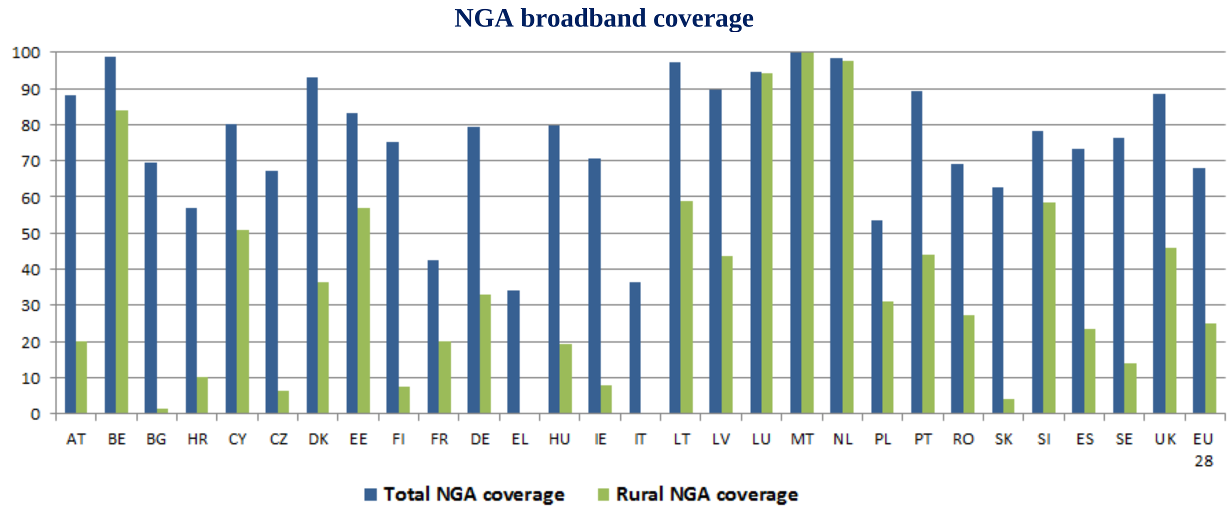
Data source: Digital Agenda Scoreboard 2015 data collected by the European Commission, DG Communications Networks, Content and Technology. Data published on the web on 18/06/2015 and accessed on 17.12.2015.

The size of the gap between total and rural coverage at the country level is shown in Figure 2 for fixed broadband technologies (top chart) and NGA technologies (bottom chart). By focussing on the next DAE targets for fast and ultra-fast broadband, the data highlight that none of the EU28 countries has so far reached the target of 100% NGA coverage. In addition, rural coverage of NGA is evidently lagging behind across the whole EU, even if some Member States (MS) are performing (much) better than others in reaching out to rural households. It is not a case that the best performers (i.e. Malta, the Netherlands, and Luxembourg) have almost all of their area classified by Eurostat as ‘predominantly urban’ or ‘intermediate, close to a city’, i.e. with limited or nil shares of ‘predominantly rural’ areas. Countries having a rural NGA coverage below the EU average include (from the best to the worst coverage): Spain, Austria, France, Hungary, Sweden, Croatia, Ireland, Finland, Czech Republic, Slovakia, Bulgaria, Greece and Italy. Italy is the only country having reported no rural NGA coverage at the end of 2014.

In terms of **fixed broadband technologies**, DSL is the most common connectivity approach across the rural EU. It is widely available in almost all countries, with the exception of the three Baltic States. The Worldwide Interoperability for Microwave Access (WiMax) technology follows at a significant distance. Twelve countries have no or below 2% rural WiMax coverage but this technology contributes greatly to the coverage of some countries (e.g. Lithuania, where WiMax rural coverage is about 84%). Finally, cable broadband is only available to 10% of the rural households throughout the EU while total coverage by cable is 43%.

Figure 2. Broadband coverage, total and rural, by country, end of 2014





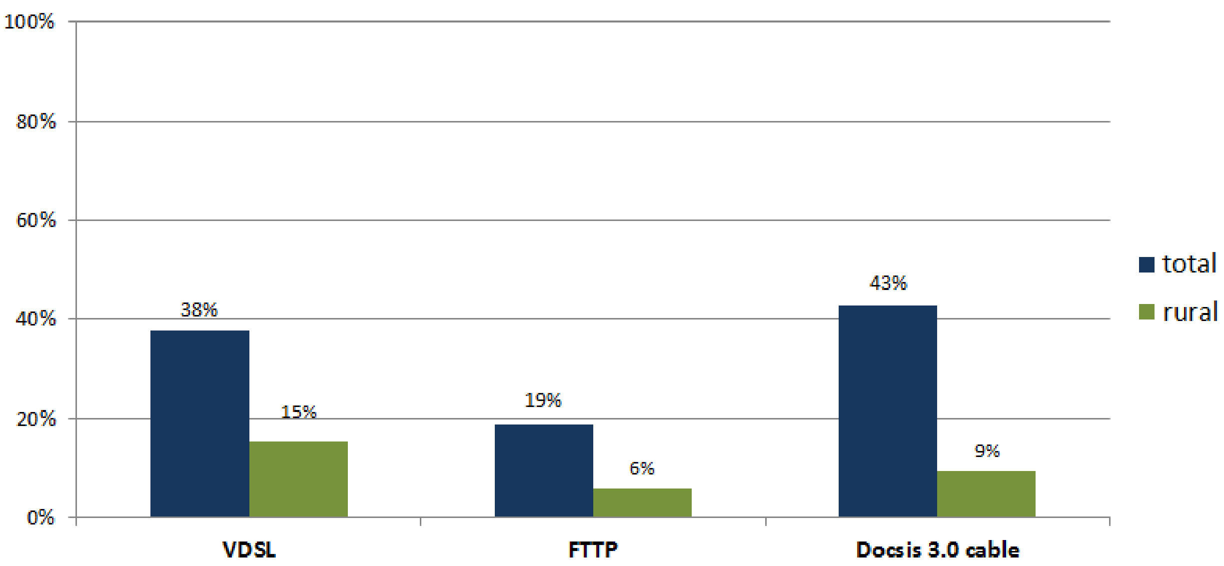
Data source: Digital Agenda Scoreboard 2015 data collected by the European Commission, DG Communications Networks, Content and Technology. Data published on the web on 18/06/2015 and accessed on 17.12.2015. Countries are ordered alphabetically in both charts to facilitate the comparison.

With regard to **mobile broadband technologies**, High Speed Packet Access (HSPA) provides the widest rural broadband coverage in the EU after satellite broadband. Only Czech Republic, Belgium, Portugal, Slovakia and Germany have a rural HSPA coverage below 80%. Rural Long Term Evolution (LTE) coverage is less common but plays a significant role (i.e. above 50% coverage) in Denmark, Sweden, the Netherlands, Luxembourg, Slovenia, Germany, Estonia, Ireland, Portugal and Finland.

The **satellite technology** covers the whole of the EU territory, with the same reach out capacity in both urban and rural areas. The coverage is incomplete only in the three Baltic countries of Estonia (75%), Lithuania (50%), and Latvia (20%). For the rest of Europe, the technology is able to provide a broadband connection of at least 2 Mbps and in some sparsely populated and remote areas it represents the only option so far available (EC, 2015).

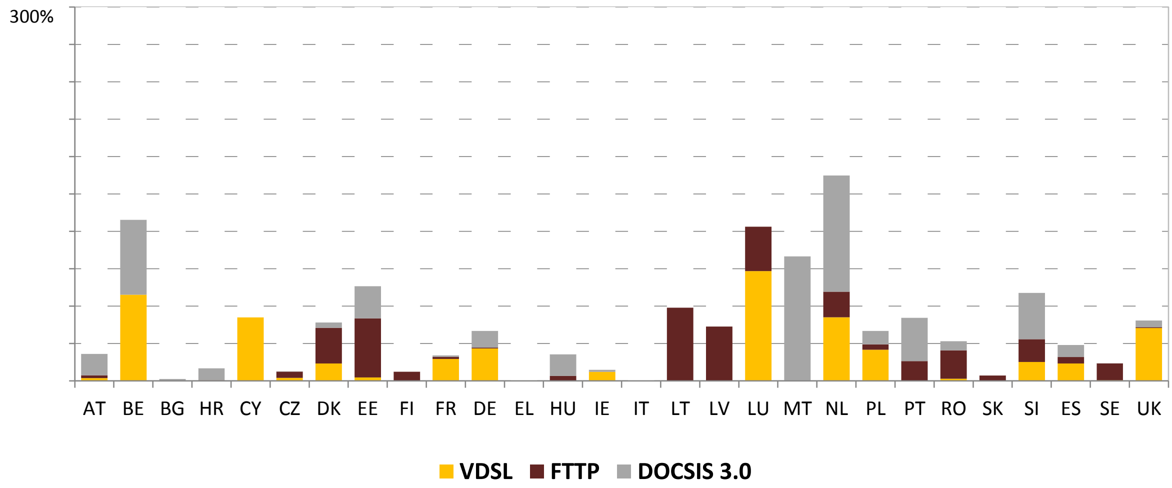
In terms of **NGA broadband technologies**, VDSL is the most common in rural areas, followed by DOCSIS 3.0 and then FTTP networks (Figure 3). Figure 4 shows the contribution of the main NGA technologies to the rural coverage of each country at the end of 2014. Box 1 explains the basic concepts of infrastructure, technology and network.

Figure 3. Main NGA technologies at the EU level, total and rural, end of 2014



Data source: Digital Agenda Scoreboard 2015 data collected by the European Commission, DG Communications Networks, Content and Technology. Data published on the web on 18/06/2015 and accessed on 17.12.2015.

Figure 4. Contribution of main NGA technologies to rural coverage, by country, end of 2014



Data source: Digital Agenda Scoreboard 2015 data collected by the European Commission, DG Communications Networks, Content and Technology. Data published on the web on 18/06/2015 and accessed on 17.12.2015. Notes: Each of the three considered technologies may reach the full coverage of rural households (i.e. 100%). Therefore, the maximum level of coverage against which the contribution of each technology is measured is 300%.

Box 1. Infrastructure, technology and network

Infrastructure, technology and network are well-distinguished concepts. The '**passive infrastructure**' is at the basis of a broadband network. Passive infrastructure is a permanent asset expected to last for decades. It includes ducts, cables (copper wires, coaxial cables, or optical fibres), premises, poles, or antenna towers and sites for wireless (radio and satellite) technology. The '**technology**' is what allows the transmission of the information over the infrastructure. The technology is implemented through an '**active equipment**' component such as routers, switches, management servers, and DOCSIS. The active equipment is expected to last less than 10 years as it changes along with technological progress. Importantly, the physical properties of the infrastructure determine the performance of the technology. Hence, it is also necessary to tackle the most effective combination of the two. A '**broadband network**' encompasses the passive infrastructure and the active equipment at three different hierarchical levels: at the regional or municipal level is the '**backbone**' network, usually consisting of a ring of fibre optic cable connecting the areas falling under the administration; the '**area**' network is an aggregation point, usually corresponding to a settlement, a village or a defined area; finally, '**first mile**' connections link individual homes, buildings, factories, hospitals, etc. to the area network. Notably, not all technologies are equivalent for high speed connection. Even if the choice of the technologies is finally determined by the local context, the ENGAGE (Enhancing Next Generation Access Growth in Europe) project recommends prioritising the technologies according to the following order: fibre to the premises, cable networks, fibre to the cabinet, long range wireless, ADSL and related technologies, and then satellite. In fact, fibre connections are considered "*the only long term sustainable infrastructure*" for high speed broadband (ENGAGE, 2014).

Source: EC, 2014.

1.3.2 State of NGA coverage and ICT take-up in RRS areas

With a view to monitor the progress of the DAE targets on broadband coverage, the EC has regularly commissioned independent studies. The study on '*Broadband Coverage in Europe 2014 - Mapping progress towards the coverage objectives of the Digital Agenda'* published in October 2015 provides information on the state of the art of broadband and NGA coverage at the end of 2014. Statistics are publicly available at the national level, while at the territorial level the information is only disclosed to the public as maps. These maps detail the information at NUTS3 level. The broadband coverage studies commissioned by the EC so far use a different definition of rurality than the one of Eurostat.[4] For the scope of our analysis, in order to tailor the latest information on NGA coverage to the Eurostat urban–rural typology, we have considered the data on total NGA coverage and overlapped it to our target area, i.e. over the predominantly rural, remote and sparsely populated NUTS3. The result is shown in Map 2.

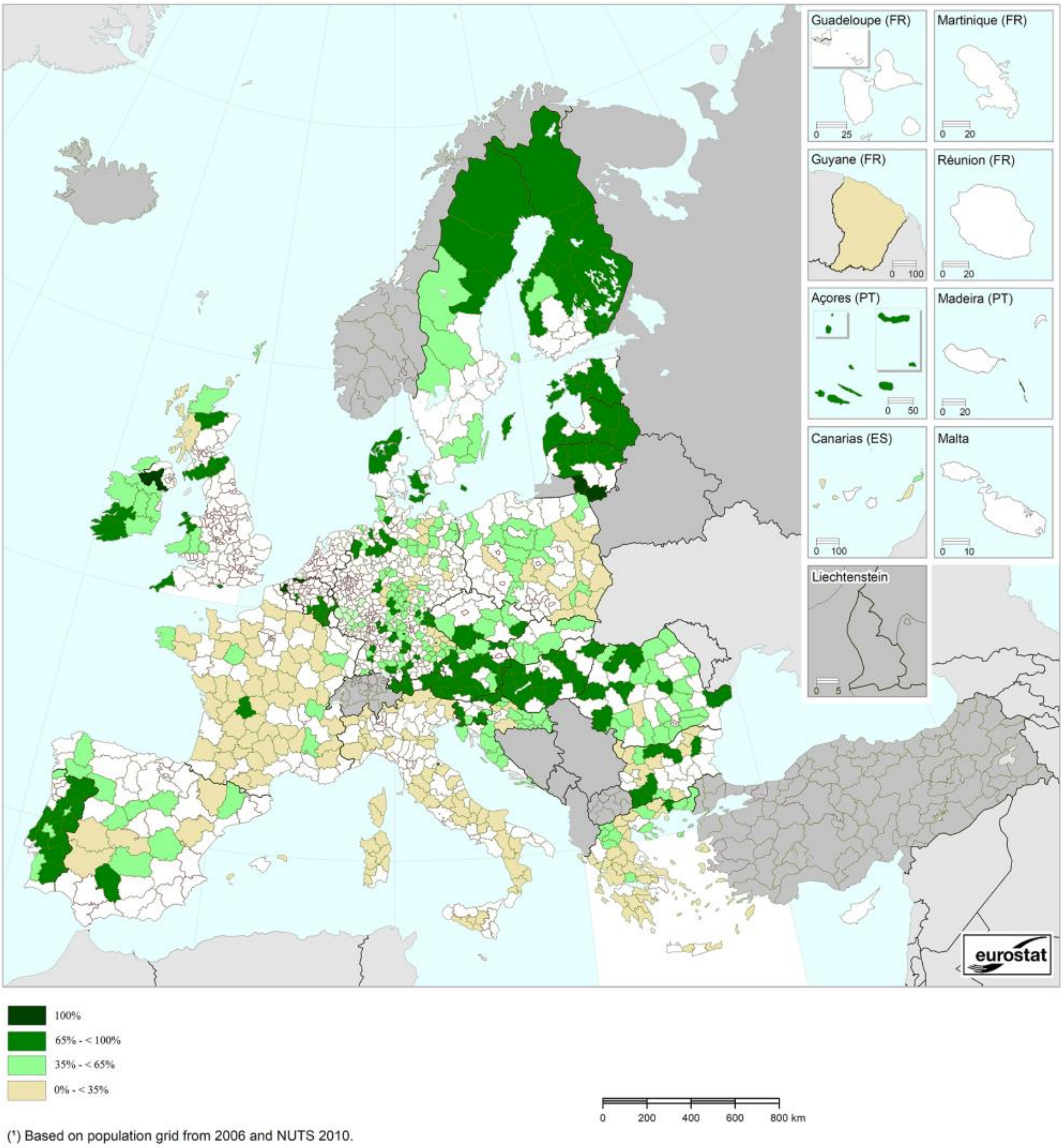
The DAE targets of having the EU covered by basic or fast/ultrafast broadband infrastructure refer to the theoretical possibility for households and enterprises to access a broadband connection but not to the **actual** connection to the network. In fact, part of the digital divide is also determined by a differentiated uptake of ICT across the EU as for every European to become digital "*two preconditions are necessary: having the internet accessible by users, and having individuals who have the capacity and willingness to use the internet*" (COR, 2015). The NGA coverage reported on Map 2, for example, refers to the percentage of households being able to subscribe to the service **if they wish to do so**. Instead, for the actual uptake of broadband connection, two indicators are commonly used: the 'broadband penetration', expressed as the number of fixed and/or wireless broadband subscriptions (lines) per 100 persons; and the 'broadband access', expressed as the share of households having a fixed and/or wireless broadband connection. Since statistics at NUTS2 level are not available for broadband penetration, our reference is, in Map 3, to the latest data available on broadband access.

Map 3 provides evidence that broadband access is much lower than the broadband coverage, meaning that there are areas where broadband connection is available but it is not taken up by end-users. Broadband access is therefore a proxy indicator for ICT preparedness. In other terms, we may assume that households accessing standard broadband are potentially ready to enhance the technology, if available, as they are expected to handle increasing data traffic volume and to take advantage of improved tools and services made available on

[4] In these studies, rural areas are defined as areas with less than 100 persons per km^2.

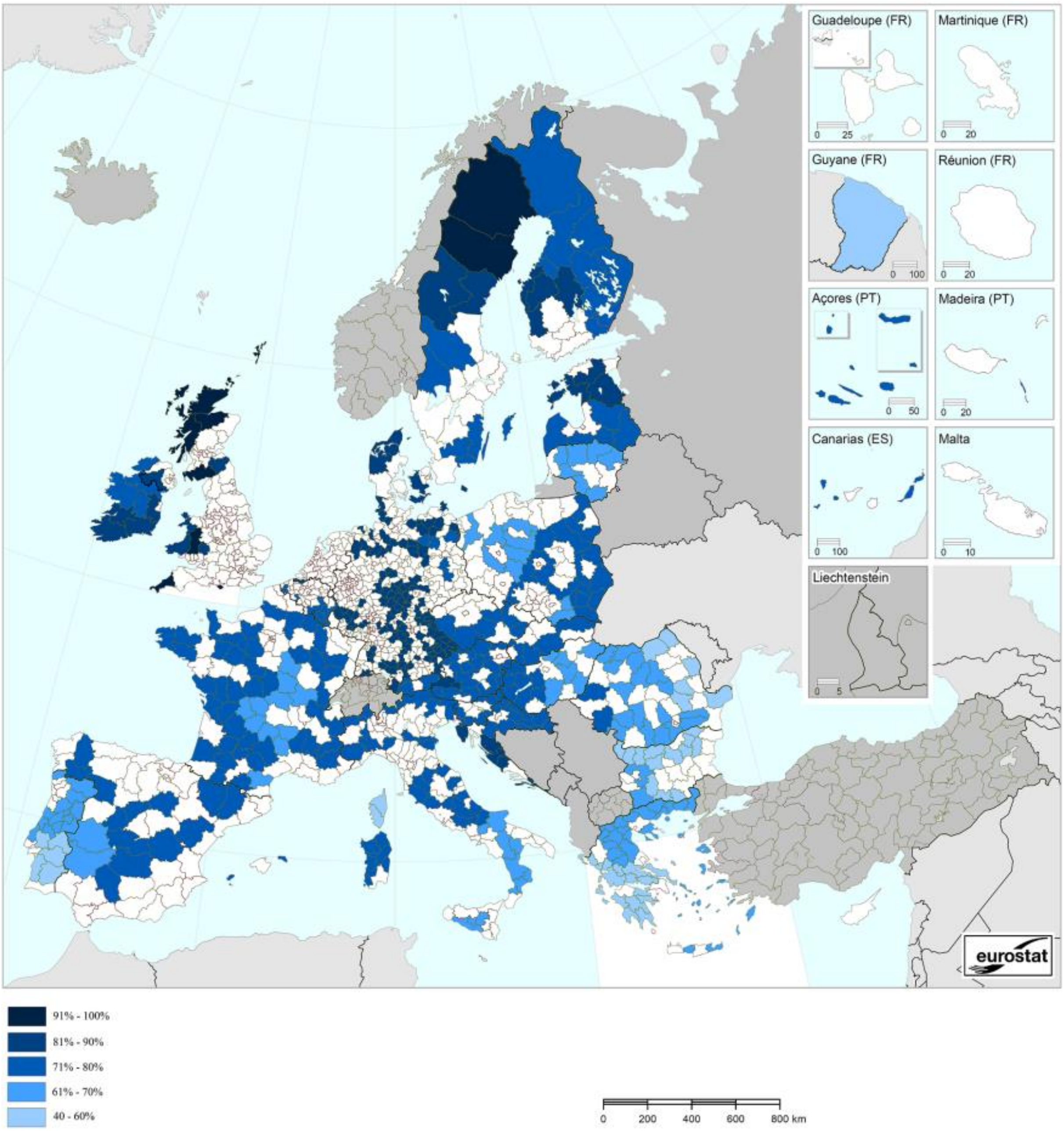
the internet. Meanwhile, areas where access is limited are likely to express a limited demand potential.

Map 2. NGA coverage in rural, remote and sparsely populated areas, 2014



Notes: the information is derived from the maps included in the report on Broadband Coverage in Europe in 2014 (EC, 2015). Data for Guyane (FR) and Azores (PT) refer to 2012 and are from EC, 2013a. Map created by the authors. The administrative boundaries map is taken from the Eurostat Statistical Atlas.

Map 3. Share (%) of households with broadband connection (broadband access), 2015



(') Based on population grid from 2006 and NUTS 2010.

Notes: statistics are from Eurostat table [isoc_r_broad_h] = Households with broadband access, last updated on 11.12.2015. Year: 2015, with the exception of Austria and Slovenia (2014). Geo coverage: NUTS2 level, with the exception of Germany, Greece and Poland (NUTS1). Map created by the authors. The administrative boundaries map is taken from the Eurostat Statistical Atlas.

1.3.3 *Classification of RRS areas and common challenges to connectivity*

The potential demand for NGNs is relevant in the light of defining investments for upgrading the existing broadband infrastructures or deploying new ones. On the basis of the existing NGA coverage and ICT preparedness level, we distinguish **six groups of RRS areas**. Groups 1, 2 and 3 are characterised by low ICT preparedness, i.e. the share of households having a broadband connection is ≤ 70%. Furthermore, in Group 1 the NGA coverage is lagging behind (< 35%). In Group 2, the NGA coverage is between 35% and 65% of the households. In Group 3, the NGA coverage is high and over 65%. Groups 4, 5, and 6 have all a good level of ICT preparedness, i.e. over 70% of the households have a broadband connection. Similarly to the previous three groups, in Group 4 the NGA coverage is lagging behind (< 35%). In Group 5, the NGA coverage is between 35% and 65% of the households. In Group 6, the NGA coverage is high and over 65%. The characteristics of the six outlined groups are summarised in Table 2.

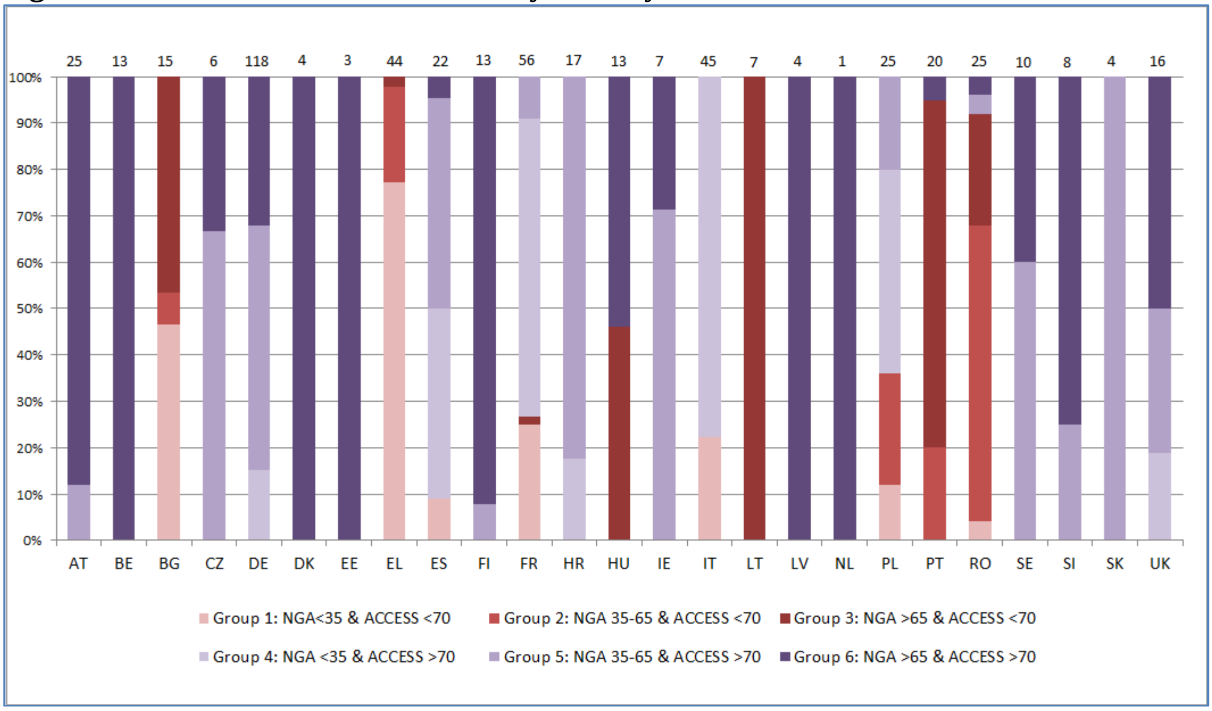
Table 2. Classification of RRS areas according to NGA coverage and ICT preparedness levels

Group 1	**Group 2**	**Group 3**
Low ICT preparedness: % of households having a broadband connection ≤ 70%		
NGA coverage < 35%	35% ≤ NGA coverage ≤ 65%	NGA coverage > 65%
Group 4	**Group 5**	**Group 6**
High ICT preparedness: % of households having a broadband connection > 70%		
NGA coverage < 35%	35% ≤ NGA coverage ≤ 65%	NGA coverage > 65%

There are 522 NUTS3 categorised as RRS areas across the EU. Figure 5 shows the classification of these areas in each country and according to the above grouping criteria. The NUTS3 belonging to each group are listed in Appendix I.

On the top of each bar of the chart in Figure 5 the number of RRS areas (i.e. of NUTS3) found in every Member State is reported. For example, in the Netherlands there is only one RRS area, which belongs to Group 6. Germany has the highest number of RRS areas (118), all of which have high levels of ICT preparedness but are differentiated in terms of NGA coverage (hence, they belong to Groups 4, 5, and 6). The same high level of preparedness is found, for example, in all the RRS areas of Slovenia, Slovakia and of the UK. Instead, all the 44 RRS areas located in Greece are characterised by low levels of ICT preparedness and hence belong to groups 1, 2, and 3. The same situation applies to Bulgaria. Belgium, Denmark, Estonia, Lithuania, Latvia, the Netherlands and Slovakia have all their RRS areas falling in one single group, i.e. there is no variability at the country level. Instead, Romania, for example, is characterised by a high variability of classification, as its 25 RRS areas belong to five different groups.

Figure 5. Classification of RRS areas by country



Notes: Raw data are from EC, DG Communications Networks, Content and Technology and from Eurostat. Åland, in Finland, is not classified due to absence of data on broadband access.

In general, it is noted that areas belonging to Groups 1, 2, and 3 are mostly found in Bulgaria, Greece, Lithuania, Portugal and Romania. RRS areas belonging to these three groups are likely to be the most challenging in terms of future deployment of fast and ultrafast broadband infrastructures as their readiness level is low.

Importantly, the most populated groups are those with a broadband access above 70% (i.e. Groups 4, 5 and 6). This means that, overall, there is a satisfactory level of ICT preparedness across RRS areas and hence a good potential for demand of enhanced broadband connections. Finally, the classification highlights those RRS areas which are already enjoying a reasonably good NGA coverage and have a good level of readiness. These RRS areas belong to Group 6 and are soon likely to achieve the 2020 DAE targets of 100% coverage of fast broadband. They are commonly found in Austria, Belgium, Denmark, Estonia, Finland, Latvia, the Netherlands and Slovenia.

Our classification shows that the situation of RRS areas is quite differentiated across countries and, in some cases, also within countries. Nevertheless, RRS areas face some common and recurrent challenges with respect to the deployment of broadband infrastructures. These challenges are summarised in Table 3.

Table 3. Common challenges to broadband infrastructure deployment in RRS areas

Challenge	Comments
Lower demand	If structural, a lower demand is determined by the low density of the population. If societal, it is determined by the lack of interest or capacities to access the service. If economic, it may be due to the lower competition among service providers which is reflected in higher prices to the potential customers for accessing broadband services. Lessons learnt from the past indicate that broadband investments need to be sufficiently linked to the real uptake of the technology by the end-users. However, the problem is that there might be insufficient evidence on the market feedback on this specific aspect in RRS areas.
Fragmented demand	Geographical distance between potential customers constrains the achievement of economies of scale.
Higher deployment cost	Caused by remoteness and/or terrain conditions of the area (e.g. mountainous).
More difficult selection of the technology	ICT infrastructures need to be considered as a long-term investment (50 years) but nowadays technological needs may vary hugely in 10 years' time. Selection of the most 'lasting' or flexible technology which is expected to remain valid and functional with respect to increasing standards and demand requirements (e.g. download and upload speed) is essential. Lessons learnt from the past indicate that a successive upgrade should be avoided as far as possible.
Higher maintenance costs	The absolute costs to maintain a widely distributed network (human costs, transport costs, assets and replacements) are higher in RRS areas than in a concentrated space. Higher absolute maintenance costs and lower audience may be reflected in higher unit costs per customer and represent a deterrent to accessing the network.
Lower availability of other existing infrastructures	The sharing of existing physical infrastructures (e.g. those of utility companies) is considered a great opportunity to reduce the costs but RRS areas may not provide a great range of alternatives to the digging of new cable pipes in the ground.

Part 2: Typology of existing tools and instruments to finance ICT infrastructure

Part 2 first reviews the barriers to ICT infrastructure investments in RRS areas and then describes feasible ways to finance the deployment of broadband infrastructures in these areas. As telecommunication services are nowadays mostly provided on a competitive basis, financial returns are the main trigger of investments in broadband infrastructure. This leaves any social consideration to a compensatory public policy action. In RRS areas, the analysis of the impacts of enhanced broadband access may highlight the existence of alternative drivers to the usual market dynamics. These drivers may be able to attract private telecom/service providers and network operators and/or to justify higher spending in these areas by the public sector.

2.1 Characteristics of ICT infrastructures investment and barriers in RRS areas

A broadband network consists of a passive infrastructure and a number of active equipment components (Box 1). The passive infrastructure is usually deployed by a network operator or by an actor taking up this role. Most of the investment in a broadband network is absorbed by the passive physical infrastructure that is considered as a long-term, if not a permanent, asset. In general, an investment in broadband infrastructure is characterised by:

- High initial deployment costs which typically create natural monopolies.
- High capital expenditure (CAPEX) to acquire assets, services and human capital needed to deploy or upgrade the passive infrastructure as well as to implement and upgrade the active layer.
- Low operational expenditure (OPEX) for maintaining and running the infrastructure and active layer towards the provision of services.
- Stable returns with low rates over a long-term period, determined by granting service providers access to the network, without, *de facto*, competition (i.e. typically, network owners stipulate medium- to long-term access contracts with service providers).
- Limited reduction of the marginal costs, determined by the fact that the enlargement of the scope of the infrastructure is not related to a reduction

of deployment costs. Nevertheless, some economies of scale can be achieved with regard to the maintenance of the infrastructure, in particular in urban and intensely populated areas.

These characteristics of the investment in broadband translate into a number of additional barriers towards the deployment of ICT infrastructures in RRS areas, as summarised in Table 4.

Table 4. Barriers to ICT infrastructures investment in RRS areas

Barrier	Comments
Capital intensive	Investments for broadband deployment imply a significant economic effort if they are to be met only by the concerned (local and/or regional) public entities. A crucial role will be played in this sense by the Directive 2014/61/EU on '*Measures to reduce the cost of deploying high-speed electronic communications networks*', once the Directive is transposed into national legislation by MS within 1 January 2016; but also by the availability of innovative financing instruments supporting higher risk projects, not implying additional burdens on or indebtedness of public budgets, and able to drive capital markets towards the financing of projects.
Size of the market (niche markets)	The size of the intervention in RRS areas may be too small to attract big investors. Most of these areas in the EU are considered as 'niche markets'. Investment strategies need to be tailored to smaller and more flexible operators which may have the appropriate costs structure to invest in these markets.
Lower revenue	Determined by higher unit costs to serve a customer compared to urban areas.
Higher risk	Lower return on investment compared to urban or high-demand areas (without considering social gains, which are, however, not computed in the investment decision by service providers and telecom network operators).
Longer pay-back period	Determined by a lower number of customers with respect to demand-intense areas.
The 'competition versus investment' dilemma	Investment decisions shall guarantee a balance between incentives for private investments and the safeguarding of competition. Also, public funding used for broadband deployment shall leverage private investment and not replace it.

Considering the characteristics of ICT infrastructures investment and the barriers to such an investment in RRS areas, different levels of involvement by public authorities may be envisaged. Such involvement needs to be considered with regard to the business model, the funding modalities, and the investment model for the undertaking of the upgrading or deployment works. The **business model** defines the role of all stakeholders involved in the deployment of the physical infrastructures, in its operation and maintenance as well as ownership. It also defines the operation, maintenance and ownership of the active equipment, and regulates the provision of services to the end-users. The business model further details the relationship among these actors. The **funding modalities** explain how the deployment, operation and maintenance of the network are financially supported, i.e. from where the necessary resources originate. Finally, the **investment model** defines how the public (local or regional) authorities are involved with respect to the investment for the development of a broadband network. According to the four main investment models identified in the *Guide to High-Speed Broadband Investment* (EC, 2014), the authority may: (1) be directly involved (direct investment); (2) delegate the development to the private sector (indirect investment); (3) empower the communities to develop the network ('supportive' investment); or (4) subsidising an operator ('filling the gap' investment) through grants, to make the intervention of the operator commercially attractive. Box 2 reports on the main considerations to be made when determining the most suitable investment model. It is to be noted that, with the exception of the satellite technology, whose deployment is governed at the national or the supra-national level, the type of broadband network infrastructure to be deployed or upgraded does not substantially affect the selection of the business model, the funding modalities and the investment model.

Box 2. Identification of the investment model

The most appropriate investment model should be selected taking into account the:

- State of the current infrastructure, when it exists, in order to understand the entity of the needed investment.
- Goals of the new/upgraded network.
- Number and type of network players already existing and operating in the area.
- Respect of the neutrality of the network, in order to ensure fair competition among service providers for accessing it.
- Public interest in the ownership of the infrastructure, both in terms of revenues and social benefits.
- Sustainability of the deployment intervention and of the ICT infrastructure.

Source: EC, 2014.

Therefore, LRAs may have multiple roles. They are, of course, part of the business model, at least for the definition of the ownership and of the operation modalities of the infrastructure. They may be directly or indirectly part of the investment model. And they may also cover the majority of the demand of network access at the local level to achieve the connectivity of public services such as hospitals, schools, police and emergency utilities and, of course, public administration (EC, 2014). Indeed, the exploitation of broadband networks for the delivery of these public utilities and services may act as a leverage to promote private business and individual demand of broadband access. Finally, LRAs may arrange for the direct funding of the deployment of ICT infrastructure or for the mobilisation of other (private, community) funds or financial instruments (e.g. guarantees, corporate financing). They may act as promoters of public private partnerships, initiators of a federation of regions as public buyer, promoters of citizens' aggregation to ensure the supply of the service, or even as 'anchor tenants'[5] to reduce demand risk.

2.2 Main tools and instruments to finance broadband deployment

We **outline four main types of tools and instruments** used to finance broadband network deployment by LRAs:

1) Contractual arrangements.
2) Multi-stakeholders engagements.
3) Strategic frameworks.
4) EU funding instruments.

Within the first and second type our description is structured around three main elements:

(i) Adopted business model for the deployment/upgrade (i.e. roles and responsibilities, including at the administrative level) and the management of the new/upgraded infrastructure (i.e. ownership and governance). Emphasis is given to distinguish between the role of the public authority (i.e. LRAs) and the role of the main private actors involved (i.e. network operators and service providers).

(ii) Sources of funding (public, private, or combined) and the investment model (i.e. risk and revenues distribution).

(iii) Considerations on the applicability in RRS areas.

[5] The 'anchor tenant' is a subject able to act as primary attractor for suppliers by generating the initial demand flow.

2.2.1. Type 1: Contractual arrangements

Contractual arrangements between public administrations and private actors for specific projects/initiatives of large relevance are commonly managed through a partnership. In particular, a public private partnership (PPP) implies a contractually binding relationship between a public authority and one or more private entities, allowing the sharing of assets, skills, and resources among partners. Risk, exposure, responsibility, and benefits vary according to the role and tasks each partner is willing to bear within the PPP. The PPP has been frequently used for the deployment and management of public infrastructures, in particular through the creation of a 'Special Purpose Vehicle' (SPV), i.e. a new legally recognised business initiative.

2.2.1.1 Public Design, Build and Operate

The public Design, Build and Operate (DBO) approach is also known as Publicly Run Municipal Network Model. Usually, a public DBO without a PPP does not imply economic revenues and the main goal remains the deployment or the upgrade of the infrastructure. This possibility is illustrated through the IT-*Norrbotten* case, in Sweden (Part 3). When a PPP is envisaged, the achievement of social benefits goes along with the tackling of higher efficiency in infrastructure management and profit-making for all partners involved. This possibility is illustrated through the case of *Wielkopolska*, in Poland (Part 3).

Adopted business model for the deployment/upgrade of the infrastructures
In this approach the public authority has a prominent role. This approach implies the establishment *ex novo* of a Special Purpose Vehicle as a separate entity. The SPV may also be implemented as a dedicated division of an existing utility company. In both cases, the SPV has the specific aim of designing and deploying the infrastructure according to the interest and needs of the public authority. Even if the public authority is playing a dominant role in the partnership, the participation of the private sector in the PPP (i.e. network operators) would ensure that relevant expertise is brought in. The SPV acts as a deputed entity and deploys the infrastructure via direct initiative or public procurement on the market. In the latter case, the competition is open only to network operators, and not to service providers, in order to ensure the neutrality of the network.

Adopted business model for the management of the new/upgraded infrastructures

The public authority owns the physical infrastructure and finances the construction of the new assets, with the investment being paid back by selling the access to service providers under non-discriminatory market conditions. In order to attract service providers, a consistent demand needs to be ensured and public authorities themselves may constitute a primary source of demand to support eGovernment service provision, with the potential to leverage additional private sector and individuals' demand.

Sources of funding and investment model

Although taxpayer money is the most common source of funding of a public DBO, evidence demonstrates that alternative funding sources such as bank loans or revenues from dark fibre leasing are also used. Provided that once constituted the SPV behaves as a commercial entity, the public financial contribution can take the form of: equity (cash, stocks, or physical assets), for which the authority receives shares equivalent to the value of the contribution to the capital; or debt (cash, medium- to long-term bonds or guarantees, offered with market interest rates).

Applicability in RRS areas

In this approach, the leading role played by the public authority implies that social benefits are implicit in the investment decision. Hence, provided that the necessary financial resources are available, this approach is highly suitable for RRS areas. The involvement of private network operators may further lead to economic benefits in terms of time and cost savings, as a consequence of their profit-oriented approach. The public DBO has been frequently implemented in north European countries with valuable results in terms of coverage, service availability, end-users affiliation, competition levels, and financial sustainability (EC, 2014). Box 3 reports on an example from Finland where the delegated entity is fully owned by public authorities. Box 4 illustrates a case from the UK where the SPV includes both public and private actors.

Box 3. *Suupohja* fiber in rural Finland

Suupohja is located in *Etelä-Pohjanmaa*, a predominantly rural and remote area (RRS FI194) belonging to Group 5 of our classification. With a population density of 8.8 persons per km^2, *Suupohjia* was not considered sufficiently attractive to invest in by national telecom operators. In 2004, over 50% of the villages of the area had still no broadband access. In 2005, five municipalities founded the *Suupohjan Seutuverkko Oy*, a non-profit limited company whose scope was to bring broadband network in the area. First, trunk connections to the municipality centres were made. This was followed by network extensions to built-up areas and villages by leading optical fibre connections all the way into the houses. Deployment started in 2005 and is still on-going. The company, which comprised seven municipalities in 2013, owns the passive and active infrastructure and is in charge of maintenance. Total investment is EUR 10.1 million and is expected to provide a positive return on investment (ROI) in 8-10 years. The initiative is funded by combining a bank loan, guaranteed by the municipalities, with national funding and a one-time connection fee of EUR 1,500. Any Internet Service Provider (ISP) has free use of the open access network.

Source: FTTH Council Europe, 2014.

Box 4. Shetland SHEFA 2 Interconnect Project, UK

Shetland is a subarctic archipelago of Scotland that lies north-east of the island of Great Britain (RRS UKM66, belonging to Group 5 in our classification). The SHEFA 2 Interconnect project relates to the provision of a backhaul network infrastructure connecting the main town in the Shetland Islands (Lerwick) to an existing sub-sea cable. This NGN will enable access to reliable, high capacity and affordable bandwidth. The project is part of the Shetland Islands Council's (SIC) 'Digital Shetland' strategy which aims to ensure that 80% of Shetland's communities are connected to a fibre optic backbone by March 2016. Total cost is EUR 1.7 million, funded through ERDF (approximately 25%) and SIC funds. This project is an example of public DBO relying on the use of public funds (State aid) to address market failure in the provision of broadband services. SIC finances the infrastructure, which is then fully publicly owned. Management and operation of the network is expected to be through a SPV, i.e. a partnership between SIC and a private telecoms operator selected through a tender procedure. The SPV will be independent from the SIC, will benefit from the expertise brought in by the selected operator, and will manage the network on an open access wholesale basis. As a return of the funding, part of the profits of the SPV are expected to go back to the SIC.

Sources: Shetland SHEFA 2 Interconnect project sheet; EPEC, 2012.

2.2.1.2 Public outsourcing

Public outsourcing is an approach also known as the 'concession model' or Privately Run Municipal Network Model.

Adopted business model for the deployment/upgrade of the infrastructures

This approach is based on the outsourcing of the deployment, implementation and running of the broadband network by LRAs to a private actor on the basis of public procurement. The NGA cluster in *Nordhessen*, Germany, illustrates a concession model implemented by a federation of public authorities (Part 3).

Adopted business model for the management of the new/upgraded infrastructures

In terms of management, the public authority keeps the ownership of the passive infrastructure but establishes an operation contract with a private firm, typically in the form of indefeasible right to use. The contracted firm sustains the business risk and receives the revenues derived from the selling of the access to the network by service providers all along the contract period. At the end of the contract with the selected private actor, the operation of the network passes back under the responsibility of the public authority which may decide to renew the contract to the original operator, manage the network by itself, or stipulate a contract with a different actor. The incumbent is expected to build a neutral network over which competing broadband providers can deliver their services to the end-users.

Sources of funding and investment model

Funding has to be provided by the public sector. The public authority minimises the risks related with the operation of the network by outsourcing it to a private operator. A negative side effect may be related to the reduced control by the public authority over the operational management of the network. The neutrality of the network may be guaranteed by including a condition in the procurement procedure or by barring the firm which builds and operates the network from the delivery of its own services on the same.

Applicability in RRS areas

Due to the fact that the private actor has to bear the operation risks, this approach might be applicable in RRS only under certain conditions, namely: (a) the presence of a network operator with consolidated interest in the area (e.g. management of broadband networks in nearby areas with potential economies of scale for expansion); (b) the presence in the area of another utility operator with an interest in expanding its business; (c) existing evidence of opportunity for valuable returns on investment (e.g. high GDP levels of the residential population). This approach has recently found application in continental Europe. An example from France is reported in Box 5.

Box 5. The Auvergne broadband project, France

Through public outsourcing to France Telecom, the Auvergne Regional Council aims at providing high speed internet, television and telephony over one single connection to 95% of the population by 2025. Three out of the four constituent NUTS3 of the region are rural areas, all of which belong to Group 1 of our classification, i.e. the group with the lowest NGA coverage and ICT preparedness level. The region is sparsely populated, with evident difficulties in finding private operators willing to invest in ICT infrastructures. France Telecom got a contract to extend the existing broadband network and operate it for 10 years. The passive infrastructure will remain under the ownership of the regional authority. The collaboration between the Regional Council and France Telecom is in the form of a PPP, where the funding is provided by the Council both for the capital investment related to the infrastructure and for paying an income to the operator. Total investment is EUR 38.5 million. Funds are from the region, the departments, the State, and the ERDF. France Telecom is responsible for the technical design and implementation of the infrastructure as well as for its operation.

Source: EPEC, 2012.

2.2.1.3 Subsidy to a network operator

This approach is also known as ‘gap-funding’ or private DBO. Its scope is limited to the upgrading of existing infrastructure.

Adopted business model for the deployment/upgrade of the infrastructures

In this approach the public authority subsidises a network owner/provider to upgrade or enlarge the existing infrastructure up to what is considered a desirable level by the authority. Hence, the public authority is not directly involved with broadband infrastructure deployment. Obviously, this approach is not possible in the absence of a pre-existing infrastructure with the potential to be upgraded. Nevertheless, in the case that this condition is met, the approach implies some benefits, including (EC, 2014):

- A comparatively simple contractual arrangement from the perspective of the public authority.
- Substantial added-value both in the competition and in the implementation phases for the network operator owning existing passive infrastructure in the area.
- The possibility to reduce the risk of a limited broadband demand because of the direct commitment of the public authority to becoming a demand driver via eGovernment service provision.

Adopted business model for the management of the new/upgraded infrastructures

In this approach the network operator is the owner of the passive infrastructure and the active equipment. The operator also manages service provision or the procedure to assign the services to a provider. The peculiarities of this approach are: the public authority funds the gap between the coverage that is commercially viable and the coverage that is desirable but not profitable for private operators at market conditions; the risks associated with the upgrading or enlargement of the infrastructures as well as for attracting customers are borne by the selected network operator.

Sources of funding and investment model

This approach may initiate a fast deployment of the desired coverage. However, it lacks a long term perspective and has a poor sustainability given the risk of the additional upgrading requirements of the network in the short-to-medium term. The application of this approach frequently relies on the mobilisation of Structural Funds but there are also cases where funding comes from LRAs own resources. In addition, a drawback of this approach is the lack of any revenue for the public authority as funding is offered as a grant to one or more private operators to upgrade their infrastructures (EC, 2014).

Applicability in RRS areas

The decision to adopt this approach in RRS areas depends on the existence of passive infrastructure and the presence of at least one active network operator. These two conditions can make this approach barely applicable in a number of RRS areas where existing infrastructure is poor and network operators are difficult to attract because of low profitability evidence. In those RRS areas where the two conditions are met, the approach allows for a rapid take-off of implementation but will not generate any return of investment for the public authority. The social return on investment is moderate if compared to situations in which the broadband infrastructure is deployed *ex novo*. Examples of this approach are found in Finland (Box 6) and in the UK (Part 3).

Box 6. Broadband deployment in North Karelia (*Pohjois-Karjala*), Finland

In North Karelia (RRS FI1D3, belonging to Group 6 in our classification), a predominantly rural, remote and sparsely populated region in Eastern Finland, broadband deployment was achieved through the implementation of a private DBO approach. Public funds were given to one local telecom operator (the only one expressing interest) as a grant to build the core infrastructure, with the obligation for the backbone to reach each household within at least 2 km and to provide services for 30 years. Last-mile access had to be financed by the same households which had to sign an agreement before the fibre was actually deployed. The first project ('North Karelia eRegio'), implemented from 2005 to 2008, aimed at providing households with basic broadband (1 Mbps) and increasing the connection coverage from 74% to 98%. The second project ('Broadband for all in Eastern and Northern Finland') had the objective of upgrading the connection to high speed broadband (100 Mbps) by 2015. The investment in the eRegio project included EUR 6.2 million from the public sector (including funds from the ERDF) and EUR 3.1 million from the private sector. The investment for the upgrading of the broadband infrastructure to high speed totalled EUR 91 million (government and EU funds).

Source: EC, 2011.

2.2.1.4 Joint Venture

The Joint Venture (JV) is a formal business agreement setting the basis of a continuous cooperation between two or more actors. JV aimed at the building or upgrading of ICT infrastructures usually represents a tool to combine the financial capacity of the public authorities with the technical competence of the private operators. The actors involved in the venture jointly exercise control over the initiative and share revenues, expenses and assets.

Adopted business model for the deployment/upgrade of the infrastructures

This approach assumes a split in ownership between the public and the private actors. The network operator takes responsibility for the design, building and operation of the broadband network infrastructure. On the other side, the public entity guarantees the initial investment needed to deploy the infrastructure. A JV may be structured as a simple formal agreement or as a new legal entity. This approach is sometimes configured as a PPP.

Adopted business model for the management of the new/upgraded infrastructures

The infrastructure is partly owned by the network operator and partly by the public entity, in line with the JV agreement. The network infrastructure is typically made available to other service providers and Internet Service Providers (ISP) on a wholesale and open access basis. Costs related with systems and processes associated with the management of the infrastructure and the on-going administration of the joint venture are shared among the participants of the venture.

Sources of funding and investment model

Public sector funding is required but funding may be also sourced from private sector partners. The capital investment of each participant is determined according to the way rewards and risks are shared. Typically, a considerable amount of the fund needed to kick-start the infrastructure deployment is covered by the public authority, in order to improve the attractiveness of the investment for the private counterparts. This major financial undertaking of the public entity in the initial phase implies more control later, over the design and construction of the network. Depending on the terms agreed, at the end of the deployment the public authority may retain its ownership in the venture or it may disinvest its share in order to recoup the initial investment.

Applicability in RRS areas

This approach requires the existence of a mutual interest of public and private actors to undertake a business initiative for the deployment of broadband infrastructures. It can be applicable in RRS areas but it implies a strong financial exposure of the public actor. Examples of joint ventures implemented to cover RRS areas are rare. The one reported in Box 7 is, in fact, a JV made up of public entities only, where the regional authority acts as the 'operator of the operators'.

Box 7. The Gigalis network in the *Pays de la Loire*, France

Three out of the five constituting NUTS3 of the *Pays de la Loire* (FR51) are RRS areas belonging to Groups 4 and 5 of our classification. Initiated in 2008 by the Regional Council as part of its 2006 Regional Digital Innovation Policy, the Gigalis project was implemented as a JV made up of local authorities and public entities from the region. The region gradually purchased all pre-existing fibre optic routes from service providers, in the form of indefeasible rights of use. Over the first phase of the project (2008-2010), the backbone of the network was built to connect all the *préfectures* and *sous-préfectures*. From 2010 onwards, phase two focused on bringing high speed access to premises and public buildings, with both the management and roll-out of the network entrusted to a private telecom operator, Alcatel-Lucent. The network comprises 500 km of optical fibre. The total investment is EUR 15 million over a 15 years period, totally funded by the Regional Council under phase one, and expected to be complemented by other funding sources in phase two.

Sources: EC, 2013b; Alcatel-Lucent, 2010.

2.2.2 Type 2: Multi-stakeholders engagements

These approaches are characterised by the achievement of a critical mass of actors involved, which creates enabling conditions for the deployment of broadband infrastructures.

2.2.2.1 Community broadband

This approach is based on a bottom up initiative by residents of the concerned areas who decide to jointly bear the costs of broadband deployment. In this case, a task of primary relevance for the public authorities is to define and implement guidelines on how to start the cooperation, based on the contextual conditions, the financial support available from the residents, and the needed funds.

Adopted business models for the deployment/upgrade & management of the new/upgraded infrastructures

Generally, this approach has been able to produce valuable results in terms of sustainability of the projects but on the basis of very heterogeneous business models. Indeed, they vary from 'open network' models to 'vertically integrated operators' models. In open networks, different actors cover the various roles along the supply chain, from passive infrastructure deployment, to active layer management and service provision. Literature suggests that the presence of more actors, presumably leading to a higher level of competition in the provision of services, implies the achievement of relatively higher quality broadband networks (Rajabiun and Middleton, 2015). On the other hand, in the case of vertically integrated operators, usually the incumbent telecommunication operators (as service providers) cover all roles of the supply chain, owning both the passive and the active infrastructures and then offering services to the end-users. In deciding between an open network model and a vertically integrated operator model, additional considerations need to be made, regarding (EC, 2014):

- Population density and market size.
- Telecom providers having an interest in the target area.
- Ownership of the infrastructures in the target area or existence of infrastructure owners in nearby areas, as such operators may have a potential interest to expand.

Sources of funding and investment model

In this case the role of public authorities is concerned with the provision of *ad hoc* support, if and where needed, in the form of (EC, 2014):

- Co-financer.
- Right-of-way granting.
- Coordination with other infrastructures' deployment and data centres.
- Brokerage for the establishment of fair conditions for all operators/providers to manage/access the broadband network (in particular, in the vertically integrated business model).

Applicability in RRS areas

This is a bottom-up approach where the awareness of local communities with respect to the benefits brought by a broadband network is fundamental. This requirement makes the approach applicable in RRS areas only if specific conditions are met, namely: (a) a consistent demand for broadband services exists and is made explicit; (b) the community enjoys sufficiently favourable economic conditions, so that individuals/households are able to be involved in a direct investment; (c) the existence/establishment of community collaboration vehicles/structures able to aggregate citizens' interest around a single initiative.

Where these conditions are met, public authorities can have a key role as awareness promoters, supporters of the initiative, providers of quality performance guidelines, and/or monitors of the quality output. This approach has been practiced in European Nordic countries, especially in the Netherlands, Germany and the UK (Whalley and Sadowski, 2015). Box 8 reports on an example from the UK.

Box 8. Community Broadband Scotland (UK)

The Community Broadband Scotland project is a scheme to financially support communities across rural Scotland in introducing superfast broadband in their areas. Among these areas are the Highlands and Islands (UKM6), all of which fall in the RRS classification and belong to either Group 4, 5 or 6. The project is administered by the Highlands and Islands Enterprise which is acting on behalf of the Scottish Government's Rural Payments and Inspections Division. The scheme provides grants for the implementation of deployment projects in areas which are unlikely to be reached by the Digital Scotland Superfast Broadband Programme. It also helps in aggregating demand, and site advisers provide guidance through the stages of community engagement, project planning and business planning. The scheme covers 70%-89% of total eligible costs related to capital costs, and there is no upper limit to the size of the project. The scheme is part of the Scottish Rural Development Programme 2014-2020.

Source: Community Broadband Scotland website.

2.2.2.2 Federation of LRAs

In this approach, municipalities or regions can aggregate in order to create a single point of contact with respect to the market for the deployment of broadband network and provision of access services (EC, 2014).

Adopted business model for the deployment/upgrade of the infrastructures

Aggregation of LRAs implies the creation of a critical mass in terms of broadband coverage demand that may be considered profitable by private network operators. For the effective implementation of this approach a number of preconditions need to be met, including:

- Similarity of the network requirements in the federating territories.
- Shared motivation and commitment across the federating authorities towards the achievement of certain levels of network coverage and service access.
- Availability of financial resources among participating authorities.

Once the above conditions are met and agreement is found among partners, the investment approach might take different forms such as direct investment, subcontracting, or even operator subsidy to network operators. The most appropriate approach will be defined according to the specific needs and expectations of the concerned territories. Existing incumbents will be preferably selected by the involved authorities according to the set needs and expectations, taking into account both the financial and technical value of the offers of the different operators.

Adopted business model for the management of the new/upgraded infrastructures

The challenge of this approach is essentially related to the need for different stakeholders to converge on a single project. This interaction must be managed in a way that ensures its correct functioning over the time period necessary to complete the deployment or the upgrading of the infrastructure. Towards this purpose a new organisation may be created *ex novo* (i.e. a SPV), or the tasks may be delegated to a specific department of an existing utility.

Sources of funding and investment model

In this approach, funds may originate from LRAs own resources, Structural Funds or even private loans. Indeed, the key determinant in this approach is not from where the resources can be mobilised, but the cost savings that are expected from a joint initiative of a plurality of entities. As these entities approach the market as a single actor, the provider selected for the deployment of the infrastructures has a higher chance of achieving economies of scale/scope. Indeed, the federation of different authorities brings along a number of advantages for all players involved, including (EC, 2014):

- Improved contractual power on the market, offering operators the possibility to gather a contract of wider scope (in time and space), with the potential to achieve consistent penetration advantages on the concerned territory.

- Improved economies of scale/scope for the deployment of the network on a wider area, making it financially and technically feasible to deploy a complete fibre network rather than deploying limited, unconnected sections.

- Increased revenue potential deriving from the selling of the network access to service providers on a wider network.

- Lower costs, thus optimising the use of resources and streamlining operations.

Applicability in RRS areas

This approach is considered highly applicable and beneficial for RRS areas, provided that the needs of all participants in the federation are equally balanced and expressed. In fact, this latter aspect may imply higher negotiation costs compared to other approaches. Since the public authorities have a leading role in all phases of the initiative, quality and social considerations are likely to play a relevant role in the investment decision. Box 9 reports on one example from Italy, while a case from Portugal is illustrated in Part 3.

Box 9. The *Consorzio Terrecablate* (IT)

The territory of the Province of Siena (ITI19) is classified as RRS and belongs to Group 4 of our classification. Due to its geographic configuration, the territory is not attractive for ICT investments by the private sector. Established in 2002 with the aim of providing the territory of the Province of Siena with fibre optic broadband infrastructure and services, the consortium *Terrecablate* engages the following institutional entities: the Province of Siena (18%), the Municipality of Siena (18%), the 35 municipalities of the Province (58%), the aggregations of Municipalities ('*Unioni dei Comuni*') (4%) and the mountain community of *Amiata Val d'Orcia* (2%). The consortium has so far achieved the deployment of 800 km of infrastructure, covering 25 out of the 36 municipalities. Besides infrastructures, it is also concerned with the technology(ies) and provision of services.

Sources: Terrecablate website; consortium website.

2.2.2.3 Crowdfunding

This is a recent approach not yet commonly implemented in the EU with regard to broadband deployment initiatives. It is based on fundraising over the internet from a large number of small investors towards the implementation of a specific project. Crowdfunding has been typically used for financing start-up companies in different sectors (real estate, technologies, etc.) but it has also found application towards the achievement of fast broadband access, for example in the United States.

Adopted business model for the deployment/upgrade of the infrastructures

The promoter of the initiative describes its project on a crowdfunding website and defines, through a business plan, the investment target as well as the deadlines for funding and for rewarding the investors. The amounts raised by an individual project may vary from a few thousands to millions of EUR.

Crowdfunding does not imply the success of the funding initiative. The minimum threshold of funding needed is indicated in the project description. If such threshold is not achieved within the set deadline, the project will not be started. Because crowdfunding is a risk capital investment, owners of the broadband infrastructures are those financially supporting the project according to the contribution share. If the promoter is a public authority, in order to give more credibility to the initiative, the local or regional authority concerned may declare in the project description the share it is directly contributing to the initiative.

Adopted business model for the management of the new/upgraded infrastructures

The promoter(s) of the initiative will be in charge of the development of the project and will manage it according to what has been defined in the project plan. For example, if LRAs are the promoters, the development and management may be outsourced to a SPV. Potentially, contributors with relevant shares may also be involved. Anyhow, both governance and management models are detailed in the project description. The risks of the initiative and the return on investment (ROI) are proportional to the capital share of each investor.

Sources of funding and investment model

The crowding approach relies on several small scale investments gathered from a large number of people. An internet-based platform which is accessible worldwide is the channel for the collection of funds. Individual investments can be small (i.e. of a few hundreds EUR), making participation affordable to many people and rendering formal notice on the risk of the investment unnecessary. Due to the large number of people investing their money in a crowdfunded project, potential individual losses are limited and this type of initiative may also attract semi-professionals or first-time investors. Examples of crowdfunding websites include ‘Kickstarter’, ‘RocketHub’ and ‘AngelList’.

It is worthwhile to distinguish three types of crowdfunding:

- Donation crowdfunding, where the investors are typically driven by reasons other than economic return. Often, the factor driving participation is the simple intention ‘to contribute’ to the initiative and often, in this case, investors are also the direct beneficiaries of the project.

- Equity crowdfunding, where investors receive a proportional share in return for the investment. These investors are typically driven by market considerations, in particular by the attractiveness of the investment in terms of potential ROI.

- Debt crowdfunding, where investors lend funds to a project and expect the funds plus interest to be returned by a fixed date. Typically, this approach has been used by well-established companies which are generating profits, and hence work as a leverage to attract investors who do not like to take high risks, as these investors are reassured by the past positive trend of the companies.

Applicability in RRS areas

Donation crowdfunding is potentially applicable in RRS areas where end-users' awareness of the value of broadband connection is good. In this case most of the considerations made for the community broadband (see 2.2.2.1 above) apply, although the achievement of the minimum threshold of funds for project kick-off is challenging. Equity crowdfunding potentially suits the RRS areas where the deployment/upgrade of the broadband infrastructure can guarantee attractive returns, at least in the medium term. Debt crowdfunding is potentially applicable in all RRS areas where LRAs may guarantee the loan, even in front of limited revenues from the management of the infrastructure. Therefore this is the case where LRAs are willing to bear the risk of limited profitability.

Box 10 describes a crowdfunding approach used to deploy broadband in the UK.

Box 10. Crowdfunding for Fibre to Rural Nottinghamshire (UK)

Nottinghamshire is not classified as a RRS, however, this is the only example found on the web on crowdfunding in the EU aimed at deploying ICT infrastructures. The Fibre for Rural Nottinghamshire (F4RN) is a Community Benefit Society established with a twofold aim to provide high speed broadband in rural areas of Nottinghamshire not expected to be reached by commercial operators, and to promote ICT take up. The microgenius.org.uk website was set up to raise funds for the deployment of fibre optic connection to the two villages of Fiskerton and Morton. These villages are expected to become a hub facilitating further expansion of the initiative to neighbouring settlements. The needed amount for this initial stage is set on a range from GBP 120,000 (minimum, to start the network construction) to GBP 150,000 (maximum, to cover the construction and start-up costs, provided that members of the community get involved and physically contribute to digging and cable burying). On the crowdfunding platform, it is specified that the network is already designed and that works will start as soon as funding is available. Contributions of minimum GBP 1,000 are sought, with a maximum contribution per person of GBP 15,000. Costs for connecting each house will be covered by a 'connection charge'. The daily operation of the network will be funded through a monthly line rental. According to the F4RN, with a minimum of 150 subscribers there will be enough resources for the operation of the network and for initiating the payment of interests to the investors. Some 300 subscribers would allow profit, or investment for expansion, or price reduction for end-users.

Source: microgenius platform.

Table 5 summarises the main positive (+) and negative (–) aspects of the approaches belonging to categories 1 and 2, from the perspective of the public authority.

Table 5. Overview of strengths (+) and weaknesses (–) of reviewed contractual arrangements and multi-stakeholders engagements

Type 1: contractual arrangements	
Public DBO *Case 3.1 (SE)* *&* *Case 3.4 (PL)*	(+): significantly high level of involvement of the public sector reflected in public ownership and delivery; good public control over the ICT investment, including desired technical standards; possibility to prioritise socio-economic benefits; capacity to mobilise relevant expertise of the private sector through a PPP; lack of conflicts of interest in achieving competition among private service providers. (–): funding needs to be sourced by the public entity (i.e. no private sector contribution).
Public outsourcing *Case 3.2 (DE)*	(+): private expertise is brought in as deployment, implementation and running are outsourced to a private actor; the public sector retains control over the initiative (public stability) and ownership; the financial risk of the operation of the network stays with the private entity. (–): funding is from public sector sources; returns may not be attractive enough to the private sector; neutrality problems of the network if not properly addressed in the procurement procedure.
Subsidy to a network operator (Private DBO) *Case 3.3 (UK)*	(+): low public sector burden; rapid take-off of implementation; participation of a commercial operator whose commitment, once formalised, is guaranteed by its relevant financial participation. (–): limited public control, unless benchmarking mechanisms are implemented; the level of public funding must be attractive enough to the private operator; no generation of ROI for the public authority; limited scope, as the approach is applicable only for the upgrading of existing infrastructures.
Joint Venture	(+): benefits are based on risk sharing among partners. (–): the public sector is responsible for making a larger financial commitment especially in the beginning; joint ownership may translate into conflicts of interest and limit the success of the joint venture.
Type 2: multi-stakeholders engagements	
Community broadband	(+): low public sector burden. (–): several conditions need to be met (consistent and explicit demand, financial capacity of the community members, capacity to aggregate around a single initiative).
Federation of LRAs *Case 3.5 (PT)*	(+): good public control; possibility to prioritise socio-economic benefits; cost savings; higher chances to achieve economies of scale for the incumbent; increased revenue potential. (–): it requires the capacity and willingness of public authorities to aggregate around a single initiative.
Crowdfunding	(+): benefits are based on risk sharing among participants; potentially good public control if the public authority acts as promoter of the project; potentially limited financial burden for the public authority. (–): a minimum level of funding is required for the kick-off of the initiative, which is cancelled if not reached.

2.2.3 Type 3: Strategic frameworks

Research and innovation strategies for smart specialisation (RIS3) and national or regional plans for NGA are the key tools to facilitate a more effective use of Structural Funds for broadband deployment. Public authorities at the national and regional level bear the responsibility of complying with *ex ante* conditionalities in order to mobilise European Structural and Investment Funds (ESIF) for ICT investment. Under the broadband target, funding from the European Regional Development Fund (ERDF) requires (1) the formulation of a digital growth strategy within the national or regional smart specialisation strategy for those investment priorities related to ICT-based products and services; and (2) the existence of national or regional NGN Plans for the investment priority "*extending broadband deployment and the roll-out of high speed networks and supporting the adoption of future and emerging technologies and networks for the digital economy*" (EC, 2014a).

Under the European Agricultural Fund for Rural Development (EAFRD), funding of broadband infrastructures is envisaged under Article 20 'Basic services and village renewal in rural areas'. The measure foresees support for the '*creation, improvement and expansion*' of broadband infrastructure, for passive broadband infrastructure, and for the provision of access to broadband and public eGovernment solutions. Infrastructural interventions are not necessarily at a small-scale if relevant provisions for derogations are made in the rural development programmes and if complementarity with support from other instruments is envisaged (Regulation (EU) No 1305/2013).

By reviewing the Commission's decisions on State aid granted in the last few years for broadband deployment, initiatives undertaken at the local or regional level in RRS areas are commonly found in: Italy, e.g. for the construction of infrastructure and 3G/4G equipment to achieve mobile telephony coverage and data transmission in mountainous areas (*Provincia Autonoma di Bolzano*) or for the deployment of fibre infrastructure (*Valle d'Aosta* region); Germany, e.g. in the States of *Bayern*, *Sachsen-Anhalt*, and *Brandenburg* for the deployment of NGA broadband networks in 'NGA white' areas; and Poland, e.g. in the voivodeships of *Lodzkie* and *Wielkopolskie* (for the deployment of NGA broadband networks in 'NGA white' areas), or of *Podlaskie* (for the construction of a broadband network for connecting 18 municipal authorities). Initiatives having a national scope and being directly addressed to rural or sparsely populated areas are, for example, found in Finland (2012, amended in 2014)[6], Greece (2011, prolonged in 2014), Lithuania (2012, amended in 2013), Germany (2011), and Latvia (2011).

[6] The year in brackets refers to the year when the decision for State aid was taken by the Commission.

2.2.4 *Type 4: EU funding instruments*

Public funding is often necessary to kick-start the infrastructure deployment initiative, if not to fund it in full. According to the EC, public sources play a critical role in the funding of broadband deployment since "*a gap analysis on the funding needed to meet the EU broadband targets by 2020 estimates that, in the most optimistic scenario, the coverage target (30 Mbps for all) will be reached if EUR 34 billion is invested, of which EUR 21 billion comes from public sources*" (EC, 2015a). Subsequently, the role of LRAs in accessing or facilitating the access to these funds becomes essential not only for the direct contribution of EU funding to broadband deployment but also for the **leverage effect** they are expected to play in attracting investments from external sources. The *Wielkopolskie* region case illustrates this situation well (Part 3).

Notably, the adoption of the revised General Block Exemption Regulation (GBER) for State aid by the Commission importantly simplifies investment opportunities by the public sector as aid for broadband infrastructure has been included in those categories exempted from prior notification to the Commission, if undertaken in the so called 'white areas', i.e. areas where no operator exist or is likely to invest in the next three years (EC, 2014b).

ESIF funds are subject to the compliance of conditionalities, as illustrated above. Funding programmes outside the ESIF (e.g. COSME) do not have allocated funds for ICT infrastructure deployment but may be suitable to finance projects aimed at the take up of ICT-based services. Indeed, evidence suggests that **demand creation** from individual citizens and enterprises is often a **necessary complementing strategy in RRS areas** to infrastructure deployment, in order to assure a reasonable level of ROI for operators. In addition, other instruments are accessible by public and private actors and may contribute to the achievement of the combination of the public and private funds necessary to cover the investment size. As the focus of this study is on European instruments, a brief description of these instruments is provided below.

2.2.4.1 The European Fund for Strategic Investments (EFSI)

The EFSI is a fund to support strategic investments in the real economy, in a range of areas from infrastructure and energy to education, research and innovation. It is specifically meant to "*finance projects with a higher risk profile, thereby maximising the impact of public spending and unlocking private investments*".[7] The fund is guaranteed by EUR 16 billion financed through the EU budget and is contributed in cash by the European Investment Bank (EIB)

[7] EC press release dated 13 January 2015.

with EUR 5 billion. It may be further contributed by Member States and private sector entities. The EFSI officially became operational on 22 July 2015 when its working arrangements were agreed upon by the EIB, the European Commission and the European Investment Fund (EIF). The EIF, in fact, is expected to deploy about EUR 5 billion out of the total EUR 21 billion capacity of the EFSI.[8] Funding will be on a project-basis. A European Investment Advisory Hub will advise on the identification, preparation and development of projects. An Investment Committee composed by independent market experts will decide on the projects to be funded, while the overall investment strategy of the fund will be set by a Steering Board. **This fund is to provide the risk tranche of an investment.** By lowering the risk, chances to attract private investments and to complement the necessary funding with other public sources increase.

2.2.4.2 The Connecting Europe Facility (CEF)

The CEF provides complementary EU support by means of financial instruments and technical assistance. The allocation for broadband deployment within the CEF is limited to EUR 150 million, out of which one third for networks above 100 Mbps. A common platform for technical assistance provision is set up in cooperation with the World Bank. Such provision is directed to managing authorities as well as communities and may encompass feasibility studies, demand analyses, or analysis of legal and financial requirements. In 2015, 120 applications from 24 MS responded to the Connected Communities Initiative, i.e. a call for expression of interests from those interested in the use of financial instruments for broadband projects specifically aimed at achieving connection at the local level.[9] CEF financial support is in the form of grants and contributions to innovative financial instruments (e.g. the Project Bond Initiative). Guidelines for accessing funds in the telecom strand of the CEF, which is the relevant strand for the funding of high-speed broadband connections, are given in Regulation (EU) No 283/2014 of 11 March 2014. Such guidelines **underline the limited size of the resources** made available under the facility and **emphasise the need to use these resources to create multiplier effects** through the use of financial instruments "*open to additional contributions from other sectors of the CEF, other instruments, programmes and budget lines in the Union budget, Member States, including regional and local authorities and any other investors, including private investors*" (Regulation (EU) No 283/2014).

[8] ESFI web page

[9] Connected Community Initiative web page

2.2.4.3 The EIB Project Bond Initiative

The EIB Project Bond Initiative is expected to be fully operational as part of the CEF in the 2014-2020 multi-annual financial framework. This financing instrument was jointly developed by the EC and the EIB and is meant to **facilitate investments by institutional investors** such as pension funds and insurance companies **in favour of infrastructure project promoters, usually represented by public private partnerships**. During the pilot phase of the initiative (2007–2013), some EUR 20 million were dedicated to the financing of fast broadband projects. Projects approved in the pilot phase will have to be closed by the end of 2016.

2.2.4.4 European Bank for Reconstruction and Development (EBRD)

The EBRD offers **direct financing in the form of loans, equity and guarantees**, the latter through a Trade Facilitation Programme. Through loans, the EBRD **may take entirely or part of the credit risk of a project**. The Bank works in south-eastern and central-eastern European countries as well as in the Baltic States. Recent ICT infrastructures projects supported by the EBRD include a EUR 20 million loan to Bulsatcom EAD, a private provider in Bulgaria (2014), for the roll-out of mobile broadband network and the expansion of its fibre optic broadband network (2014); and a EUR 15 million loan to Digital Cable Systems, a cable TV private operator in Romania, to reach out underserved regions with digital TV and broadband internet.

2.3 Socio-economic territorial impacts of broadband deployment in RRS areas

Understanding the socio-economic territorial impact of broadband deployment allows policy makers to make more informed decisions when setting spending priorities. It may also facilitate the selection of the most appropriate financing tool and/or instrument. However, assessing the territorial impact of broadband deployment in RRS areas is not a straightforward task as most of the impact in rural areas is either intangible or only detectable after some years (Stenberg, 2014). Additionally, the impact of broadband access is strictly related to the historical moment when the deployment occurred. For example, it has been demonstrated that in 2006 broadband access contributed to GDP roughly USD 10 billion more than dial-up internet connection (Greenstein and McDevitt, 2009).

At the end of the nineties, when the internet was something brand new for most citizens and enterprises, telecommunications infrastructures were classified as 'hard economic infrastructures,'[10] having a primary role in providing key services to business and in enhancing productivity and innovation but with limited direct social relevance (Grimsey and Lewis, 2004). The revolution of the Internet of Things enormously enlarged the economic scope of telecommunications infrastructures and affected the social sphere of life. Initially, social benefits derived simply from the possibility to access the broadband. Then, quality and speed of the network enabled the access to advanced internet-based and socially impacting applications, such as telemedicine or eLearning. Likewise, businesses had new direct economic benefits, for example, by the savings implied from the increase in labour productivity.

Nowadays broadband access is still crucial for exploiting the opportunities of the digital world. For this reason, RRS areas where broadband coverage is lacking have a **growth potential** from both the social and the economic perspective. The challenge is to provide a reliable assessment of this potential. The aim is twofold: incentivise private network operators to find ways to internalise some of these benefits (i.e. through economies of scope with other utilities operators while deploying large infrastructures), and encourage public authorities to prioritise digital infrastructure deployment/upgrading as part of their development strategies. Following the break out of the economic and financial crisis, many countries considered investments in broadband infrastructure within their 'stimulus packages' as a way to stimulate growth (OECD, 2009). Some of these countries specifically targeted broadband roll-out in underserved areas, such as Germany (EUR 150 million) and Canada (USD 211 million).

2.3.1 Evidence from the businesses' perspective

There are several contributions in literature suggesting the indicators to be used for assessing the territorial impacts of broadband investments from the socio-economic perspective (Sheppard and Spillane, 2011; ITU, 2012), even if the most investigated aspects relate to the economic dimension of the impact. They include:

- Employment opportunities in the target area (e.g. number of jobs created and wage rates).

[10] Infrastructures were distinguished between 'social' and 'economic' and within each of these categories between 'hard' and 'soft' (Argy *et al.*, 1999). For example, hospitals were 'hard social infrastructures' and environmental agencies 'soft social infrastructures'.

- Economic growth in the target area (e.g. increase in percentile of GDP).

- Business innovation level of the enterprises located in the target area in terms of input (i.e. adoption of new eSolutions allowing for an increase in productivity) and/or output (i.e. creation of new products and services such as new patents).

- Incremental cost savings and/or reduced administrative burden determined by the adoption of new eSolutions (e.g. number of filled forms in eGoverment services by businesses).

- Incremental revenues of the firms in the target areas (e.g. increase of profits).

The territorial impact on the **employment** level is controversially discussed in literature. Indeed, it is claimed that jobs are gained in the short term with the actual building of physical infrastructure or the activities related to the activation of the broadband services. Jobs are created also through the manufacturing of the network equipment, and via the 'induced' jobs related to the spending generated by new workers' salaries (Atkinson *et al.*, 2009). In these cases, given the globalisation of the technology supply chain, only a limited part of the employment growth can be local. Atkinson *et al.* (2009) proved that investments in broadband networks for USD 10 billion in one year generated about 498,000 jobs in the USA, including direct telecom jobs, direct capital equipment jobs, indirect and induced jobs, and network effects. It was also determined that only indirect and induced jobs or jobs generated by network effects had an impact on the local territory.

Some evidence is also available for non-urban areas regarding the positive side effect of broadband availability on employment. Lehr *et al.* (2006) found, from 1998 to 2002, that employment in local rural communities of the USA having the possibility to access broadband grew about 1.5 percentage points more than in communities without such a possibility. Over a 4-year period, a local community with broadband would have had 1% more employees compared to a similar (in terms of population) community without broadband. A leverage effect on the local employment demand and supply is noted also in Forzati and Mattsson (2012). The authors reviewed the socio-economic effects of the deployment of FTTH/FTTx on a sample of 290 Swedish municipalities over the period 2007-2010. They found that after two and a half years a 10% increase in the proportion of the population with access to FTTH was associated with a positive change in municipality-level employment by a percentage ranging from 0% to 0.2%. Furthermore, it is demonstrated that the deployment of broadband carried out in 2013 in the region of *Limousin*, France, created 800 jobs a year in the infrastructure industry as well as in the IT/telecom industry (EC-DG CONNECT, 2015). However, the impact of broadband availability on the employment level seems to vary across the different economic sectors, as confirmed by an empirical analysis carried out in the USA (Box 11).

Box 11. Broadband impact on employment growth by sector: an analysis from Kentucky

In 2007, the Federal Reserve Bank of St. Louis published a study on '*The economic impact of broadband deployment in Kentucky'* (Shideler *et al.*, 2007). The aim of the study was to identify the economic impact, in terms of employment, that broadband deployment had in Kentucky in a number of economic sectors. Results demonstrated that broadband deployment was significantly and positively related to the employment growth both as total employment and as employment in the mining, construction, information and administration, waste management, and remediation services sectors. In these sectors, broadband deployment contribution to employment growth ranged from 21.76% (construction) to 87.07% (information and administration, which are by nature connection use-intensive). The analysis showed also that broadband deployment contributed to employment growth within other sectors (namely, real estate, rental and leasing, arts, entertainment and recreation, and other services) although in these cases economic variables other than broadband availability had an important influence. Finally, broadband deployment showed a negative correlation with the employment level (-39.68%) in only one sector, namely the accommodation and food services sector, possibly due to the fact that broadband access allowed individuals to directly access online information and booking services.

Source: Shideler D., Badasyan N., Taylor L. (2007).

In the longer term, effects of broadband access on employment are more controversial. The increased use of broadband has a positive effect on labour productivity that, in turn, may displace jobs, especially low-skilled ones. Although difficult to be assessed, the net balance of gained and lost jobs is apparently positive (Wieck and Vidal, 2010). The fact that the job creation generated by the increased competitiveness surpasses the loss of jobs produced by the improvements in labour productivity is also confirmed by the results of an extended literature review on the economic impact of broadband access (ITU, 2012).

Moving to a more general economic perspective, investment in broadband should be followed by a tangible economic growth in **GDP**. In RRS areas, where strategies to spur growth may be several, an assessment of the potential ROI in broadband is key for the decision makers. Even if most of the studies carried out on impact in terms of GDP are at country level, the main indications derived from these studies can also be applied to the local context. For example, Koutroumpis (2009) found a strong positive relation between the level of broadband adoption and GDP expansion. On a sample of 22 OECD countries over the period 2002-2007 the author shows that the annual GDP of the 'average' country increased by 0.24% as a consequence of broadband adoption. On a yearly basis, this means about 10% of annual GDP growth. Apart from the positive relation between broadband adoption and growth, there is evidence that growth is larger in areas with a high-level of connectivity. According to Czernich *et al.* (2011), broadband adoption in the period 1996-2007 had a relevant impact on the national GDP per capita of a large set of OECD countries, with the increase ranging from 0.9% to 1.5% for every additional 10 broadband lines per 100 people. Indications of the positive effects of the relevance of quality of connections and of price of subscriptions are also reported by Greenstein and McDevitt (2012). They found that in 30 OECD countries, the consumer surplus[11] and the revenue growth (defined as the broadband bonus) strongly depended on internet use and its quality. Authors noted how countries with large internet economies, such as the United States, Japan and Germany, are receiving large economic bonuses from investment in broadband with respect to those with smaller internet economies. Additionally, introducing the quality of broadband access in their analysis, Greenstein and McDevitt (2012) showed that countries' performance in terms of GDP growth is positive because they simultaneously experience large improvements in broadband quality and a decline of real prices of the broadband services.

Taking into account the different industrial sectors, apparently broadband access creates an advantage for only some of them. Some recent exercises carried out in the USA give insights into the impact of broadband infrastructure deployment on different sectors (Box 12), where the county with unserved and underserved areas is in a situation comparable to those of some of the RRS areas of our study.

Broadband access makes businesses in RRS not only more efficient but also more effective. The study carried out by Strategic Network Group Inc. (2014) on two counties in Minnesota assesses the impact of the adoption of eSolutions given the availability of broadband. Comparison shows that in a county with 100% broadband coverage, annual **incremental costs savings** from eSolutions amount to USD 77,000; while in a county with unserved and underserved regions and with only 27% broadband coverage incremental costs savings are estimated to total USD 2,166,000. While investments in the connected county are limited (estimated to range from USD 120,000 to USD 145,000) and focused on increasing broadband usage within businesses, investments in the unconnected county are meant to have 100% broadband coverage and include

[11] The consumer surplus is the difference between the price that consumers are willing to pay and the (lower) actual market price paid. Quite complex to be measured, the consumer surplus is intended as a benefit.

USD 11.3 million for fibre to the home (FTTH) infrastructure, and USD 175,000 to USD 225,000 for driving broadband usage within businesses. In the same study evidence is provided also for **incremental revenues**. In the connected county, the incremental revenue from new eSolutions is estimated to be USD 1,220,000, while in the unconnected county such revenue is estimated to be USD 18,231,000.

Box 12. The sectoral impact of broadband infrastructure: indications from the USA

In 2014, the Strategic Networks Group Inc. conducted a study on '*The return from investment in Broadband Infrastructure and Utilization Initiatives*'. The aim was to provide an objective analysis of the potential economic benefits of investment in broadband infrastructures and in the promotion of the use of eSolutions. To this end, two counties in the state of Minnesota were analysed, one with a high broadband coverage and one with unserved and underserved areas. The analysis of the investment impact on three economic sectors (Manufacturing, Professional and Technical Services, and Retail Trade) evidenced that the less covered county had higher incremental revenues and cost savings generated by broadband investments with respect to the most covered one. In addition, the size of the impact was manifestly different in the three sectors. The table below presents the results of the analysis related to the less covered county. The Retail Trade sector shows the highest incremental revenues while the Manufacturing sector benefits from the larger incremental costs saving from broadband deployment.

Less covered county	**Incremental revenues**	**Incremental cost savings**
Manufacturing	35,49 $ per 1$ invested	5,61 $ per 1$ invested
Professional & technical services	6,24 $ per 1$ invested	0,44 $ per 1$ invested
Retail Trade	39,28 $ per 1$ invested	3,56 $ per 1$ invested

Source: Strategic Network Group Inc., 2014.

What authors most frequently agree on is that investments in broadband access improve the **competitiveness and innovation** level of a territory (Huges, 2013; Stenberg, 2014). In RRS areas, this implies that broadband deployment may support the creation of new businesses, which is one of the essential conditions to spur economic growth. Lehr *et al.* (2006) show that the establishment rate of new firms is higher in local communities having broadband access than in those without broadband. A relevant share of the newly established firms is in IT-related sectors, generating a positive loop effect. Modern economic growth theory considers knowledge as a direct input to the production function. In addition, technological progress (generated by the knowledge increase) acts as a multiplier of the economic impact. Hence, the presence in a territory of high-speed internet via broadband infrastructure may generate growth at the firm level by (CESifo, 2009):

- Increasing the innovative capacities through newly developed products and processes.
- Facilitating the adoption of new technologies devised by others.
- Affecting firm productivity.

Bertschek *et al.* (2011) contributed to highlight the multiplier effect of broadband access on **business innovation**. Using a sample of over 900 German manufacturing and services firms over a three year period (2001-2003), the authors found that, during that historical moment of national economic growth, broadband access had a substantial impact on the innovation activity of firms. In particular, broadband use had a positive and significant impact on the probabilities that the firms of the area generated process innovation and product innovation. Also Katz and Suter (2009) identified the "*acceleration of innovation resulting from the introduction of new applications and services*" among the impacts of broadband.

2.3.2 Evidence from the citizens' perspective

In general, the deployment of broadband infrastructures allows many social challenges affecting individual citizens or the communities to be addressed. From the social perspective, the most investigated aspects are those related to:

- Employment opportunities (e.g. share of high-skilled and/or high-wage jobs in a community, or share of self-employment).

- Incremental wealth and income of the community (e.g. increase of personal income, increase of housing values, or rents).

- Skills/quality of labour force in the target area (e.g. educational attainment, share of work-force in more skilled jobs).

- Incremental cost savings and/or reduced administrative burden determined by the adoption of new eSolutions (e.g. number of filled forms in eGoverment services by citizens).

- Community participation and quality of life (e.g. voting participation, eCommerce increase).

For many citizens, a residential broadband connection is a prerequisite for working at home. This enables a productive use of non-traditional working hours, flexible working arrangements, and/or remote employment where the distance from home to the work place is significant. Home broadband access may enable more effective job hunting through the internet, reducing unemployment and searching frictions, and making labour markets more efficient. Expanded broadband availability at home may raise professional skills, through improved access to educational opportunities via eLearning programs. Home broadband access may improve quality of life, by enabling more participation in community, civic and commercial activities.

Employment effects of broadband are not limited to the increase in the number of jobs. At the local level, broadband access may also affect **salaries**. According to Larry (2008), broadband generates high-skilled, high-paying jobs. For example, jobs related to the building/expansion of the broadband networks have salaries which are 42% higher than the average salaries in the manufacturing sectors. In RRS areas, this means that broadband deployment may generate IT-related jobs and, at the same time, improved economic conditions of citizens. Assessment of the additional impact on citizens' **personal income** is provided by Strategic Network Group Inc. (2014). Benefits due to marginal investment in broadband adoption in a Minnesota county having 100% broadband coverage are lower (i.e. USD 529,000 incremental annual income related to all the households in the county) with respect to those obtained in deploying broadband to reach 100% coverage in an underserved (i.e. with only 27% coverage) county. In the latter case the incremental annual income of all the households in the county was estimated in USD 6,605,000.

A multiplier effect of the effective access to broadband and increased wealth of an area relates to the local housing market. According to Lehr *et al.* (2006), rental rates were almost 7% higher for broadband communities. Crandall *et al.* (2007) and Lehr *et al.* (2006) studying differences in broadband development across the USA found positive effects of broadband penetration on different economic outcome variables including housing prices.

Looking at the direct benefit to individuals, the opportunity to access fast and ultrafast internet connection generates an improvement of the average **technological skills** of a community (European Parliament, 2015), with people in RRS areas becoming more technologically competitive on the labour market. The ICT skills gained by a community that has implemented a broadband infrastructure imply a generalised digitalization process of the citizens, who can start benefitting from eProducts and eServices, and from the creation of professional technical and technological capacity.

Facilitated access through broadband networks and high technological skills make people rely increasingly on the internet for everyday activities with **costs saving and improvements** derived from the opportunity to access distance learning programmes, health services (e.g. electronic prescriptions), private and commercial eServices (e.g. eCommerce), and public eServices (e.g. utilities' payments). Over a territory with limited geographical connectivity such as RRS areas, improved internet access facilitates citizens in accessing **added value services**. In fact, according to EC-DG CONNECT (2015), *"Some services work much better over FTTH, while others simply won't work at all without it.*"

Hayes (2011) identifies at least the following domains in which broadband access makes a difference: eHealth, eEducation, eGovernment[12], home entertainment and other home-based services, smart grids, transport and logistics, teleworking, and cloud computing. The report conducted by Analysis Mason (2013) highlights side effects on crime, public safety, environment, and equality. Stenberg (2014) also includes community participation among the most relevant benefits for citizens in rural areas. Indeed, in RRS areas, **social inclusion and civic engagement** may benefit from broadband access, for example through the use of social networks, which have recently become tools used for building awareness, disseminating information, raising funds, reporting events and news in real time, and coordinating virtual meetings (Digital Impact Group Inc., 2010). More generally, as identified by Dickes *et al.*, (2009) through the review of 26 studies on rural communities in the USA, online opportunities **reduce the gap with urban areas** in terms of quality of life and opportunities.

The socio-economic impacts of broadband deployment in RRS areas are summarised in Table 6.

Table 6. Potential socio-economic impacts of broadband deployment in RRS areas

Domain	Impacted aspect	Examples of benefits in RRS areas by stakeholders ([B] business, [C] citizens)
Community building	Quality of life Social inclusion	Participation in social life reducing geographical distances (including politics, leisure activities, etc.) [C]. | Interaction among citizens allowing for the participation of a larger set of stakeholders (including elderly people, minorities, people living in remote areas, etc.) [C].
Crime and public safety	Quality of life	Reduction of crime due to the deterrent of remote surveillance (e.g. safer small villages) [C]. | Control of strategic assets/infrastructures located in areas not easily accessible (e.g. increasing security and response capacities to man-made damages or natural disasters) [B].

[12] eGovernment in particular can mitigate typical structural weaknesses of RRS areas related, for example, to the limited or complex access to basic services by citizens and businesses (e.g. for the payment of taxes or the opening of a new firm).

Domain	Impacted aspect	Examples of benefits in RRS areas by stakeholders ([B] business, [C] citizens)
Education and skills	Competiveness and innovation Employment Technological skills Social inclusion	Increase of productivity [B]. | Increased contacts with research and innovation actors (i.e. universities and enterprises) allowing connections and technology transfer processes at distance [B]. | Increase of competitiveness on the job market with skills alignment with those of the citizens of urban areas [C]. | Creation of ICT professional competences as a side effect of deployment and management of broadband infrastructures [C]. | Increase of education delivered in remote mode facilitating access to knowledge also by those having difficulties in accessing transport networks (from disabled people to people living in areas poorly covered by public transport services)[C]. | Improvement in the ICT take-up (eServices, eCommerce, eGovernment) [C] [B].
Economy	Employment Growth Competiveness and innovation Incremental cost saving Incremental revenues	Selection and employment of workers at distance, accessing competences not available locally or located in areas not attractive for business [B]. | Opportunity for workers to contribute remotely to specific ICT-based jobs [C]. | Creation of new ICT-based businesses [B]. | Increase of the Total Factor Productivity of the areas [B]. | Increased competitiveness of local firms in other sectors than ICT through the creation of new/innovative products and services [B]. | Face-to-face communications worldwide, saving travels costs and time [B]. | Access of remote technological services to increase firms' efficiency (i.e. cloud computing) while avoiding local physical installation of ICT equipment [B]. | Implementation/adoption of logistic solutions addressed to increase firms' efficiency (i.e. monitoring of stocks) while avoiding traditional transport and logistics [B]. | Direct access to global markets [B] and potential gaining of a market share through eCommerce solutions [B].
Environment	Incremental cost saving Quality of life Incremental revenues	Use of smart grids with energy efficiency benefits [B] [C]. | Less physical travels, implying reduced CO_2 emission and use of fuels and time [B] [C]. | Adoption of remote control systems to prevent and mitigate natural disasters [C].

Domain	Impacted aspect	Examples of benefits in RRS areas by stakeholders ([B] business, [C] citizens)
Equality and well-being	Employment Technological skills Quality of life Social inclusion Incremental cost saving	Job opportunities for disabled people or people not served by public transport means [C]. | Education opportunities for disabled people or people not served by public transport means [C]. | Connection opportunities with families/relatives displaced in different areas [C]. | Connection opportunities through smartphones and tablets [B] [C]. | Connection opportunities for disabled people or people not served by public transport means [C]. | Opportunities to access information and data worldwide [B] [C]. |Opportunities to save money from traditional telecommunications means (i.e. fixed lines) [B] [C]. |Opportunities to access eCommerce and eGovernment services [B] [C].
Finance and wealth	Wealth Incremental cost saving	Valorisation of the value of an area reflected in increased prices for housing/business location [B] [C]. | Opportunities to access financial services for disabled people, people not served by public transport means, and remotely located businesses [B] [C].
Health care	Incremental cost saving Quality of life	Reduction of costs for health consultations (for less critical pathologies) [C]. | Digitalisation and automation of administrative procedures within public and private health systems [B] [C]. | Monitoring of basic health conditions through mobile apps [C]. | Monitoring of patients at distance without requiring hospitalisation (for less critical pathologies) [C].

Source: the information reported in the table is from Analysis Mason (2013) and Hayes (2011), further integrated and modified by the authors.

Finally, the long-term effect on the supply side should be mentioned as an increase in broadband access may generate spillovers in terms of private and public eServices in sectors such as electricity, finance, health, and education. Several researchers have conducted analysis on the socio-economic impacts of broadband deployment in terms of externalities including those affecting the supply side (ITU, 2012). Among them, those more related to RRS areas are new forms of commerce and financial intermediation, reduction of excess inventories and optimisation of the supply chains, and a general growth in service industries.

Part 3: Case studies

3.1 Broadband networks deployment in Norrbotten, Sweden

This is an example of municipal and regional broadband deployment planned and implemented by the public sector alone. The initiative is strongly grounded in the political will to sustain the development of the territory and facilitate business and citizens' everyday life in a sparsely populated area.

Authorities involved: County Council and municipalities of *Norrbotten*
Implementation period: 2001–2006
Investment size: EUR 73 million out of which EUR 7 million from EU Structural Funds
Target categories: public sector, citizens, businesses
Type of approach: Public DBO (without PPP)
Type of RRS area: intermediate, remote and sparsely populated (SE332) area, belonging to Group 6 of our classification

3.1.1 Description

Across the EU, the county of *Norrbotten* is one of the most sparsely populated areas, with a population density of just 2.6 inhabitants per km^2. Established in 1996 by the municipalities of *Norrbotten* and by the *Norrbotten* County Council together with the County Administrative Board and *Luleå* University of Technology, IT-*Norrbotten* was entrusted with the building of the broadband networks of the 14 municipalities of the county. Deployment occurred between 2001 and 2006. Concurrently, a 3,500 km regional backbone (dark fibre) network called *Lumiora* was also planned and built, connecting all the municipal-owned networks, for a total of 9,000 km of fibre optic. Since 2005, the company became owned by the 14 municipalities of *Norrbotten* and the *Norrbotten* County Council. IT-*Norrbotten* is also involved in the delivery of services, i.e. wholesale services to other operators and direct services to businesses and the County Council. However, in 2008, the company signed an agreement with OpenNet, a service provider which is not providing services directly but is inviting retails service providers, creating a competitive environment which is beneficial for the end-users as they finally have a choice to make on the basis of offered services and prices. IT-*Norrbotten* keeps on managing and developing the intra-county fibre-based high-speed network with the specific will to give "*equal opportunities for enterprise, communal activities* *and individual freedoms regardless of domicile*” (ITN website). As a publicly owned company, its role in regional and social development is very clearly spelled out in its corporate concept.

3.1.2 Financing

The total investment is covered with funds from the municipalities and the county. EUR 7 million were contributed from the EU Structural Funds.

3.1.3 Evaluation (or Strengths & Weaknesses)

Norrbotten is frequently quoted as an example of successful application of eHealth, in terms of both efficiency and cost effectiveness of the services provided. This is also a direct consequence of the fact that the County Council is responsible for health care provision and hence its capacity to deliver services and apply ICT to health management were dramatically improved by the deployment of the network and the connection of hospitals, health centres and dental clinics across the county. In terms of impact on the connected hospitals, clinics and dental clinics, Forzati and Mattsson (2011) report a reduction by 50% of communication costs and a fifty times faster communication. Education through remote learning is another area managed by IT-*Norrrbotten* and directly benefitting from the network deployment.

3.1.4 Sustainability

IT-Norrbotten is well-established and running a series of projects aimed at either using the network or at making the infrastructure more reliable and available. The networked municipalities and the County Council regularly carry out virtual meetings, reducing physical travel to the minimum. The native language learning, where teaching is through videoconferencing technology, is another pilot project based on the *Lumiora* platform. It was launched in late 2009 and is progressively being expanded to more municipalities and languages.

References: IT-*Norrbotten* website; FTTH Council Europe (2014); DAE project synopsis webpage; Forzati M. and Mattsson C. (2011), *Socio-economic return of FTTH investment in Sweden, a prestudy*, Acreo AB, a part of Swedish ICT Research.

3.2 NGA Cluster Nordhessen, Germany

This is an example of local authorities (districts) gathering together in the form of a SPV whose aim is to achieve the deployment of NGA networks on the districts' territories. The SPV contracts out the deployment works. The initiative achieves synergies, cost-reduction and co-responsibility in financing.

Authorities involved: the districts of *Kassel*, *Schwalm-Eder*, *Waldeck-Frankenberg*, *Werra-Meißner* and *Hersfeld Rotenburg*
Implementation period: 2014 - 2022
Investment size: EUR 170.7 million out of which EUR 150 million from EIB loan
Target categories: businesses (prioritised) and households, totalling some 1 million citizens
Type of approach: public outsourcing (concession model)
Type of RRS area: all districts but *Kassel* are predominantly rural areas (DE73), belonging to Groups 4, 5 and 6 of our classification, hence having a good level of ICT preparedness

3.2.1 Description

The territories of the five districts are characterised by a relatively low population density and do not sufficiently attract private investment. The coverage with 1 Mbps internet was achieved in 2011 due to the efforts of municipal authorities. However, in the light of an over-the-average economic growth of the area and in order to support this positive trend, district authorities decided to invest in the deployment of NGA networks to reach download speeds of at least 30 Mbps or even higher if justified by demand. The public authorities of the five districts joined together in a common project aimed at the deployment of high-speed broadband connection to all their municipalities through the construction of the necessary passive infrastructure. To this end, they set up an independent company, *Breitband Nordhessen GmbH*, to manage the project. The company will contract out the deployment works. It will be the owner of the infrastructure and will lease it, through a concession agreement lasting 20 years, to a service provider that will be in charge of implementing the active layer and delivering the services to the end-users. The concession will be awarded following an open selection procedure which is technology-neutral. The physical construction of the infrastructure will be tendered only after a network operator is selected.

3.2.2 *Financing*

The total investment of EUR 170.7 million covers physical infrastructure works with EUR 143.2 million for the deployment and building of the infrastructure, and the operating expenses of the first years with EUR 27.5 million. The physical works are financed through a loan by the development bank of Hessen (WIBank) which is guaranteed by the regional authority of Hessen. The WIBank, in turn, received a EUR 150 million framework loan from the EIB to finance the initiative. The five participating districts contribute EUR 25,000 EUR as equity capital to the *Breitband Nordhessen GmbH* and provide EUR 27.5 million EUR as loan for the operating expenses.

3.2.3 *Evaluation (or Strengths & Weaknesses)*

The initiative is firmly grounded on evidence and commitment. Firstly, the driver of the involvement of public authorities is the acknowledgement of the positive impact ICT investments may have on sustaining the on-going (economic) development of their territories. Secondly, there is the will to undertake all the necessary appraisal activities, including: (1) A feasibility study related to coverage and demand, in order to 'justify' the project. The study confirmed that communities were underserved in terms of coverage and that demand for faster connection was good among citizens and businesses. (2) An analysis of the technical aspects of the initiative (engineering concept of the network) which was accompanied by a detailed mapping of existing infrastructures, carried out by the districts in cooperation with the municipalities and the energy companies, to understand the potential contribution of existing infrastructure and planned works and to design the most cost-effective routing of the physical broadband infrastructure. (3) A review of the most appropriate business models to be adopted, also on the basis of a risk analysis of potential options. (4) The conducting of market surveys/public enquiries among regional and federal network operators, asking whether they had any interest in deploying NGN over the target administrations. Areas for which at least one private operator expressed an interest to develop NGA in the next three years were kept out of the project to avoid competition being biased. Thirdly, the five districts managed to secure the necessary funding in cooperation with regional actors (the regional authority and the regional development bank) and contributed to the financial needs of the project. The initiative has been awarded the European Broadband Award 2015 as the best project in the category of cost reduction and co-investment. Apart from the cost-effective routing of the infrastructure, the choice of the federation as the implementing entity of the initiative allowed the creation of synergies on technical and management capacities, the lowering of administrative costs as the company is shared by all administrations, and the achievement of economies of scale as demand was aggregated. Hence, it became more attractive for the various purchasers (company undertaking the infrastructure works, the network operator, and the service providers).

3.2.4 Sustainability

The cable that will be deployed is appropriate for future upgrades.

References: Short Description NGA Cluster *Nordhessen*, downloadable from the DAE project synopsis webpage; DAE release 'Five projects get first ever European Broadband award' published on 16/11/2015; EIB release 'EIB and WIBank promote broadband development in Hesse' dated 14/07/2015.

3.3 Superfast Broadband Cornwall and Isles of Scilly, UK

In an area characterised by remoteness and complex configuration, the project successfully managed to achieve high shares of fast broadband coverage through the combined use of public (ERDF) and private funds. Territorial impact is outstanding.

Authorities involved: Cornwall Council
Implementation period: 2010-2015
Investment size: GBP 134 million out of which GBP 53.5 from ERDF funds
Target categories: households and businesses
Type of approach: subsidy to a network operator
Type of RRS area: intermediate, remote and belonging to Group 6 of our classification (UKK3)

3.3.1 Description

The Superfast Cornwall 2011-2015 programme claims to have created one of the best connected rural locations in the world. With the target to reach a minimum of 80% of the houses by 2015 with NGA, the programme, in fact, laid down 130,000 km of optical fibre corresponding to 95% coverage and allowing some 255,500 premises to connect to fibre broadband. One third of the FTTP connections allow a speed up to 330 Mbps. In addition, coverage of almost 100% was achieved in the Isles of Scilly by deploying a cable connection within an existing unused subsea cable. The Isles of Scilly, located 28 miles offshore, are one of the most remote communities in the UK and Europe and were previously connected to the mainland through radio broadband. Superfast

Cornwall was implemented following the ‘funding the gap’ approach, where the public sector finances part of the initiative and leaves the rest of the investment to a private operator. An application to grant State aid was submitted to the EC in 2009 and approved in 2010. A telecom operator (BT) was selected on the basis of a public tender procedure for the provision of fibre optic broadband (passive and active) infrastructure and services. Being BT the owner of most of the existing infrastructure, it retained ownership of the upgraded and of the newly deployed infrastructures, while BT Wholesale offered active and passive wholesale services to service providers on open, non-discriminatory terms. The programme was managed by the economic development company of the Cornwall Council with a view to monitor the achievement of the set targets (monitoring activities were meant to overcome one of the negative aspects of the subsidy to the operator approach, i.e. a limited public control over roll-out unless clear benchmarking is defined and implemented).

3.3.2 Financing

Funding for the total investment came from the ERDF (GBP 53.5) and from the BT Group, i.e. BT Wholesale, Openreach and its retail businesses (GBP 78.5 million). The Cornwall Council is contributing to investment in marketing activities to stimulate demand. Wholesale service revenues are expected to cover part of the capital investment and part of the operational expenses. Hence, the take up of services by the various and potential private service providers is critical in assuring the financial viability of the investment.

3.3.3 Evaluation (or Strengths & Weaknesses)

A study by SERIO at Plymouth University and Buckman Associates quantified the impact of high speed broadband on the business community in Cornwell. The overall benefit has been estimated in GBP 186.1 million and is determined, among other factors, by a 400% higher turnover of firms with fast connection with respect to those without, by the creation or safeguarding of 4,493 jobs, expected to increase to 6,000 by June 2016, and by the generation of some GBP 30 million by start-ups, whose number is on the rise. The approach was successful in leveraging investments by the private sector. The involvement of a well-established operator such as BT allowed bringing in the necessary technical expertise to address the engineering challenges involved and in achieving a long-term commitment. The public authorities were firm in pursuing the funding from ERDF. In fact, both the intention to use public funds and the selection of BT were objected to by another UK broadband operator. This also explains the delayed approval by the Commission of the State aid, as the EC had to request clarifications to the concerned UK public authorities on all the points raised by the complainant. The EC approval letter of ERDF details the measures used to minimise potential distortions of competition within the initiative. They include: market research and consultation, open tender process, selection of the most economically advantageous offer, technology neutrality, use of existing infrastructures, wholesale access to third party operators, benchmarking of pricing, and claw-back mechanism to avoid over-compensation of the operator.

3.3.4 Sustainability

The long-term commitment of both public and private partners to superfast broadband deployment in Cornwall has been confirmed by the launch of a new programme which is expected to provide access to some additional 8,600 houses across the region by 2018. The total investment of the new project is GBP 7.6 million. In this case funds are provided also by the UK Government (GBP 2.96 million), in addition to BT (GBP 1.23 million) and the Cornwall Council through the Cornwall's Growth Deal, and the Regional Growth Fund.

References: EPEC, 2012; DAE project synopsis webpage; information and documents downloadable from superfastcornwall.org; Cornwell Council news on 'New multi million pound deal will make Superfast Broadband available to thousands more Cornish homes and businesses' dated 22/06/2015; EC approval letter of State aid dated 12/05/2010.

3.4 Broadband Network for Wielkopolska region, Poland

This regional initiative is one of the several undertaken in Poland and, more generally, in Eastern European countries to deploy regional broadband networks in areas affected by market failure. These initiatives rely on the use of ERDF funds and usually involve the private sector by means of a PPP.

Authorities involved: regional and local authorities
Implementation period: 2010 - 2015
Investment size: EUR 96.7 million out of which EUR 66.8 million from ERDF funds
Target categories: citizens, businesses, public entities
Type of approach: Public DBO with PPP
Type of RRS area: four out of the six constituting NUTS3 of *Wielkopolskie* (PL41) are predominantly rural areas belonging to Groups 1 and 2 of our classification.

3.4.1 Description

Wielkopolskie is one of the regions in Poland lagging behind in terms of NGA coverage. Realising that the required broadband investment was substantial and acknowledging the lack of sufficient profitability to attract private telecom companies, local and regional authorities took on the responsibility of initiating a deployment project with the support of EU funding. The project went through the approval process at the national and EU level. The approval of State aid granting by the Commission is dated 23.05.2012 and confirmed the lack of distortion of competition in the telecommunication market. Earlier in 2011, a public consultation was held to "*to identify correctly the areas subject to intervention under the project and to ensure transparency in granting state aid*" (Polish Office of Electronic Communications, 2011). The consultation was specifically addressed to telecom operators which were supposed to comment on any incongruence noted in the results of the infrastructure stock-taking exercise and to communicate any plan they might have had to invest in the region in any type of broadband infrastructure (basic or fast) in the next three years. Implementation has been conducted in the form of a public private partnership. Firstly, the *Wielkopolskie* regional authority established a fully owned company, the *Wielkopolska* Broadband Network S.A (WSS S.A.). The company prepared the project and secured the funding from the EU. Secondly, in order to obtain the remaining necessary financing, WSS S.A. offered a share to private investors. Two telecom operators, INEA S.A. and Asta-Net, were selected through an open procedure. The ownership of the network remains with WSS S.A. which is expected to give progressively higher shares of the company to the private actors (INEA in this specific case which, in 2014, retained 74.68% of the company, against 25.17% of the regional authority and 0.15% of Asta-Net). Design and construction and then operation were assigned through public procurement. The selected operator will pay rent to WSS S.A. for the leasing of the infrastructure and will retain the revenues obtained through the management and operation of the network. The operator will only provide services to the public administrations and wholesale access to other operators.

3.4.2 Financing

Out of the total EUR 96.7 million, EUR 66.8 million is from the ERDF, under the 2007-2013 Operational Programme 'Greater Poland', the rest is contributed by the private sector. For example, INEA, the leading private partner of WSS S.A., procured its share of the necessary financing for the *Wielkopolskie* broadband project through five different banks.

3.4.3 Evaluation (or Strengths & Weaknesses)

Among all the initiated broadband projects in Poland, the broadband network of *Wielkopolskie* is the second highest in terms of investment and the first in terms of length of the built network. The approach of the regional authorities successfully kicked-off and secured the engagement of the private sector which is now leading the deployment process. The intervention was based on two main acknowledgments by the regional authorities: firstly, the lack of broadband infrastructure, with 4,583 localities out of the total 5,488 localities being without an optical distribution node. Secondly, the lack of adequate competition caused by the dominant market share held by the incumbent operator which was reflected in high prices or inadequate services to end-users (with a penetration rate of Local Loop Unbundled of only 4% in 2010). The market failure related to the provision of NGA services or even, in some areas, of basic broadband services was the main driver of the initiative and the intervention has proved successful in facilitating investments in NGA (last mile) networks.

3.4.4 Sustainability

The fibre-optic backbone/distribution network will be about 4,500 km long and will provide some 576 access points to private operators, on an equal access basis. These are expected to attract private investors or operators towards the deployment of the last mile infrastructure that will secure NGA services to end-users. According to the DG REGIO project description, a decision to provide a fibre-to-the-home (FTTH) network that allows internet connection of 100 Mbps directly to households has already been taken by the regional authorities.

References: PMR press release dated 31 January 2014; DG REGIO project fact-sheet dated 23/11/2015; Polish Office of Electronic Communications press release of 09/09/2011; *Cámara de Comercio Polaco – Española* press release dated 09/09/2014; EC approval letter of State aid for the *Wielkopolskie* project.

3.5 Community Fibre Networks in Évora County, Portugal

This is one of the four community network projects belonging to the second group of NGN deployed in Portugal starting from the second half of 2008. These networks were specifically meant to reach rural areas and, more generally, areas not sufficiently covered by the market in terms of telecommunication services.

Authorities involved: municipalities of *Alandroal, Arraiolos, Borba, Estremoz, Évora, Montemor-o-Novo, Mora, Mourão, Portel, Redondo, Reguengos de Monsaraz, Vendas Novas, Viana do Alentejo, Vila Viçosa*
Implementation period: 2008-2010
Investment size: EUR 6.8 million out of which EUR 3.06 million (45%) from EU Structural Funds
Target categories: citizens, businesses, public entities
Type of approach: Federation of LRAs
Type of RRS area: *Évora* county is part of the *Alentejo Central*, a predominantly rural, remote area (PT183) belonging to Group 3 of our classification

3.5.1 Description

Broadband infrastructure deployment was achieved through the creation of a wide partnership (in the form of a consortium) of local and regional actors led by the Association of Municipality (CIMAC) and the *Agencia de Desenvolvimento Regional do Alentejo* (ADRAL). The intervention was primarily driven by the understanding that ICT infrastructure was necessary to boost regional development (e.g. SME competitiveness, eGovernment, and social inclusion). The project deployed a 640 km fibre NGA network over the period 2008-2010 using new self-owned, as well as existing, infrastructures. The design and building of the network were tendered and awarded to a consortium led by PT PRIME, NEXTIRAONE and ENSULMECI. The operation and management of the network was given to a telecom operator, through a 10-year concession. The operator pays an annual fee and is obliged to maintain the network according to clearly established standards. The network allows for fast broadband connections between 1 and 10 Gigabits per second. It also provides for wireless coverage of 14 entrepreneurial parks. The *Évora* network is very much inclusive of the cultural, leisure and knowledge-based realities of the participating municipalities, including scientific, technology and higher education communities.

3.5.2 Financing

Total investment was EUR 6.8 million, out of which 55% financed with regional funds and 45% financed with EU funds under the POSC - *Programa Operacional da Sociedade do Conhecimento* (Knowledge Society Operational Programme) of the Ministry of Science, Technology and Higher Education.

In 2006, within the POSC, a tender for community network projects was launched. Four projects were approved a year later, for a total of EUR 34 million, comprising the *Évora* project and three other initiatives (*Vale do Minho*, *Valimar Net*, and *Terra Quente Transmontana*) all of which were aimed at providing broadband coverage in rural areas. The four projects resulted in the deployment of 1,200 km of optic fibre cable, plus data centres, Points of Presence, and active equipment.

3.5.3 Evaluation (or Strengths & Weaknesses)

Among the success factors of the project are the capacity to aggregate actors at the territorial level and the high commitment level demonstrated by the public authorities. The project resulted in good connectivity and shared services for the participating municipalities and their communities, as well as in cost savings. The ANACOM outlines the main characteristics of the community networks, among which: they are infrastructures of public interest; they serve local communities; traffic within the network should tend towards no charge; they are technology neutral and open to all operators.

The four projects approved in 2007 are defined on the Knowledge Society Agency (UMIC) website of the Ministry of Education and Science as 'remarkably efficient'. UMIC constituted and operated the Technical Support Commission, as a requirement set by the POSC, and provided support to the four communities throughout the application and deployment processes of their projects.

3.5.4 Sustainability

The project's sustainability was evaluated at the time of the selection for the funding through the POSC. The concession ensures a medium-term (10 years) commitment by the private operator while the ownership of the network by the public authorities consolidates sustainability.

References: *DAE project fact-sheet; ENGAGE, 2014a; ANACOM webpage on 'Community networks' site; UMIC webpage on Next Generation Networks.*

Part 4: Recommendations

The analysis presented in the previous sections shows a range of tools and instruments used to finance broadband network deployment by LRAs. In the case of contractual arrangements and multi-stakeholders engagements, their applicability in RRS areas has been discussed in Part 2. In this Part 4, the focus is on proposals for ‘new ways’ of financing of ICT investments in RRS areas. ‘Novelty’ refers to existing approaches which appear to be suitable for financing broadband deployment/upgrade in RRS areas but which are not yet taken up by LRAs. This is the case, for example, of equity crowdfunding. Alternatively, ‘novelty’ also refers to the outlining of proposals to improve the effectiveness and efficiency of financing/investment models and/or the use of EU funds by LRAs.

The use of Structural Funds for ICT investments is, of course, not a novelty but it will continue to play a significant role, especially in underserved or unserved RRS areas. Even if the adoption by the Commission of the revised GBER for State aid importantly simplifies investment opportunities through Structural Funds, public authorities still bear the responsibility of complying with *ex ante* conditionalities in order to mobilise ESIF funds for ICT investment. A recent report underlines how the development of strategic documents to this end still represents a critical step for LRAs (Ciampi Stankova and Sörvic, 2015). The authors highlight that most common difficulties faced within the limited sample of regions analysed (seven, out of which four are Italian) relate to lack of capabilities, insufficient awareness of the requirements of strategic development, involvement of stakeholders, and governance coordination. These recent findings demonstrate that there is still ample room for improvement by LRAs in the use of existing tools and instruments.

Each of the following recommendations is associated with one of the types of tools and instruments outlined in Part 2 (‘Type’). The ‘Target’ relates the Groups of RRS areas as defined in Part 1 and summarised in Table 2. Finally, the ‘Problem statement’ refers to the challenges and barriers specific to RRS areas outlined in Table 3 (Part 1) and in Table 4 (Part 2).

4.1 Pooling of small financial shares through equity crowdfunding

Type: Multi-stakeholders engagement
Target: This way of financing fits areas where there is awareness of the benefits brought about by fast or ultra-fast broadband, i.e. areas belonging to Groups 4, 5 and 6.
Problem statement: The pooling of resources through an online internet platform for equity crowdfunding has the twofold aim of: (i) structuring and aggregating the demand for broadband of a territory (i.e. response to the challenges 'lower and fragmented demand' and to the barrier 'small size of the market'); and (ii) involving external investors, hence disentangling the economic condition of the broadband-demanding community (target area) from the capital size needed for broadband deployment or upgrade (i.e. response to the barrier 'capital intensive nature of ICT infrastructure investments').

4.1.1 Key aspects

Implementation of this way of financing requires the following conditions to be met:

- Residents need to participate in the crowdfunding to guarantee interest and awareness for broadband deployment in the target area, i.e. demand.

- The concerned LRAs take a leading role, contributing an important sum to demonstrate their policy and administrative commitment to the initiative as well as to acquire a significant ownership share of the infrastructures. In particular, LRAs should be the promoters of the initiative so as to decide the most suitable governance and management models, and to ensure other important conditions such as: the coordination with the deployment of other infrastructures, the right-of-way granting, or the preparation of a comprehensive and feasible deployment project, including the technical designs.

- Equity crowdfunding implies the existence of an intermediary, which is referred to as the 'funding portal' or 'platform', usually represented by a profit making organisation working on a fees-basis.

4.1.2 Expected benefits

- Equity crowdfunding is usually considered a financing channel which does not rely on loans. Ideally, this should limit the implied administrative burden.

- Equity crowdfunding implies that investors buy shares and get returns. Being a major participant, returns are expected also for the concerned public authority.

4.1.3 Potential drawbacks

- A minimum amount is required for the project to kick-off. If such an amount is not reached, the project is cancelled.

- LRAs may lack competence in defining an appealing business plan or in organising a successful crowdfunding campaign. For example, they may be insufficiently skilled to reply to technical questions asked by potential investors or in promoting the campaign on social networks or by means of social media (JRC-IPTS, 2015).

- Equity crowdfunding is a relatively new instrument and MS may have different laws or rules to regulate it, or may still lack adequate legislation. The lack or inconsistency of rules may weaken the effectiveness of the instrument if it hampers participation by potential investors. According to a recent study of JRC-IPTS (2015), "*At the European Union level, the European Commission has already in place a number of directives that can apply to equity crowdfunding. Some EU Member States such as France, Italy, and the United Kingdom are passing equity- (and sometimes lending-) based crowdfunding regulations. Other Member States such as Germany are currently considering their own position. These individual regulations regulate equity crowdfunding differently and crowdfunding in the EU may benefit from a harmonisation effort to avoid inconsistencies between Member States.*"

4.2 Support scheme for securing EFSI finance for ICT infrastructure in RRS areas

Type: EU funding instruments
Target: This approach fits areas which are characterised by a low level of coverage of NGA, i.e. the so called 'white areas'. White areas are potentially present in all the groups of our classification of RRS areas, although they may be expected to be found more frequently in Groups 1 and 4 and, to follow, Groups 2 and 5.
Problem statement: Higher risk is one of the barriers to ICT infrastructures investment in RRS areas. On the other hand, the EFSI is specifically meant to finance projects with a higher risk profile and in strategic areas of the real economy. The proposed scheme aims at matching these two perfectly compatible conditions.

4.2.1 Key aspects

EFSI has no sector allocation and is supposed to distribute funding on a project-basis. The idea is to develop a dedicated advisory support tool to prepare competitive project proposals for ICT infrastructure deployment in RRS areas which are lagging behind in terms of NGA coverage. An example of a similar support service is the InnovFin Advisory set up as a joint EIB-EC initiative under Horizon 2020 to assist public and private actors "*to improve the bankability and investment-readiness of large, complex, innovative projects that need substantial long-term investments*" (InnovFin Advisory website). An alternative to the EIB service would be the development of guidelines to prepare successful project applications. The guidelines may draw on the valuable experience gained so far through the application process of public authorities to the EC for the use of State aid for ICT infrastructures deployment in white areas (e.g. the '*EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks*'). The examples shown in the report demonstrate the multiple and comprehensive aspects public authorities had to comply with for granting State aid for broadband deployment. Such aspects covered, for example, the carrying out of market research and consultation, open tendering, inventory of existing infrastructures for re-use purposes, ensuring a level playing field in terms of technologies and wholesale access to third party operators, benchmarking of pricing, claw-back mechanism to avoid over-compensation of the operator, etc.

4.2.2 Expected benefits

Since EFSI has no sector allocation, competition to access its resources is high. The proposed scheme, by increasing the competitiveness level of ICT infrastructures project proposals, aims at facilitating the allocation of EFSI resources to ICT investments.

4.2.3 Potential drawbacks

The empowerment of LRAs in the preparation of high-level project proposals once again puts pressure on public authorities who are expected to acquire capabilities which are not part of their common duties, such as competing for funds on a project-basis. This drawback could be overcome by considering a third (private) actor who is charged with the task of preparing the project proposal on behalf of the authorities.

4.3 Publicly-sponsored venture capital for leveraging market capitals

Type: Contractual arrangement
Target: This approach fits RRS areas which are characterised by a low level of coverage and therefore need a substantial investment in terms of size, i.e. areas belonging to Groups 1 and 4.
Problem statement: Limited investment by LRAs in the ICT domain may be due to limited availability of public funds, especially if other types of infrastructures are prioritised. The proposed approach, which is meant to leverage external funds, responds to the barrier 'capital intensive' nature of ICT infrastructure investments.

4.3.1 Key aspects

This approach is designed to leverage large funds from a combination of public funds and risk capital through the creation of publicly-sponsored venture capital. Public venture capital is a way to maximise the effective use of public money in a project or an initiative, as the money is not made available to third parties through, for example, public subsidies or outsourcing, but is directly invested in the initiative. In return, the public authorities(y) obtain(s) shares of the capital which are able to generate profits (equity-based investment). A private professional institutional investor in risk capital (i.e. private venture capitalist) is involved in managing public funds according to a detailed business plan of the initiative. Managerial and financial competences of an experienced professional investor are necessary to take into account all potential risks and to properly address them. In addition, the presence of such an investor in a public initiative creates a reputational pull side-effect, attracting other (professional and non-professional) investors interested in contributing to the initiative and in the medium term ROI.

4.3.2 Expected benefits

Public authorities may expect to leverage significant market capitals through this approach. In addition, they may expect a return on investment in the medium period by the service providers that will use the broadband network or by the selling of the infrastructure to a network operator.

4.3.3 Potential drawbacks

A critical aspect of this approach is the need for the project to be robust in terms of return on investment. Private professional institutional investors in risk capital assess the project also in terms of its short-term feasibility and medium-term sustainability. Only initiatives having the prospect of being successful are selected for investment by the private professional investor.

4.4 Identification of non-conventional broadband investors

Type: EU funding instruments
Target: This approach fits areas which are characterised by a low level of coverage of NGA, i.e. the so called 'white areas'. White areas are potentially present in all the groups of our classification of RRS areas, although they may be expected to be found more frequently in Groups 1 and 4.
Problem statement: In some cases, RRS areas lacking broadband infrastructures also suffer from a lower availability of other infrastructures. This is considered as a challenge because it limits the potential to reduce deployment costs. This proposal suggests a way to actually take advantage of the condition of poorly infrastructure-endowed areas.

4.4.1 Key aspects

There is an increasing dependency of the management of physical infrastructures through ICT (i.e. remote mode). A simple example in this sense is the remote control of smart electricity or gas meters. Operators managing other public utilities may therefore have an interest in supporting the deployment and/or upgrade of broadband infrastructure in unserved or underserved RRS areas. This is especially true for energy operators. At the end of November 2015, Enel, the most important Italian electricity network provider, announced its intention to create a new company (Enel Open Fiber) in order to support the national broadband coverage plan decided by the Italian Government. The plan has the double aim of meeting the needs of areas affected by market failure and of reaching the targets of 100% coverage at 30 Mbps and 85% coverage at 100 Mbps by 2020. To compete with the main telecom network operators, utilities providers rely on economies of scope derived from the combination of the upgrade of their own infrastructures and components (i.e. wires, meters) with the interventions on broadband networks. LRAs, especially at the regional level, should be responsible for adjusting their procurement activities accordingly, i.e. on the basis of a broad overview of territorial infrastructural requirements. In the specific case of Italy, regional authorities were asked to set aside a total of EUR 1.6 billion from EU funds to support the implementation of the national broadband coverage plan. Additional EUR 2.2 billion will be sourced from Cohesion Funds, while the overall investment for the Italian national plan for broadband coverage totals EUR 12 billion (CIPE, 2015).

4.4.2 Expected benefits

Positive side-effects on ROI of the operators of utilities other than telecom ones are driving the implementation of this approach. This, in turn, is reflected in improved infrastructures for connectivity and other public utilities such as electricity and gas. Development of broadband networks in parallel with electricity grids may reduce the cost of implementation up to 40%. Although this percentage will not be proportionally reflected on the end-users, lower access prices of services relying on this 'shared infrastructures' may be expected.

4.4.3 Potential drawbacks

Operators of other utilities may disregard the broadband investment if the economies of scope are not enough or if their investment in also improving the telecom infrastructure becomes excessive. LRAs will have a strategic role in incentivizing the presence of other utilities operators in filling potential funding gaps.

4.5 Maximising the efficiency of public financial support within the public DBO

Type: EU funding instruments
Target: This approach fits areas which are characterised by an average level of coverage of NGA, hence RRS areas belonging to Groups 2 and 5.
Problem statement: A partial coverage of broadband infrastructures over a territory may indicate that the investment has been kick-started but was profitable only up to the level of coverage deployed. This heterogeneous network deployment in RRS areas, probably due to inconsistent service demand, clearly indicates the need for a public commitment to broadband infrastructure deployment.

4.5.1 Key aspects

As discussed in Part 2, the implementation of a public DBO approach implies that the upgrade or deployment of an infrastructure is financed by public funds. The approach is particularly suited for RRS areas as it allows the consideration of social benefits in the investment decision. However, as shown in the IT *Norrbotten* case study, this approach may imply the mobilisation of a large pool of public funds (in the case of *Norrbotten*, non-EU funds amounted to EUR 66 million). This is basically why its applicability is suggested to be enhanced by taking advantage of existing EU instruments. To reduce the financial pressure on local, often limited, budgets and/or to reach the amount of funds actually needed, the public investment can be combined with the use of other existing instruments such as the Project Bond Initiative (PBI) of the EIB. The PBI facilitates debt financing of major infrastructures projects (*'project bonds'*), in particular in the fields of energy, transports and ICT broadband. This instrument allows the integration of the available public funds in two ways: (1) through a direct contribution, by means of a loan or of an additional credit line sponsored jointly by the EIB and the EU (typically equaling about 20% of the bond issuance); (2) indirectly, by enhancing the reputation of the initiative that, in turn, affects the credit rating of the project bonds and increases the interest of potential additional private investors.

4.5.2 Expected benefits

Financial instruments such as the PBI allow the enhancement of the efficiency of the investment in terms of value for money, and improve the debt rating.

4.5.3 Potential drawbacks

No specific drawbacks are associated with this suggestion, although it is worth noting that in any case, the approach implies an important financial exposure of the public authority.

Appendix I – Classification of RRS areas

Group 1: NGA coverage < 35% & broadband access ≤ 70%		Group 2: NGA coverage 35% - 65% & broadband access ≤ 70%		Group 3: NGA coverage > 65% & broadband access ≤ 70%	
BG311	Vidin	BG313	Vratsa	BG314	Pleven
BG312	Montana	EL111	Evros	BG321	Veliko Tarnovo
BG315	Lovech	EL113	Rodopi	BG333	Shumen
BG324	Razgrad	EL126	Serres	BG412	Sofia
BG325	Silistra	EL127	Chalkidiki	BG413	Blagoevgrad
BG334	Targovishte	EL131	Grevena	BG423	Pazardzhik
BG424	Smolyan	EL132	Kastoria	BG425	Kardzhali
EL114	Drama	EL133	Kozani	EL112	Xanthi
EL115	Kavala	EL134	Florina	FR633	Haute-Vienne
EL121	Imathia	EL245	Fokida	HU312	Heves
EL123	Kilkis	PL411	Pilski	HU313	Nógrád
EL124	Pella	PL414	Koninski	HU331	Bács-Kiskun
EL125	Pieria	PL416	Kaliski	HU332	Békés
EL141	Karditsa	PL423	Stargardzki	PT117	Douro
EL142	Larisa	PL614	Grudziadzki	PT118	Alto Trás-os-Montes
EL144	Trikala	PL615	Wloclawski	PT162	Baixo Mondego
EL211	Arta	PT111	Minho-Lima	PT163	Pinhal Litoral
EL212	Thesprotia	PT167	Serra da Estrela	PT164	Pinhal Interior Norte
EL214	Preveza	PT16C	Médio Tejo	PT165	Dão-Lafões
EL221	Zakynthos	PT181	Alentejo Litoral	PT166	Pinhal Interior Sul
EL222	Kerkyra	RO115	Satu Mare	PT168	Beira Interior Norte
EL223	Kefallinia	RO124	Harghita	PT169	Beira Interior Sul
EL224	Lefkada	RO125	Mures	PT16A	Cova da Beira
EL231	Aitoloakarnania	RO212	Botosani	PT16B	Oeste
EL233	Ileia	RO215	Suceava	PT182	Alto Alentejo
EL241	Voiotia	RO216	Vaslui	PT183	Alentejo Central
EL242	Evvoia	RO222	Buzau	PT184	Baixo Alentejo
EL243	Evrytania	RO226	Vrancea	PT185	Lezíria do Tejo
EL244	Fthiotida	RO412	Gorj	RO112	Bistrita-Nasaud
EL251	Argolida	RO413	Mehedinti	RO114	Maramures
EL252	Arkadia	RO414	Olt	RO116	Salaj
EL253	Korinthia			RO121	Alba
EL254	Lakonia			RO123	Covasna
EL255	Messinia			RO225	Tulcea
EL411	Lesvos				
EL412	Samos				
EL413	Chios				
EL421	Dodekanisos				
EL422	Kyklades				
EL432	Lasithi				
EL433	Rethymni				
ES431	Badajoz				
ES432	Cáceres				
FR262	Nièvre				
FR263	Saône-et-Loire				
FR264	Yonne				
FR631	Corrèze				
FR632	Creuse				
FR721	Allier				
FR722	Cantal				
FR723	Haute-Loire				
FR811	Aude				
FR814	Lozère				
FR831	Corse-du-Sud				
FR832	Haute-Corse				
FR930	Guyane (FR)				
ITF32	Benevento				
ITF46	Foggia				
ITF51	Potenza				
ITF52	Matera				
ITF61	Cosenza				
ITF62	Crotone				
ITF63	Catanzaro				
ITF64	Vibo Valentia				
ITG14	Agrigento				
ITG15	Caltanissetta				
ITG16	Enna				
PL215	Nowosadecki				
PL217	Tarnowski				
PL417	Leszczynski				
RO415	Vâlcea				

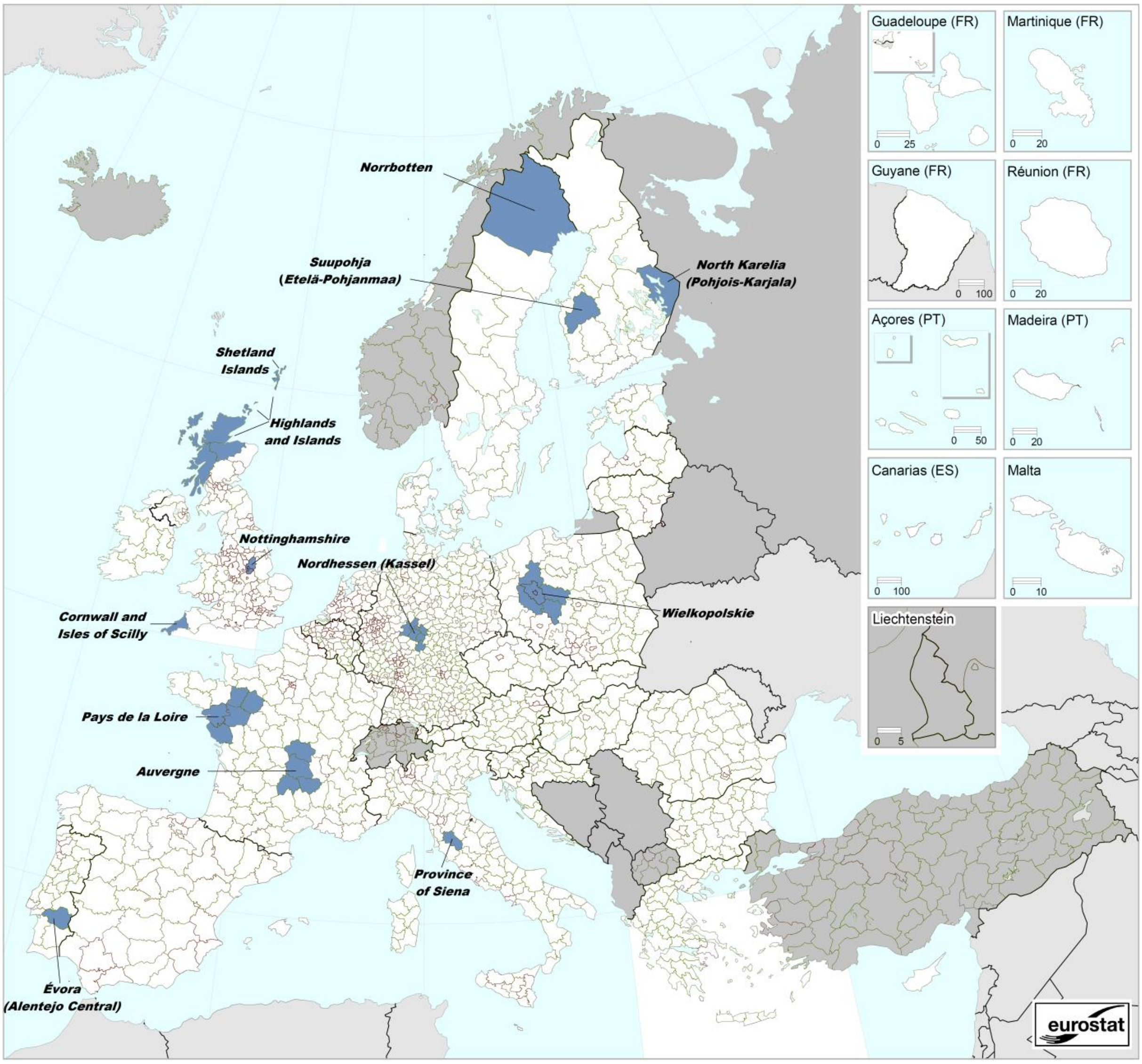
Group 4: NGA coverage < 35% & broadband access > 70%	
DE225	Freyung-Grafenau
DE229	Regen
DE22B	Straubing-Bogen
DE22C	Dingolfing-Landau
DE235	Cham
DE239	Schwandorf
DE407	Elbe-Elster
DE40F	Prignitz
DE725	Vogelsbergkreis
DE735	Schwalm-Eder-Kreis
DE809	Güstrow
DE80G	Parchim
DEB23	Eifelkreis Bitburg-Prüm
DEB24	Vulkaneifel
DEE06	Jerichower Land
DEE0A	Mansfeld-Südharz
DEG0A	Kyffhäuserkreis
DEG0F	Ilm-Kreis
ES241	Huesca
ES242	Teruel
ES425	Toledo
ES531	Eivissa, Formentera
ES533	Menorca
ES703	El Hierro
ES704	Fuerteventura
ES706	La Gomera
ES707	La Palma
FR211	Ardennes
FR212	Aube
FR214	Haute-Marne
FR221	Aisne
FR223	Somme
FR231	Eure
FR241	Cher
FR242	Eure-et-Loir
FR243	Indre
FR245	Loir-et-Cher
FR252	Manche
FR253	Orne
FR412	Meuse
FR432	Jura
FR433	Haute-Saône
FR513	Mayenne
FR515	Vendée
FR521	Côtes-d'Armor
FR524	Morbihan
FR531	Charente
FR532	Charente-Maritime
FR533	Deux-Sèvres
FR534	Vienne
FR611	Dordogne
FR613	Landes
FR614	Lot-et-Garonne
FR621	Ariège
FR622	Aveyron
FR624	Gers
FR625	Lot
FR626	Hautes-Pyrénées
FR627	Tarn
FR628	Tarn-et-Garonne
FR712	Ardèche
FR717	Savoie
FR821	Alpes-de-Haute-Provence
FR822	Hautes-Alpes
HR043	Krapinsko-zagorska zupanija
HR045	Koprivnicko-krizevacka zupanija
HR04E	Sisacko-moslavacka zupanija
ITC12	Vercelli
ITC14	Verbano-Cusio-Ossola
ITC16	Cuneo
ITC17	Asti
ITC18	Alessandria
ITC20	Valle d'Aosta/Vallée d'Aoste
ITC44	Sondrio
ITC4B	Mantova
ITH10	Bolzano-Bozen
ITH33	Belluno
ITH37	Rovigo
ITH42	Udine
ITH51	Piacenza
ITH56	Ferrara
ITI18	Arezzo
ITI19	Siena
ITI1A	Grosseto
ITI31	Pesaro e Urbino
ITI33	Macerata
ITI41	Viterbo
ITI42	Rieti
ITI45	Frosinone
ITF11	L'Aquila
ITF12	Teramo
ITF14	Chieti
ITF21	Isernia
ITF22	Campobasso
ITG25	Sassari
ITG26	Nuoro
ITG28	Oristano
ITG29	Olbia-Tempio
ITG2A	Ogliastra
ITG2B	Medio Campidano
ITG2C	Carbonia-Iglesias
PL115	Piotrkowski
PL116	Sieradzki
PL122	Ostrolecko-siedlecki
PL311	Bialski
PL312	Chelmsko-zamojski
PL315	Pulawski
PL323	Krosnienski
PL324	Przemyski
PL325	Rzeszowski
PL332	Sandomiersko-jedrzejowski
PL344	Lomzynski
UKM63	Lochaber, Skye & Lochalsh, Arran & Cumbrae and Argyll & Bute
UKM64	Eilean Siar (Western Isles)
UKM65	Orkney Islands

Group 5: NGA coverage 35% - 65% & broadband access > 70%	
CZ032	Plzenský kraj
CZ053	Pardubický kraj
CZ063	Kraj Vysocina
CZ071	Olomoucký kraj
DE127	Neckar-Odenwald-Kreis
DE12C	Freudenstadt
DE13A	Waldshut
DE146	Biberach
DE149	Sigmaringen
DE21A	Erding
DE21G	Mühldorf am Inn
DE224	Deggendorf
DE226	Kelheim
DE227	Landshut, Landkreis
DE228	Passau, Landkreis
DE22A	Rottal-Inn
DE236	Neumarkt in der Oberpfalz
DE246	Bayreuth, Landkreis
DE24A	Kronach
DE256	Ansbach, Landkreis
DE25A	Neustadt an der Aisch-Bad Windsheim
DE25C	Weißenburg-Gunzenhausen
DE266	Rhön-Grabfeld
DE267	Haßberge
DE268	Kitzingen
DE26A	Main-Spessart
DE278	Günzburg
DE27C	Unterallgäu
DE40D	Ostprignitz-Ruppin
DE40H	Teltow-Fläming
DE40I	Uckermark
DE733	Hersfeld-Rotenburg
DE737	Werra-Meißner-Kreis
DE806	Wismar, Kreisfreie Stadt
DE808	Demmin
DE80C	Müritz
DE80E	Nordwestmecklenburg
DE80H	Rügen
DE80I	Uecker-Randow
DEA44	Höxter
DEB15	Birkenfeld
DEB16	Cochem-Zell
DEB19	Rhein-Hunsrück-Kreis
DEB1B	Westerwaldkreis
DEB22	Bernkastel-Wittlich
DEB3D	Donnersbergkreis
DEE04	Altmarkkreis Salzwedel
DEE08	Burgenland (DE)
DEE0D	Stendal
DEF05	Dithmarschen
DEF07	Nordfriesland
DEG06	Eichsfeld
DEG09	Unstrut-Hainich-Kreis
DEG0B	Schmalkalden-Meiningen
DEG0C	Gotha
DEG0E	Hildburghausen
DEG0K	Saale-Orla-Kreis
DEG0N	Eisenach, Kreisfreie Stadt
DEG0P	Wartburgkreis

Group 5 (cont'd): NGA coverage 35% - 65% & broadband access > 70%	
IE011	Border
IE012	Midland
IE013	West
IE022	Mid-East
IE024	South-East (IE)
ES112	Lugo
ES113	Ourense
ES411	Ávila
ES416	Segovia
ES417	Soria
ES419	Zamora
ES422	Ciudad Real
ES423	Cuenca
ES513	Lleida
ES708	Lanzarote
FR414	Vosges
FR514	Sarthe
FR522	Finistère
FR711	Ain
FR713	Drôme
HR044	Varazdinska zupanija
HR046	Medimurska zupanija
HR047	Bjelovarsko-bilogorska zupanija
HR048	Viroviticko-podravska zupanija
HR049	Pozesko-slavonska zupanija
HR04A	Brodsko-posavska zupanija
HR04B	Osjecko-baranjska zupanija
HR04C	Vukovarsko-srijemska zupanija
HR04D	Karlovacka zupanija
AT124	Waldviertel
AT224	Oststeiermark
AT313	Mühlviertel
PL117	Skierniewicki
PL121	Ciechanowsko-plocki
PL326	Tarnobrzeski
PL345	Suwalski
PL521	Nyski
RO421	Arad
SI016	Spodnjeposavska
SI018	Notranjsko-kraska
SK021	Trnavský kraj
SK023	Nitriansky kraj
SK032	Banskobystrický kraj
SK041	Presovský kraj
FI194	Etelä-Pohjanmaa
SE212	Kronobergs län
SE213	Kalmar län
SE221	Blekinge län
SE311	Värmlands län
SE312	Dalarnas län
UKL14	South West Wales
UKM61	Caithness & Sutherland and Ross & Cron
UKM66	Shetland Islands

Group 6: NGA coverage > 65% & broadband access > 70%			
BE252	Arr. Diksmuide	HU211	Fejér
BE253	Arr. Ieper	HU213	Veszprém
BE321	Arr. Ath	HU221	Gyor-Moson-Sopron
BE331	Arr. Huy	HU222	Vas
BE334	Arr. Waremme	HU223	Zala
BE336	Bezirk Verviers - Deutschsprachige Gemei	HU232	Somogy
BE341	Arr. Arlon	HU233	Tolna
BE342	Arr. Bastogne	NL341	Zeeuwsch-Vlaanderen
BE343	Arr. Marche-en-Famenne	AT111	Mittelburgenland
BE344	Arr. Neufchâteau	AT112	Nordburgenland
BE345	Arr. Virton	AT113	Südburgenland
BE351	Arr. Dinant	AT121	Mostviertel-Eisenwurzen
BE353	Arr. Philippeville	AT122	Niederösterreich-Süd
CZ031	Jihocecký kraj	AT123	Sankt Pölten
CZ072	Zlínský kraj	AT125	Weinviertel
DK014	Bornholm	AT212	Oberkärnten
DK022	Vest- og Sydsjælland	AT213	Unterkärnten
DK041	Vestjylland	AT222	Liezen
DK050	Nordjylland	AT225	West- und Südsteiermark
DE11A	Schwäbisch Hall	AT226	Westliche Obersteiermark
DE11B	Main-Tauber-Kreis	AT311	Innviertel
DE12A	Calw	AT314	Steyr-Kirchdorf
DE135	Rottweil	AT315	Traunviertel
DE148	Ravensburg	AT321	Lungau
DE217	Dachau	AT322	Pinzgau-Pongau
DE21E	Landsberg am Lech	AT331	Außerfern
DE21M	Traunstein	AT333	Osttirol
DE221	Landshut, Kreisfreie Stadt	AT334	Tiroler Oberland
DE222	Passau, Kreisfreie Stadt	AT335	Tiroler Unterland
DE223	Straubing, Kreisfreie Stadt	AT341	Bludenz-Bregenzer Wald
DE233	Weiden in der Oberpfalz, Kreisfreie Stadt	PT200	Região Autónoma dos Açores (PT)
DE237	Neustadt an der Waldnaab	RO422	Caras-Severin
DE23A	Tirschenreuth	SI011	Pomurska
DE242	Bayreuth, Kreisfreie Stadt	SI012	Podravska
DE24B	Kulmbach	SI013	Koroska
DE24D	Wunsiedel im Fichtelgebirge	SI017	Jugovzhodna Slovenija
DE251	Ansbach, Kreisfreie Stadt	SI023	Goriska
DE265	Bad Kissingen	SI024	Obalno-kraska
DE272	Kaufbeuren, Kreisfreie Stadt	FI193	Keski-Suomi
DE274	Memmingen, Kreisfreie Stadt	FI195	Pohjanmaa
DE277	Dillingen an der Donau	FI196	Satakunta
DE27B	Ostallgäu	FI1C4	Kymenlaakso
DE27D	Donau-Ries	FI1C5	Etelä-Karjala
DE71B	Odenwaldkreis	FI1D1	Etelä-Savo
DE732	Fulda	FI1D2	Pohjois-Savo
DE736	Waldeck-Frankenberg	FI1D3	Pohjois-Karjala
DE922	Diepholz	FI1D4	Kainuu
DE927	Nienburg (Weser)	FI1D5	Keski-Pohjanmaa
DE937	Rotenburg (Wümme)	FI1D6	Pohjois-Pohjanmaa
DE938	Soltau-Fallingbostel	FI1D7	Lappi
DE949	Emsland	SE214	Gotlands län
DE94F	Vechta	SE321	Västernorrlands län
DE94G	Wesermarsch	SE331	Västerbottens län
DEB3B	Alzey-Worms	SE332	Norrbottens län
DEB3G	Kusel	UKJ34	Isle of Wight
DEF0E	Steinburg	UKK30	Cornwall and Isles of Scilly
DEG04	Suhl, Kreisfreie Stadt	UKL11	Isle of Anglesey
EE004	Lääne-Eesti	UKL12	Gwynedd
EE006	Kesk-Eesti	UKM24	Scottish Borders
EE008	Lõuna-Eesti	UKM32	Dumfries & Galloway
IE023	Mid-West	UKM62	Inverness & Nairn and Moray, Badenoch & Strathspey
IE025	South-West (IE)	UKN05	West and South of Northern Ireland (UK)
ES613	Córdoba		
LV003	Kurzeme		
LV005	Latgale		
LV008	Vidzeme		
LV009	Zemgale		

Appendix II – Location of examples and cases included in the study



(¹) Based on population grid from 2006 and NUTS 2010.

0 200 400 600 800 km

Appendix III – References

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