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# **The Broadband Investment Handbook**



***Mr Guido ACCHIONI***

*Policy Officer, Unit B.5, Investment in High-Capacity Networks*

*DG CONNECT, European Commission*





## Background on the Handbook

- Builds on the 'The high-speed broadband investment guide' published in 2014 also included: technology., business and investment models, EU policy & regulation, funding, project planning, user/demand aspects, etc;
- A different handbook also published in 2014 dealt instead with the state aid issues; provided examples & additional explanation concerning the EU state **Aid Guidelines of 2013: Handbook for decision makers - The broadband State aid rules explained**
- Both documents: provided advice to public authorities about how to go about planning, implementing and monitoring broadband projects;
- Used in the interaction between the EC and national and regional public authorities involved in broadband deployment and Broadband Competence Offices network (BCOs) since 2017.



## The authors: **Marco Forzati** & Pietro Pantalissi

- **Marco's background:** A scientist and a technology expert, with experience as a manager and entrepreneur. He holds a PhD in electrical engineering and a BSc in economics.
- Marco's career: has undertaken research and consulting in digital communications, socio-economic analysis and business modelling for Ericsson, RISE Research Institutes in Sweden,
- Marco's Experience: Carried out work as an independent consultant.
- Assisted public authorities across Europe as well as the European Commission with several studies and assessments on broadband projects, digitalisation and smart specialisation.



# The authors: Marco Forzati & **Pietro Pantalissi**

- Pietro's background: Since 2015, a Case Handler for the European Commission (DG COMP: Unit C4: Information, Communication and Media & Specialises in State aid within the Information, Communication, and Media sectors (focus: broadband).
- Pietro holds an MSc in Telecommunication Engineering, a Master's in Business Administration, and a Master's in Economy and Enterprise Management.
- Pietro's career: worked for 16 years for telecommunication operators in Italy such as Italtel,(a leading multinational system integrator, focusing on strategic planning, marketing & business development).
- From 2021 to 2022: worked on the revision of the guidelines on State aid for broadband networks
- Contributed to the amendment of the Global Block Exemption Regulation (GBER).



European  
Commission

***Mr Pietro PANTALISSI,***

*Case Handler, Unit C.4, State Aid, handbook co-author*

*DG COMP, European Commission*



# Introduction

This handbook aims to assist public authorities in **planning, implementing, and monitoring** broadband projects within their territories.

It primarily addresses the deployment of **access and backhaul segments of fixed broadband networks** and **take-up of broadband services**.

In the next edition **we plan to add mobile networks**.



Broadband  
investment  
handbook

2024

# What is new

The handbook's structure builds on the '[The high-speed broadband investment guide](#)' published in 2015.

It has been comprehensively updated to encompass the **latest development in:**

- **Technology:** From NGA to VHCN
- **Policy:** From the Digital Agenda for Europe to the Digital Decade Policy Targets
- **Rules and Regulation:** A new chapter on State aid has been introduced to reflect the updated Broadband State Aid Guidelines and Global Block Exemption Regulation.
- **Financing:** EU (ERDF, EAFRD, CEF digital, RRF, etc.) vs. National funds; grants vs. loans (EIB, InvestEU), etc.



# The preliminary phase



## Key concept and context



- *Broadband connections classifications (NGA, Ultra-fast, VHCN)*
- *Fixed vs. Mobile,*
- *QoS criteria*



## The Broadband Plan



- *What is your current situation?*
- *What are your goals?*
- *What are the funds? What their source?*
- *Who are the relevant stakeholders?*
- *What are the legal constraints?*

# The strategic choices



## Investment model



**What is your role in the implementation, operation, ownership, and management of the infrastructure?**

- *Direct investment model*
- *Concessionaire model*
- *Operator subsidy model (gap funding or aid in kind)*
- *Community support model (bottom-up)*



## Network type



**What are the key elements to decide on the kind of infrastructure and technology?**

- *Passive infrastructure vs. Active network*
- *Access or Backhaul*
- *Media (copper, coax, fibre, wireless) or combination of media*
- *Topology (P2P, xPON)*



## Business model



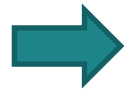
**What is the business model?**

- *Vertical integration vs. wholesale-only*
- *Wholesale access*

# Financing, action plan & execution, State aid



## Financing tools

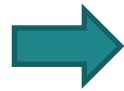


### How to finance CAPEX and OPEX?

- *Loans, equity, grants, tax incentives, etc.*
- *EU and/or National fund*
- *EIB, NPBs, commercial banks, end-users (bottom-up)*



## Action plan and execution



### A detailed action plan and its careful monitoring is the key to achieve your goals

- *Business plan: Revenues, CAPEX, OPEX*
- *Marketing and communication plan: key customers, broadband champion, demand stimulation*
- *Procurement*
- *Monitoring and management of the network*



## Broadband investment and State aid



### Does the project involve State aid? Is notification to the Commission necessary?

- *Does your project involve State aid?*
- *Is a notification needed or can go under GBER?*
- *What is the role of the Broadband Guidelines?*



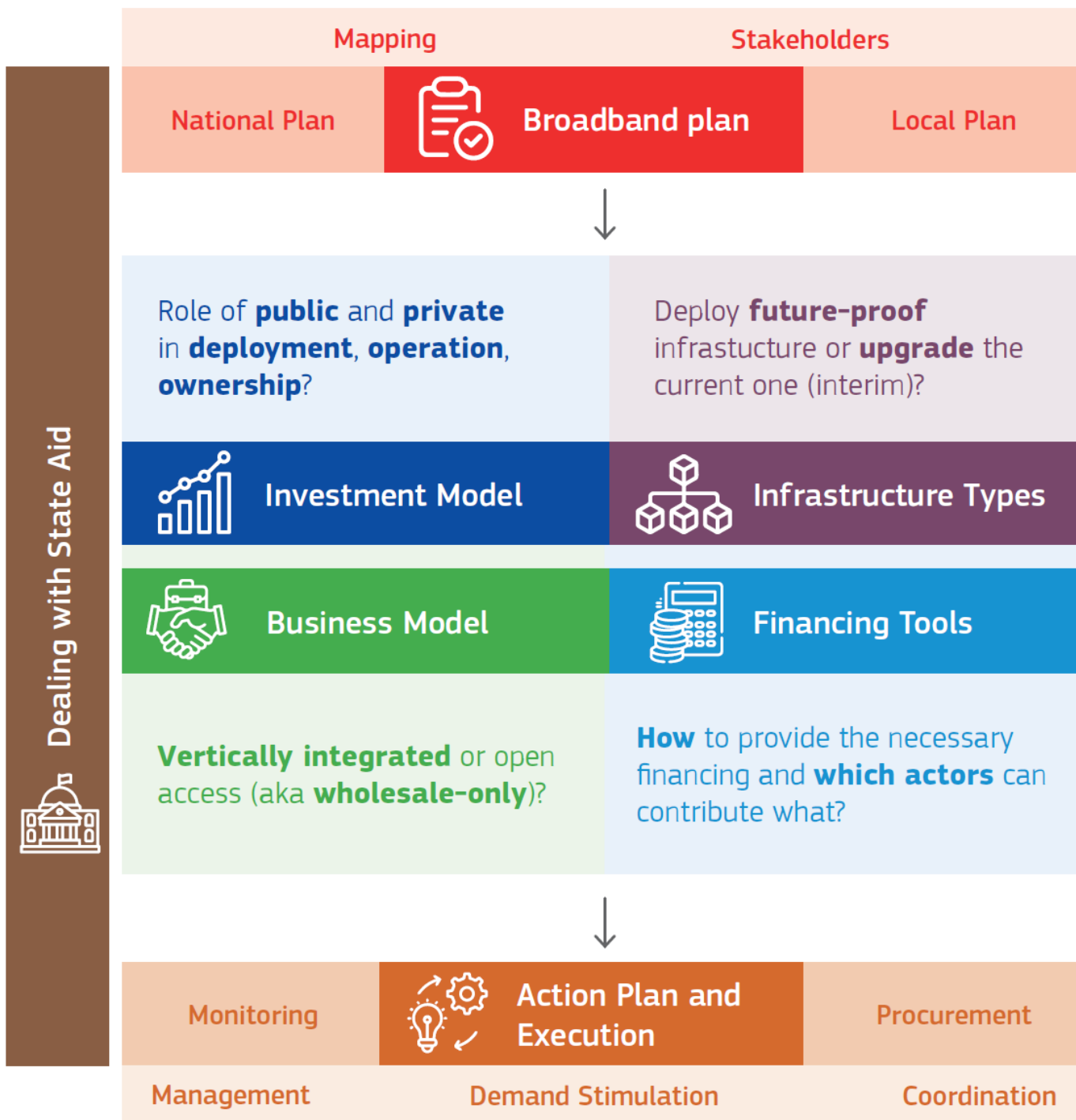
European  
Commission

***Mr Marco FORZATI,***

*Broadband Expert, handbook co-author and editor*

*BCO Support Facility*





# 1. Introduction and key concepts

1.1 Objective and target audience of the guide

INFOBOX 1.

Quality of service (QoS) of broadband: key concepts and terms

1.2 What is broadband

INFOBOX 2.

VHCN criteria for fixed and wireless networks

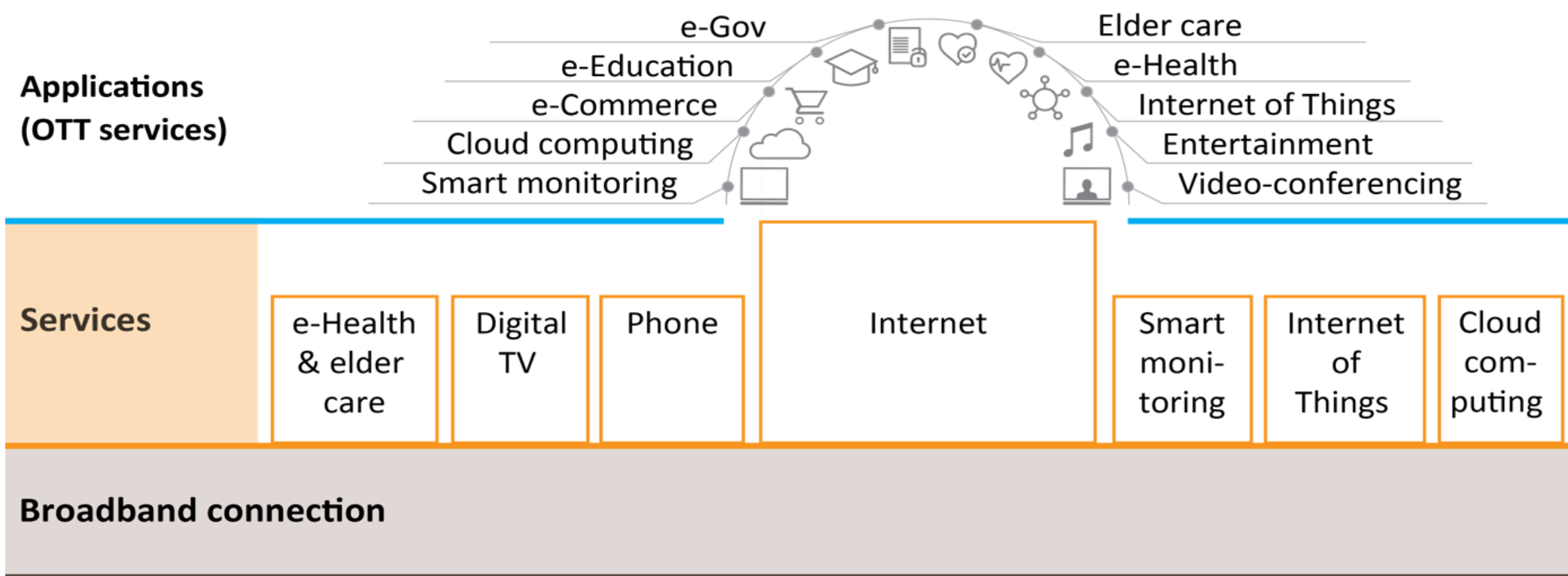
1.3 Broadband connection classification

1.4 Fixed broadband and mobile broadband

INFOBOX 3.

The European Electronic Communications Code

# 1.2 What is broadband



# 1.3 Broadband connection classification

## Basic broadband

- Download: < 30 Mbps
- Upload: < 1 Mbps

*EU 100% coverage in 2013*

## NGA broadband

*EU goal: 100% coverage by 2020 (DAE)*

- Download: > 30 Mbps
- Upload: > 1 Mbps

## Ultrafast broadband

- Download: > 100 Mbps

### Fixed VHCN broadband

*EU goal: 100% coverage by 2030 (digital decade)*

- Download: > 1 Gbps
- Upload: > 200 Mbps



# INFOBOX 1 QoS - key concepts and terms

- **Information** is measured in binary units, called bits (b).
- **Data rate** (aka connection speed or bandwidth): (unit: Mbps, or Gbps=1,000 Mbps).
- **Information storage**: measured in megabytes (MB) and gigabytes (GB).
- **Capacity**: the total maximum data rate achievable (Mbps or Gbps).
- **Contention**: the situation in which the total available capacity must be shared among many active users.
- **Latency**: the time it takes for a signal to propagate or a data transfer to start (irrespective of data rate).
- **Jitter**: fluctuation in latency. Applications sensible to latency tend to suffer greatly from jitter as well.
- **Connection symmetry**: the upload speed is as high as download speed.
- **Network availability** (also known as uptime): the percentage of time the network is delivering.

# 2. The Broadband Plan

- 2.1 Writing a national broadband plan
- 2.2 Writing a regional or local broadband plan
- 2.3 The broadband plan as an enabling ERDF condition
- 2.4 Considerations on socio-economic benefits and challenges
- 2.5 Policy context
- 2.6 Mapping current situation and defining investment goals
- 2.7 Identifying stakeholders and securing collaboration
- 2.8 General State aid considerations

## INFOBOX 4.

The broadband plan in the Common Provision Regulation

## INFOBOX 5.

Utilities and mobile operators, special types of stakeholders

## INFOBOX 6.

The Broadband Competence Offices Network (BCO)

Role of **public** and **private** in **deployment, operation, ownership**?

Deploy **future-proof** infrastructure or **upgrade** the current one (interim)?



Investment Model



Infrastructure Types



Business Model



Financing Tools

**Vertically integrated** or open access (aka **wholesale-only**)?

**How** to provide the necessary financing and **which actors** can contribute what?

# 3. Investment Models

- 3.1 Four investment models
- 3.2 The direct investment model
- 3.3 The concession model
- 3.4 The operator subsidy model
- 3.5 The community support model (bottom-up)
- 3.6 Choosing the investment model
- 3.7 State aid considerations

## INFOBOX 6.

Co-investment and public-private partnerships (PPP)

## INFOBOX 7.

Direct investment examples

## INFOBOX 8.

Concession model examples

## INFOBOX 9.

Operator subsidy examples

## INFOBOX 10.

Community broadband examples

**Co-investment**  
Two or more investors agree to invest together to deploy network infrastructure



**PPP**  
One of the parties is a public body

e.g., in connection with direct investment models

e.g., in connection with direct investment & concession models

## 3.2 The direct investment model

*the Nordic "municipal network" model*

The broadband network is

- **Built**
- **Operated**
- **Owned**

by the **public authority** (in some cases in collaboration with market via PPP)

## 3.3 The concession model

The broadband network is

- **Built**
- **Operated**

by a **market actor**

- **Owned**

by the **public authority**

## 3.4 The operator subsidy model

*(gap funding and in-kind support)*

The broadband network is

- **Built**
- **Operated**
- **Owned**

by a **telecom operator**



# Operator subsidy from state aid standpoint

Here, a private actor receives support from the public authority to build or extend its own network, either

- by means of a grant, normally corresponding to the gap between the deployment cost and reasonable profit: **gap funding**, or
- by means of equity, loans and in-kind support (civil works, access to infrastructure, technical support): **in-kind support**.

Because of the different nature in aid, gap funding and in-kind support are listed as two separate models in the **Broadband Guidelines**.

## 3.5 The community support model

*(aka bottom up)*

The broadband network is

- **Built**
- **Operated**
- **Owned**

by the **end-user  
community**

# Community support from state aid standpoint

In the operator subsidy and community support model, public authorities needs to take very different roles in the two situations, however:

- From the point of view of State aid, the community support model is equivalent to the **operator subsidy model**;
- In the Broadband Guidelines classification, community support falls within either the **gap funding** or **in-kind support models**.

# 3. Investment Models

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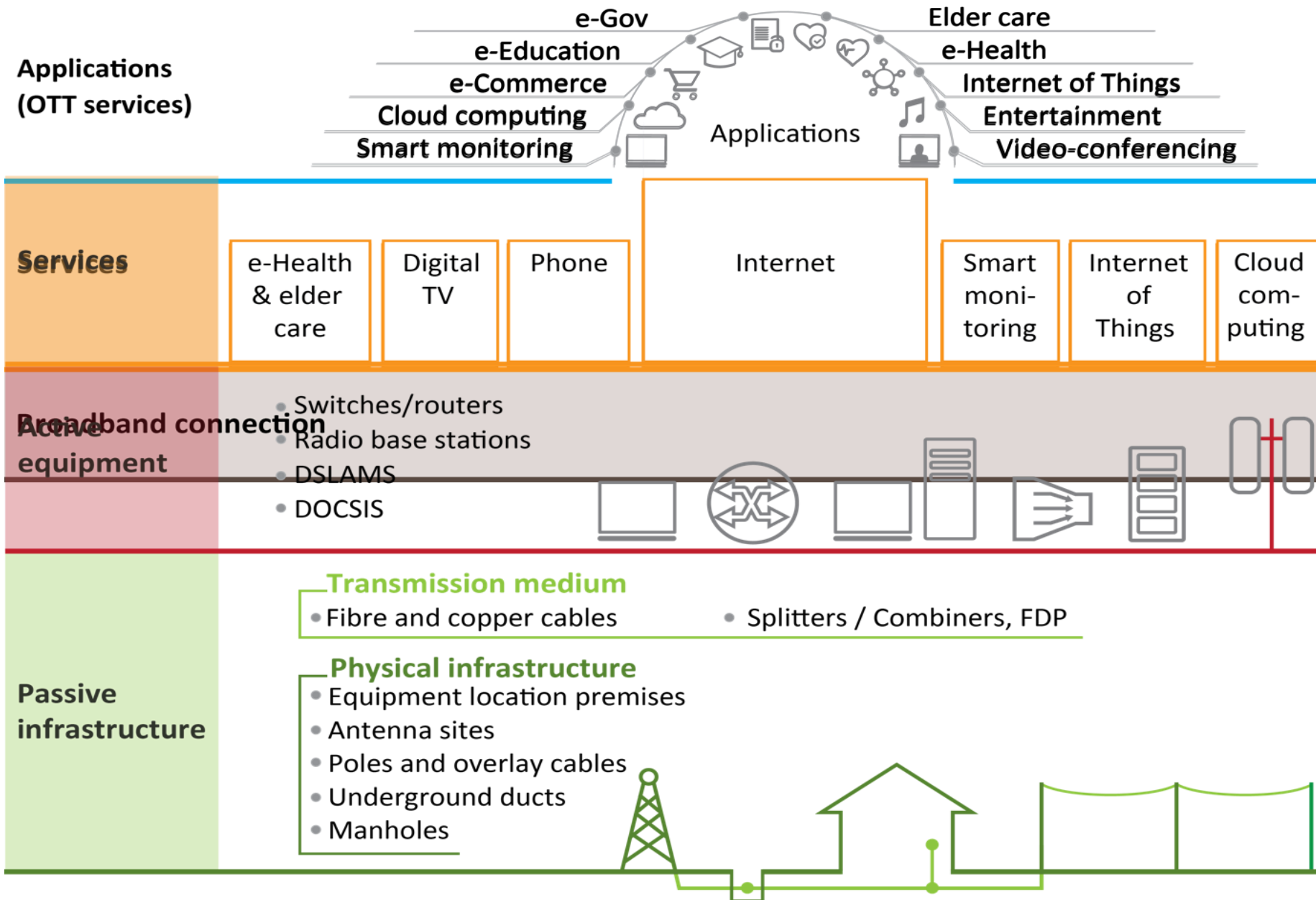
Community broadband examples

# 4. Infrastructure Types

*And technology evolution*

- 4.1 Layers of a broadband network
- 4.2 Passive infrastructure vs active equipment (technology)
- 4.3 Geographical parts of a broadband network
- 4.4 Available transmission media for the passive infrastructure
- 4.5 Broadband access solutions (infrastructure in the last mile)
- 4.6 Network robustness
- 4.7 State aid considerations

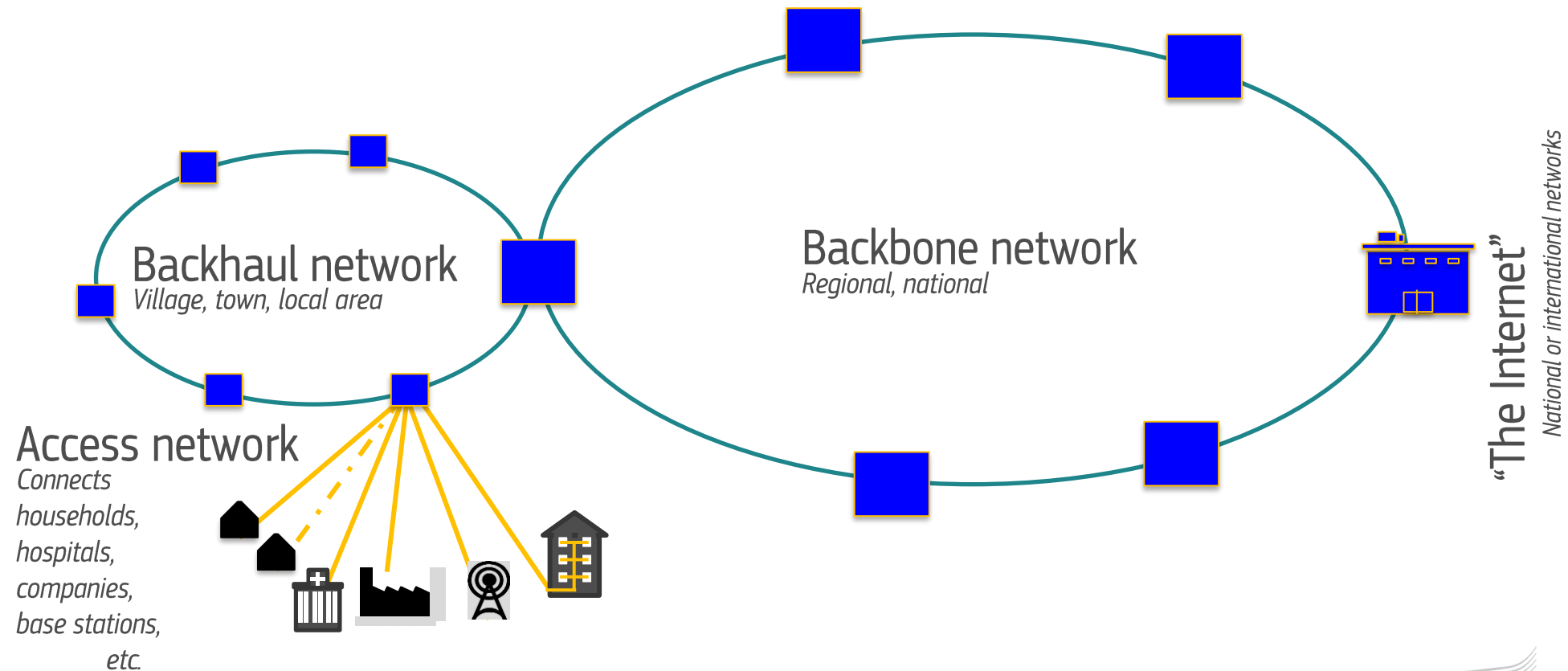
# 4.1 Layers of a broadband network



- High OPEX
- Economies of scale
- Requires ICT know-how
- Temporary asset

- High CAPEX, low OPEX
- Local, low economies of scale
- Low ICT know-how required
- Subject to regulation
- Permanent asset

# 4.3 Geographical parts of a broadband network



# Infrastructure and technology

	Current commercial technology		Fundamental properties of last-mile physical medium		
	Top commercial technology	Top data rate (down/up)	Shared medium	Available bandwidth	Indicative transmission reach
<i>fixed</i>					
1. FTTH p2p	10GbE	10/10 Gbps	No	50 000 GHz	80 km
2. FTTH p2mp (PON)	XGPON	up to 10/2.5 Gbps	Yes	50 000 GHz	20 – 45 km (32 – 8 users)
3. Twisted pair with fibre in the backhaul	ADSL2+	24/3 Mbps	No	0.05 GHz	0.5 – 2 km (high – low speed)
4. Twisted pair with FTTC	VDSL2 + vectoring	up to 90/40 Mbps	No	0.05 GHz	0.2 – 0.5 km (high – low speed)
5. Twisted pair with FTTdb	G.fast	up to 500/500 Mbps	No	0.05 GHz	<200m (high – low speed)
6. Coaxial cable with FTTC	DOCSIS 2	up to 40/30 Mbps	Yes	1 GHz	0.5 – 3.0 km (high – low speed)
7. Coaxial cable with FTTdb	DOCSIS 4	up to 10/6 Gbps	Yes	1 GHz	<100m
<i>wireless</i>					
10. FWA at mm-waves	5G	up to 10/5 Gbps	Yes	1 GHz	Less than 1 km
9. FWA at mid-low waves	5G, LTE/4G	100 Mbps	Yes	0.05 GHz	Few km
8. FWA with unlicensed spectrum	Wi-Fi 5	up to 7/1.3 Gbps	Yes	0.5 GHz	Less than 1km
11. Satellite (GEO)	Ka-band systems	up to 20/8 Mbps	Yes	10 GHz	N/A (latency inherently high)
12. Satellite (LEO)	Multi-co systems	up to 350/25 Mbps	Yes	10 GHz	N/A (latency $\cong$ copper)



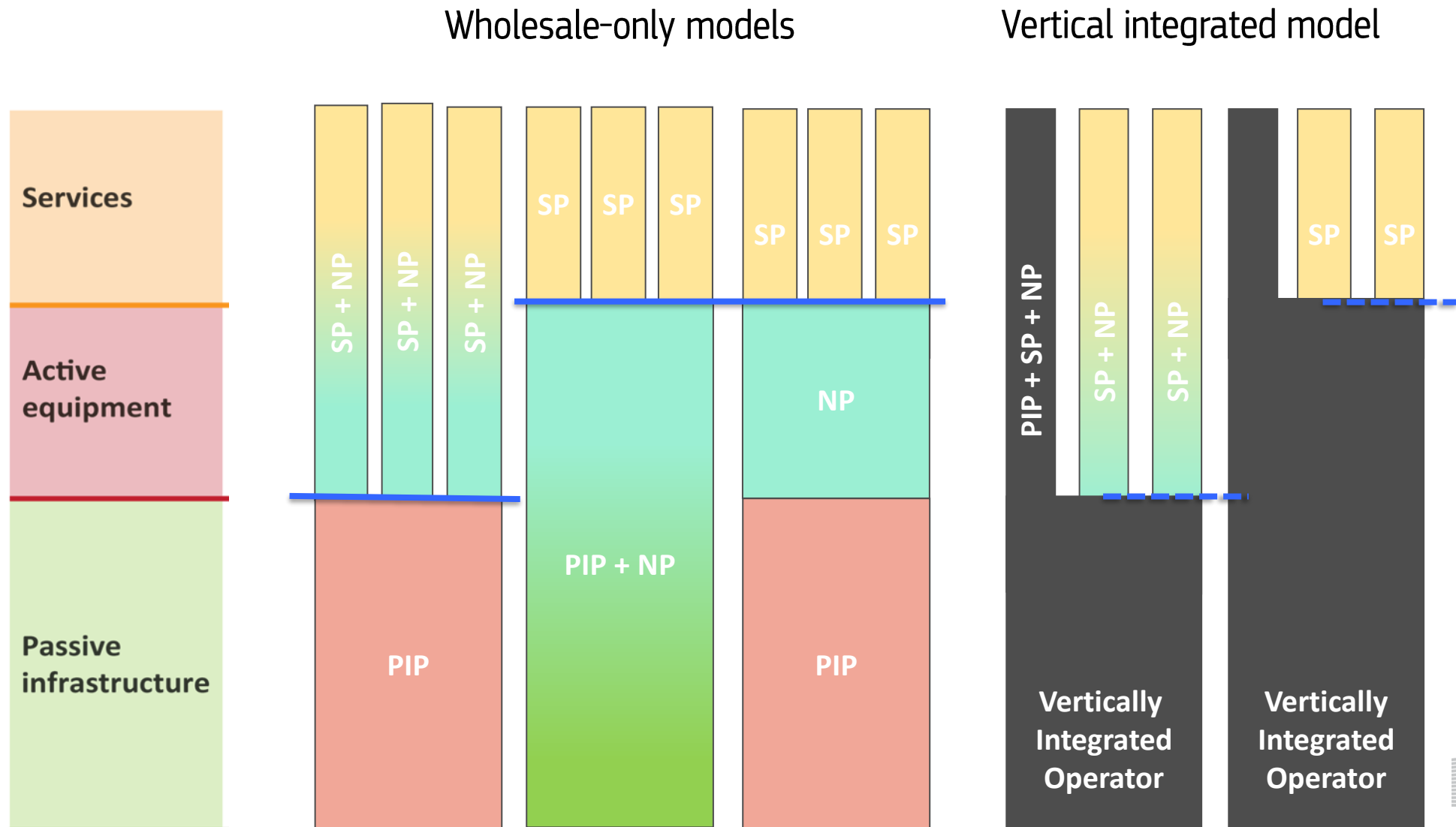
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<b>Wireless</b>					
10. FWA at mm-waves	5G	up to 10/5 Gbps	Yes	1 GHz	Less than 1 km, w/o hinders
9. FWA at mid-low waves	5G, LTE/4G	100/20 Mbps	Yes	0.05 GHz	Few km
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12. Satellite (LEO)	Multi-constellation systems	up to 350/25 Mbps	Yes	10 GHz	N/A (latency comparable to copper)

# 5. Business Models

- 5.1 Different tools
- 5.2 Vertical integration vs. wholesale-only
- 5.3 Passive-layer wholesaleonly model
- 5.4 Active-layer wholesaleonly model
- 5.5 Mediated wholesale-only model
- 5.6 Vertically integrated model
- 5.7 Choosing the business model

# Network layers and business models



		BUSINESS MODEL			
		at passive-layer	Wholesale only... at active-layer	mediated	Vertically Integrated
INVESTMENT MODEL	Direct investment	<ul style="list-style-type: none"> <li>Public administration: ownership &amp; PIP</li> <li>Operators: NP+SP</li> </ul>	<ul style="list-style-type: none"> <li>Public administration: ownership &amp; PIP+NP</li> <li>Operators: bitstream access (SP)</li> </ul>	<ul style="list-style-type: none"> <li>Public admin: ownership &amp; PIP</li> <li>Operator-neutral entity: NP (3-5y)</li> <li>Operators: SP</li> </ul>	
	Concession		<ul style="list-style-type: none"> <li>Public administration: ownership</li> <li>Concessionary: PIP+NP (20-30y)</li> <li>Operators: bitstream access (SP)</li> </ul>		<ul style="list-style-type: none"> <li>Public administration: ownership</li> <li>Conc.: PIP+NP+SP (20-30y)</li> <li>Other operators: SP or NP+SP (regulation)</li> </ul>
	Gap funding		<ul style="list-style-type: none"> <li>Beneficiary: ownership &amp; PIP+NP</li> <li>Operators: SP</li> </ul>		<ul style="list-style-type: none"> <li>Beneficiary: ownership &amp; PIP+NP+SP</li> <li>Other operators: SP or NP+SP (regulation)</li> </ul>
	Bottom up		<ul style="list-style-type: none"> <li>Beneficiary coop: ownership</li> <li>Beneficiary coop or commercial partner: PIP+NP</li> <li>Operators: SP</li> </ul>	<ul style="list-style-type: none"> <li>Beneficiary coop: ownership &amp; PIP</li> <li>Operator-neutral entity: NP (3-5y)</li> <li>Operators: SP</li> </ul>	<ul style="list-style-type: none"> <li>Beneficiary coop: ownership</li> <li>Beneficiary coop or commercial partner: PIP+NP+SP</li> </ul>

# 6. Financing Tools

- 6.1 Different tools
- 6.2 Investing own resources
- 6.3 Debt financing (loans)
- 6.4 Equity financing
- 6.5 Grant financing
- 6.6 Tax incentives
- 6.7 State aid considerations

# 7. Action Plan and Execution

- 7.1 Cost estimates and financial planning
- 7.2 Risk assessment and management
- 7.3 Network design, key connections and urban planning
- 7.4 Procurement
- 7.5 Monitoring
- 7.6 Identification of potential customers
- 7.7 Establishing internal and external coordination and collaboration
- 7.8 The broadband champion
- 7.9 Marketing and communication plan
- 7.10 Stimulating demand
- 7.11 Decision making

# Action plan and execution

## Broadband plan

Defines:

- Overall goals and strategy for broadband development
- List of relevant stakeholders
- Choice of
  - Infrastructure type(s)
  - Investment model
  - Business model
  - Financing tools

## Action plan

Defines:

- Activities needed to implement the strategy
- Procurement and detailed cost and revenue estimation
- Roles and responsibilities of different actors
- Stakeholders' engagement
- Monitoring of project outcome against goals and specs
- Relevant marketing, sales, service demand stimulation, etc.



European  
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# Notion of State aid

Any use of public funds to support the development of an economic activity, such as investment in broadband, must comply with the EU's State aid rules.

## Notion of aid – Art. 107(1) TFEU:

- *“Any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, insofar as it affects trade between Member States, be incompatible with the internal market”.*

## However, there are derogations:

- **Art. 107(2)(a):** Aid having a social character, granted to individual consumers, provided that such aid is granted without discrimination related to the origin of the products concerned.
- **Art. 107(3)(c):** Aid to facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest.

# Why do we control State aid?

## To minimise distortion of competition:

- Preventing crowding-out of existing investments by disincentivising, preventing or discontinuing them.
- Ensuring a level playing field for all operators and preventing favouring certain technology platforms
- Preventing the creation of local monopolies through competition in the market (wholesale access)

## To ensure an efficient use of taxpayers' money

- Avoiding over-compensation
- Limiting State aid where it is genuinely necessary (market failure areas)
- Fostering competition for market (using competitive selection procedures)

## Additionally

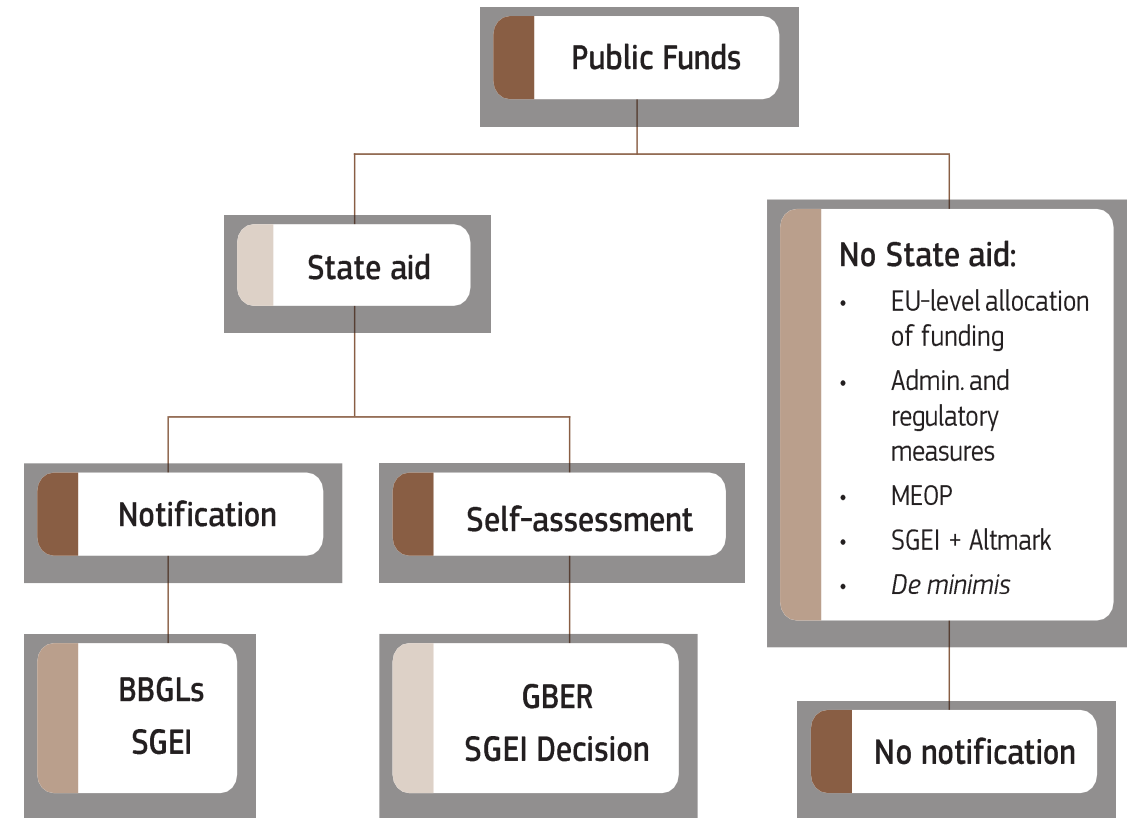
- Ensures competitive European industry
- Prevents “subsidy race”

# Broadband Investment and State aid

Under certain conditions, the use of public funds to support broadband investments **must be notified to the Commission before granting State aid**: prior to tendering out the project and before signing the contract with the beneficiary

However, a wide range of uses of State funds do not require notification because:

- the use of public funds **does not constitute State aid**
- their **compliance with State aid rules can be self-assessed under the General Block Exemption Regulation (GBER)**



# No State aid involved

There are various situations where the use of public funds does not constitute State aid:

- **EU-level allocation of EU funds:** Consistency with State aid rules is verified at EU level. National authorities have no discretion over the use of these funds.
- **Administrative and regulatory measures:** These include facilitating rights of way, coordinating civil engineering works, or sharing infrastructure under the conditions that (i) they are transparent and non-discriminatory for all interested operators, and (ii) they are open to all potential users.
- **Market Economy Operator Principle (MEOP):** There is no advantage if the State behaves like a "normal" player on the market when investing in broadband. The State must share the same risks and opportunities as a private investor. This requires extensive demonstration (ex-ante business plan, pari passu involvement, etc.)
- **Service of General Economic Interest (SGEI) + Altmark:** This requires: (1) public service obligations clearly defined by an entrustment act; (2) parameters for compensation established in advance; (3) no overcompensation (the compensation can only cover the net costs + a reasonable profit); (4) the compensation must be established either through a tender or by comparison with the costs of a typical well-run company.
- **De minimis:** Up to EUR 300k (EUR 750k for SGEI) over three years is considered too low to affect cross-border competition.

# State aid but no notification - GBER

Measures that: (i) are considered as not having a significant distorting impact on competition and (ii) Member States can carry out a self-assessment of compatibility. Key articles:

- **Art. 52 – aid for fixed networks:** <100 Mln; no existing or planned network providing >100Mbps (>300Mbps only for socio economic drivers).
  - **Requirements:** mapping, public consultation, step-change, tender, active and passive wholesale access, tech neutrality, monitoring, accounting separation, claw-back (>10 Mln).
- **Art. 52(c) – Connectivity vouchers** (no social voucher): <50 Mln over two years; new subscriptions or upgrade (>30 Mbps for consumers >100Mbps for SMEs), max 50% of eligible costs, max duration 3 years.
  - **Requirements:** public consultation, market assessment, wholesale access if market share >25%, on-line registry, tech neutrality.
- **Art. 52(d) – backhaul networks:** <100 Mln; no network based on fibre.
  - **Requirements:** mapping, public consultation, step-change, tender or direct investment, active and passive wholesale access, tech neutrality, monitoring, accounting separation, claw-back (>10 Mln).

# The Broadband Guidelines (1/2)

If a project involves State aid and the GBER does not apply, it must be notified to the Commission for assessment under the Broadband Guidelines.

The key steps and requirement for fixed access networks are as follows:

- **Establishing the existence of a market failure:** The existing and planned networks do not currently meet, nor are they likely to meet, the needs of end-users (1Gbps download/150Mbps upload). The likelihood that the market will address these needs depends on the level of competition in the area and the associated costs. The level of competition is assessed through mapping and public consultation, which categorises areas as follows: white (no ultrafast network), grey (one ultrafast network), or black (two or more ultrafast networks). The costs are determined by the performance of existing networks and the required investment to provide 1Gbps download/150Mbps upload.
- **Mapping:** This is a fundamental requirement. Key aspects include determining which parameters to map (e.g., download speed, upload speed, latency), how to measure these parameters under peak-time conditions (e.g., contention rate), and deciding on the level of granularity (e.g., address level, grids) based on premises that are connectable within 4 weeks at standard market prices.
- **Public consultation:** To collect feedback on the proposed project and gather information on future investment plans

# The Broadband Guidelines (2/2)

- **Step change:** The new network must deliver significantly enhanced performance compared to existing networks, specifically at least tripling the download speed.
- **Wholesale access (passive and active):** This is essential to increase end users' choice and competition in the areas affected by public intervention. Access products vary based on the area's classification.
- **Monitoring:** Awarding authorities are required to closely monitor the implementation of supported broadband projects throughout their entire duration. Additionally, schemes with large budgets or novel characteristics are subject to ex-post evaluation.
- **Claw-back:** Any excess subsidy must be repaid. This could occur if the network deployment costs were lower than expected or if the commercial exploitation of the network yielded higher revenues.



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