

Best practice for passive infrastructure access

for Vodafone

by
WIK-Consult GmbH
Rhöndorfer Str. 68
53604 Bad Honnef
Germany

Ilsa Godlovitch
Thomas Plueckebaum
Caroline Held
Wolfgang Kieseeweter
Desislava Sabeva
Sonia Strube Martins

19 April 2017

Abbreviations

BEREC	Body of European Regulators for Electronic Communications
CRD	Cost Reduction Directive
EC	European Commission
EU	European Union
EECC	European Electronic Communications Code
EoI	Equivalence of Input
EoO	Equivalence of Output
FTTH/B	Fibre to the Home/ Building
FTTLA	Fibre to the Last Amplifier
IRU	Indefeasible Right of Use
KPI	Key Performance Indicator
LRIC	Long Run Incremental Cost
MDF	Main Distribution Frame
NGA	Next Generation Access
NRA	National Regulatory Authority
ODF	Optical Distribution Frame
PT	Portugal Telecom
SLA	Service Level Agreement
SLG	Service Level Guarantee
SMP	Significant Market Power
UK	United Kingdom
VHC	Very High Speed Communication

0 Executive summary

0.1 Physical infrastructure access is central to strategies to boost very high capacity broadband

Extensive fibre networks contribute not only to supporting connectivity for homes and businesses, but are also necessary to enable a wave of investment in 5G mobile networks, the Internet of Things and digital services and applications which rely on high bandwidths and low latency. The European Commission's proposals for a "European Electronic Communications Code" (EECC) would make fostering access to Very High Capacity data connectivity an explicit objective for national regulatory authorities (NRAs).¹

Previous research by WIK has identified that fibre deployment is typically triggered by disruptive investors, including alternative infrastructure-based fixed and mobile operators.² However, one of the greatest barriers to disruptive investment is the high cost of digging and deploying ducts and poles. Studies by WIK and others have estimated that this constitutes at least 50% of the total costs of deploying and operating networks³. Providing efficient wholesale access to physical infrastructure, where such infrastructure exists, is therefore an important measure to foster increased deployment of fibre.

The Commission has rightly recognised the importance of physical infrastructure access in the proposed European Electronic Communications Code, by placing it at the heart of a proposed revamped market analysis process. NRAs would need to consider first whether physical infrastructure access alone would address competitive challenges in a given region and market, before applying other downstream access remedies.⁴ Moreover, the Commission clarifies⁵ that the physical infrastructure access remedy could extend beyond the boundaries of the market in which SMP has been found, provided that the obligation is necessary and proportionate to meet the objectives of Article 3. This inherently recognises the role of physical infrastructure access as a horizontal measure which could support competition in multiple downstream markets including not only residential fixed broadband, but also mobile broadband and business services.

In this report, we consider the measures taken to enable access to physical infrastructure (duct, pole and in-building wiring access) in five EU countries: France,

1 http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=comnat:COM_2016_0590_FIN article 3

2 Regulatory, in particular access, regimes for network investment models in Europe SMART 2015/0002 section 6.6.1

3 Jay, S.; Neumann, K-H.; Plückebaum, T.; Comparing FTTH access networks based on P2P and PMP fibre topologies, Conference on Telecommunications, Media and Internet Tecno-Economics (CTTE) 2011, Berlin, 16. - 18. May 2011

4 Article 71 draft EECC

5 Article 70 draft EECC

Germany, Portugal, Spain and the UK. Drawing on these case studies, we identify best practice elements and make recommendations to support the operationalization of physical infrastructure access at national level and through the upcoming EECC.

0.2 Duct access has been most effectively implemented in France, Spain and Portugal

Our study shows that in France, Spain and Portugal, the duct access regime has been elaborated by the NRA (and continues to be elaborated) to ensure that the offer can be used in practice, with the minimum of bureaucracy and maximum transparency to all parties. In contrast, in countries where SMP infrastructure access has been mandated, but not used, such as the UK and Germany, many of these detailed provisions are lacking, although there is an ongoing consultation in the UK, which aims to address several of the issues.⁶

In the countries where duct access is commonly used, there are few restrictions on its use. Usage is permitted for leased lines, fixed and mobile backhaul, in contrast with more restrictive conditions in the UK and Germany. This enables it to operate as a 'cross-market' remedy.

Regulatory controls in the countries which have effective duct access include robust mechanisms to guard against discrimination, including Equivalence of Input and/or SLAs, service level guarantees and associated published KPIs.

The relative success of infrastructure access in these three countries has also been supported by specific measures to operationalize SMP duct access. Innovations in operational conditions in these countries include:

- Availability of online systems containing up-to-date information on duct location and availability, with measures to ensure accuracy of such data
- Removal of requirements to conduct a feasibility analysis, where online information shows that there is availability
- Accreditation for engineers so that alternative operators can access physical infrastructure without supervision
- Measures to give access seekers more autonomy in accessing ducts and cables (e.g. notifying after access)
- Mechanisms to allow access seekers to recover or defray the costs associated with improvements to the incumbent infrastructure

⁶ Ofcom Dec 2016 consultation – initial proposals to develop an effective PIA remedy <https://www.ofcom.org.uk/consultations-and-statements/category-2/wholesale-local-access-market-review-proposals-PIA>

0.3 SMP pole access terms are less well defined – there has been significant take-up of pole access from energy suppliers in some countries

There appears to have been less use of SMP pole access to date than SMP duct access.

One reason might be that the terms for SMP pole access are in general less well defined than those for duct access, and provisioning takes longer. Areas in which conditions can be more restrictive than those for duct access include:

- Lack of real-time automated information on location and/or capacity, therefore requiring manual information provision
- Mandatory surveys (potentially resulting from the lack of real-time information and rules regarding space allocation)
- Lack of clear rules concerning space allocation and reservation and responsibility for removing unused cables
- In some cases, alternative operators pay upfront for augmenting or installing poles
- Lack of clear service levels and guarantees for repair

In some countries such as France and Portugal, there has been significant take-up of pole access via commercial agreements with energy operators.

0.4 In-building wiring is an essential complement to physical infrastructure access provisions

In-building wiring has received considerable attention in those countries which have sought to promote to infrastructure competition in very high capacity broadband. Symmetric regulation is typically used to address this issue. France, Spain and Portugal all have legislation on this issue which predates the 2014 Cost Reductive Directive. Important aspects of this regulation include:

- The availability of information on in-building wiring installations and Reference Offers for co-investment and access to in-building wiring
- The establishment of a connection point at an accessible and viable location - which may lie outside the building and aggregate households in some cases (less dense areas)
- The requirement to install multiple fibres in case of demand
- Guidelines on pricing – the principle of cost-orientation is applied in France and Portugal with ex post intervention by the NRA possible
- Cost-sharing mechanisms whereby second and third-comers contribute to the in-building wiring costs

0.5 Countries with effective physical infrastructure access and in-building wiring have achieved greater deployment and infrastructure competition in FTTH/B

Those countries which have operationalized duct, pole and in-building wiring access have achieved greater deployment of FTTH/B and infrastructure competition in dense urban areas than those which have not pursued this strategy. There could be significant benefits to be gained more widely in Europe if detailed rules and operational processes are put in place concerning in-building wiring, and duct and pole access.

Experience suggests symmetric in-building wiring provisions coupled with duct access from the SMP operator, where this exists, is likely to be most relevant and useful in the deployment of VHC broadband. However, in cases where there is limited duct infrastructure from the SMP operator (e.g. due to directly buried cables), or where SMP duct access does not apply (eg for core network) and more widely for pole access, symmetric obligations applying to non-telecom infrastructure such as those applied under the 2014 EU Cost Reduction Directive could play an important role, building on previous successful cases of commercial co-operation.

0.6 Recommendations for national authorities

1. Operationalization of the physical infrastructure access remedy

NRAs could usefully specify non-discrimination obligations (through use of EoI and/or SLAs/SLGs and KPIs) and operationalize existing SMP duct and pole access by establishing certain requirements in line with best practice through the market review process and/or by reviewing reference offers.

NRAs should also consider lifting existing restrictions on the usage of duct access on the basis that it could provide an important impetus for competition across a number of retail markets (including business and mobile services). Where physical infrastructure access results in infrastructure-based competition, this could enable deregulation of downstream wholesale access in some areas.

An indicative list of best practices drawn from a review of the case studies is shown in the table below.

Table 0-1: Best practice SMP duct and pole access regulatory guidelines

Regulatory conditions	Best practice SMP duct and pole access regulation
Portion of network	Consider costs and benefits of applying access obligations to the whole physical infrastructure network. If limited to local access network - apply to 'NGA' access network extending to the ODF of the access seeker rather than limiting to the legacy copper access network
Restrictions on use	Utilisation of physical infrastructure access for leased lines, fixed and mobile backhaul should be permitted
Price regulation approach	Cost-orientation (LRIC+) using top-down or bottom-up methods can be used. Consider apportioning duct costs to fibre (vs copper) in a manner which reflects low initial take-up. Exclude fully depreciated assets from asset base. Review asset lifetimes to reflect actual investment patterns.
Non-discrimination	Prefer EoI to enable competition through the whole value chain. Ensure SLAs, SLGs with detailed KPIs for each element of the SLA

Table 0-2: Best practice operational duct and pole provisions

Operational processes	Best practice operational duct and pole provisions
Automated information systems	Automated centralised system providing up-to-date data concerning the location and availability of spare capacity should be available to the widest extent possible. Standardised data formats should be used for ducts, poles under the SMP and symmetric systems to enable future integration, but integration should not be compulsory to avoid unnecessary delay. Information providers should have responsibility for accuracy of the data. There should be a system to notify errors with requirement to rectify.
Clear rules concerning space reservation	There should be rules to require the incumbent (and potentially access seekers) to ensure that space is available for later entrants – at least in network segments where infrastructure competition is viable. Clearer guidelines are also needed concerning space reservation on poles and to define what constitutes a fully loaded pole.
Maximum autonomy for the access seeker	Engineers working on behalf of the access seeker should be able to conduct surveys, decongestion and augmentation works, install and repair cables unsupervised, providing they receive the necessary accreditation, or commit to following relevant guidelines, and inform the network owner concerning these works. NRAs should consider whether and if so in which circumstances advance notification of works by the access seeker is necessary. In other cases, notification after the event should suffice.
Freeing capacity and associated cost sharing	The owners of unused cables should be liable for the removal of such cables and associated costs. Removal could be conducted by the SMP operator if they have not been removed within a given deadline. In order to address capacity constraints in the final segment (drop cable) for poles, NRAs should establish a regime to allow a single (potentially hybrid) cable to be installed and the associated costs shared. Where there is need to augment or build poles or bypass ducts, access seekers should be entitled to conduct the work themselves or request the access provider to complete such work. The access seeker should not be liable for the full costs of improvements made to the physical infrastructure of the access provider. Reasonably incurred costs should instead be reimbursed and distributed amongst services and users of the network over time.
Service levels	SLAs applying to the incumbent should be kept to a minimum through taking advantage of automation and providing the greatest degree of autonomy for the access seeker. In this context, remaining core SLAs for the access provider might include 1) availability of the information system, deadlines for provision of any additional information and deadlines to correct any inaccurate information; 2) Deadline for approval of instalment/augmentation plans by altnet 3) deadlines for removal of unused cables or decongestion (where

Operational processes	Best practice operational duct and pole provisions
	<p>not conducted by altnet), 4) deadlines for responding to an accompanying request (only where access provider attendance necessary)</p> <p>5) deadlines for repairing broken conduits or poles. Contractual requirements would also be needed for the access seeker, including the need to take due care and provide timely notice and/or reporting of works. Deadlines are also needed for the completion of installation and filing of the final deployment report.</p>
Compensation	<p>Compensation should be due for lack of availability of online information and failure to meet above SLA.</p>

2. Specification of principles and standards for in-building wiring

Member States and/or NRAs could with the involvement of industry groups, usefully expand on the CRD (Cost Reduction Directive)⁷ provisions to establish more detailed processes, principles and standards for the deployment of and access to in-building wiring, taking into account practices in France, Spain and Portugal. Specifically, rules should be established concerning:

- Information concerning planned in-building deployments including co-investment/access conditions
- Conditions under which end users or operators can demand in-building upgrades
- Multi-operator connection points which support accessibility of infrastructure and the potential for infrastructure competition; and
- Standards for in-building wiring including architecture and number of fibres which should be installed.
- Principles for cost sharing amongst operators to provide guidance in case of disputes

0.7 Implications for the EECC

In order to ensure that the provisions on infrastructure access in the Code result in real deployment, we would recommend integrating into the Code key elements of best practice that have been established in countries with a strong record in infrastructure access.

Specifically, we recommend that article 70 of the Code should be amended to require that physical infrastructure access should be made available subject to conditions of transparency, non-discrimination and cost-orientation, and that a Reference Offer for Physical Infrastructure Access (ducts, poles and associated facilities) should be published which contains at least the minimum list of items included in an Annex, which could replace the existing Access Directive Annex II. Such conditions could be further elaborated following guidance by BEREC.

⁷ Directive 2014/61/EU

Table 0-3: Minimum list of items to be included in a Reference Offer for Physical Infrastructure Access

Minimum List of items to be included in a Reference Offer for Physical Infrastructure Access	
Products to be provided	Access to ducts, cable trays, manholes, handholes, cabinets, MDF locations, building entry facilities, mutualization points
Technical guidelines	Technical characteristics of the physical infrastructure elements, minimum number or size of network elements and technical and operational guidelines regarding access to physical infrastructure, installation of cables, decongestion, enhancement or installation of new physical infrastructure connected to the access provider's network, safety and security standards
Information	Details concerning the central information system by which access seekers can access information on the location and availability of physical infrastructure. Where proportionate, this system should be automated. All data should be up-to-date.
	Processes to ensure the accuracy of information and rectify any inaccurate or incomplete information.
Space reservation	Rules concerning the allocation of space, where this is limited including rules concerning the space that should be reserved by the access provider for potential access seekers.
	Conditions for access seekers to inspect locations at which physical infrastructure access has been refused on the grounds of lack of capacity
Conditions enabling unsupervised access to physical infrastructure	Conditions such as accreditation under which engineers working on behalf of the access seeker are permitted to access physical infrastructure unsupervised to conduct a survey, install or repair cables and conduct decongestion, enhancement or bypass works
Process and service levels for the access provider	Processes and associated timescales (SLAs) concerning at least: <ul style="list-style-type: none"> - Availability of the information system and/or provision of any additional information. Processes to ensure accuracy of information - (Where applicable) Approval of the survey plans of the access seeker or completion of a (joint) survey or viability analysis - Acknowledgement and approval of the specific order for infrastructure access (ie the route or area to be covered) - Removal or reorganisation of cables under the responsibility of the access provider - (Where applicable) Deadlines for responding to requests by the access seeker for permission to access the infrastructure - Providing confirmation of final installation plans - Repair of physical infrastructure under the responsibility of the access provider
Process and service levels for the access seeker	Processes and associated timescales (SLAs) concerning at least: <ul style="list-style-type: none"> - Advance or subsequent notification of works to conduct a survey, install or repair cables and conduct decongestion, enhancement or bypass works - Period within which construction must be completed - Submission of the final installation plan
Compensation	Consequences, including where relevant financial compensation, of failing to meet service level requirements (for the access provider) or installation and notification requirements (for the access seeker)
Pricing	Prices or pricing formulae for each facility, feature and function listed above
	Mechanism by which costs incurred by the access seeker for the augmentation or enlargement of the physical infrastructure network are compensated or shared

Contents

Abbreviations	- 2 -
0 Executive summary	- 3 -
0.1 Physical infrastructure access is central to strategies to boost very high capacity broadband	- 3 -
0.2 Duct access has been most effectively implemented in France, Spain and Portugal	- 4 -
0.3 SMP pole access terms are less well defined – there has been significant take-up of pole access from energy suppliers in some countries	- 5 -
0.4 In-building wiring is an essential complement to physical infrastructure access provisions	- 5 -
0.5 Countries with effective physical infrastructure access and in-building wiring have achieved greater deployment and infrastructure competition in FTTH/B	- 6 -
0.6 Recommendations for national authorities	- 6 -
0.7 Implications for the EECC	- 10 -
1 Introduction	- 17 -
1.1 The importance of operational infrastructure access for the Gigabit society	- 17 -
1.2 Methodology	- 18 -
1.3 Structure	- 18 -
2 Duct and pole access	- 19 -
2.1 Technical description	- 19 -
2.1.1 Physical infrastructure access terminology	- 19 -
2.1.2 Where are ducts and aerial deployments used?	- 21 -
2.1.3 Access points	- 21 -
2.2 Regulatory approaches	- 23 -
2.2.1 Asymmetric (SMP) obligations	- 24 -
2.2.1.1 Scope of the access obligation	- 26 -
2.2.1.2 Restrictions on use	- 26 -
2.2.1.3 Approach to price regulation	- 27 -
2.2.1.4 Approach to non-discrimination	- 28 -
2.2.2 Symmetric obligations	- 30 -
2.3 Operational practices for SMP infrastructure access	- 32 -
2.3.1 Duct access	- 33 -

2.3.1.1	Information concerning location and availability of ducts	- 37 -
2.3.1.2	Approach to space reservation	- 38 -
2.3.1.3	Approach to decongestion and new duct construction	- 39 -
2.3.1.4	Responsibility for installing cables	- 40 -
2.3.1.5	Processes, SLAs and associated guarantees	- 41 -
2.3.2	Pole access	- 44 -
2.3.3	Information concerning pole location and availability	- 47 -
2.3.4	Space reservation rules	- 47 -
2.3.5	Approach towards decongestion and installation of new poles	- 47 -
2.3.6	Installation and accreditation	- 48 -
2.3.7	Timeframes for provisioning, repair and associated compensation	- 48 -
2.4	Benchmarking prices for SMP infrastructure access	- 49 -
3	In-building wiring and terminating segment access	- 51 -
3.1	Legal base - symmetric obligations	- 54 -
3.2	Provision of information	- 54 -
3.3	Location of the connection point	- 55 -
3.4	Approach to in-building architecture	- 59 -
3.5	Approach to pricing	- 60 -
3.6	Approach to non-discrimination	- 60 -
4	Outcomes	- 62 -
4.1	Take-up of infrastructure access	- 62 -
4.1.1	Ducts and poles	- 62 -
4.2	FTTH/B deployment and infrastructure competition	- 65 -
4.2.1	FTTH/B coverage	- 65 -
4.2.2	Infrastructure competition in very high capacity broadband	- 66 -
5	Conclusions	- 69 -
5.1	Recommendations for national administrations and authorities	- 71 -
5.2	Implications for the EECC	- 74 -

Figures

Figure 2-1:	Access network elements, overview	- 19 -
Figure 2-2:	Trench and duct, profile	- 20 -
Figure 2-3:	Access to duct and fibre cabling, schematic view	- 22 -
Figure 2-4:	Construction of intermediate cabinets	- 22 -
Figure 2-5:	Access to aerial cabling, pole access principles, for low voltage (400V) distribution/access networks	- 23 -
Figure 2-6:	Extract from Orange's monthly service quality indicators for duct access (December 2016)	- 29 -
Figure 2-7:	Screenshot of PT extranet with infrastructure information:	- 37 -
Figure 3-1:	In-building infrastructure in single dwelling unit in Portugal	- 56 -
Figure 3-2:	Connection points for symmetric access to in-building wiring in Spain	- 57 -
Figure 3-3:	Access to FTTH lines in high-density areas in France	- 58 -
Figure 3-4:	Access to FTTH lines outside of high-density areas in France	- 59 -
Figure 4-1:	Duct access (km) 2015/16 NRA estimates	- 62 -
Figure 4-2:	Contribution of public and private operators to the increase in alternative FTTH and FTTLA deployments in the duct infrastructure of Orange	- 63 -
Figure 4-3:	Accumulated km of occupied Telefonica subducts	- 64 -
Figure 4-4:	Number of answers to information requests	- 64 -
Figure 4-5:	FTTH and FTTLA deployments by alternative operators in the aerial infrastructure of Orange	- 65 -
Figure 4-6:	FTTH/B deployment (% HH) IHS/VVA for EC	- 66 -
Figure 4-7:	Areas with alternative operators in Portugal	- 67 -
Figure 4-8:	Households served by FTTH: number of operators present via the mutualisation scheme	- 68 -

Tables

Table 0-1:	Best practice SMP duct and pole access regulatory guidelines	- 7 -
Table 0-2:	Best practice operational duct and pole provisions	- 8 -
Table 0-3:	Minimum list of items to be included in a Reference Offer for Physical Infrastructure Access	- 11 -
Table 2-1:	SMP Regulation for duct and pole access Feb 2017	- 25 -
Table 2-2:	Summary of symmetric measures for access to existing infrastructure	- 31 -
Table 2-3:	Operational conditions for duct access February 2017	- 34 -
Table 2-4:	Principle of non-saturation in Oranges reference offer	- 39 -
Table 2-5:	Service level agreement in the Portuguese duct access reference offer	- 43 -
Table 2-6:	Service level guarantees in the Portuguese duct access reference offer	- 43 -
Table 2-7:	Operational conditions for pole access	- 45 -
Table 2-8:	Price benchmark for duct access (monthly price (€ per metre))	- 50 -
Table 2-9:	Price benchmark for pole access (monthly price (€ per metre))	- 50 -
Table 3-1:	Regulatory approaches to in-building wiring	- 52 -
Table 5-1:	Best practice SMP duct and pole access regulatory guidelines	- 71 -
Table 5-2:	Best practice operational duct and pole provisions	- 72 -

1 Introduction

1.1 The importance of operational infrastructure access for the Gigabit society

Boosting investment and competition in Very High Capacity broadband networks is a core objective for European NRAs and is a central theme in the European Commission's proposals for a "European Electronic Communications Code" (EECC).⁸ Extensive fibre networks will contribute not only to supporting connectivity for homes and businesses, but also enable a wave of investment in 5G mobile networks, the Internet of Things and digital services and applications which rely on high bandwidths.

Fibre deployment is typically triggered by disruptive investors, including alternative infrastructure-based fixed and mobile operators.⁹ However, one of the greatest barriers to disruptive investment is the high cost of digging and deploying ducts and poles. Studies by WIK and others have estimated that this constitutes at least 50% of the total costs of deploying networks¹⁰. Providing efficient wholesale access to physical infrastructure, where such infrastructure exists, is therefore an important measure to trigger and foster increased deployment of fibre.

The Commission has rightly recognised the importance of physical infrastructure access in the proposed European Electronic Communications Code, by placing it at the heart of a proposed revamped market analysis process. NRAs would need to consider first whether physical infrastructure access alone would address competitive challenges in a given region and market, before applying other downstream access remedies.¹¹ Moreover, the Commission clarifies¹² that the physical infrastructure access remedy could extend beyond the boundaries of the market in which SMP has been found, provided that the obligation is necessary and proportionate to meet the objectives of Article 3. This inherently recognises the role of physical infrastructure access as a horizontal measure which could support competition in multiple downstream markets including not only residential fixed broadband, but also mobile broadband and business services.

⁸ http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=comnat:COM_2016_0590_FIN

⁹ Regulatory, in particular access, regimes for network investment models in Europe SMART 2015/0002 section 6.6.1

¹⁰ Jay, S.; Neumann, K-H.; Plückebaum, T.; Comparing FTTH access networks based on P2P and PMP fibre topologies, Conference on Telecommunications, Media and Internet Tecno-Economics (CTTE) 2011, Berlin, 16. - 18. May 2011

¹¹ Article 71 draft EECC

¹² Article 70 draft EECC

1.2 Methodology

In this report we benchmark approaches to (i) SMP and symmetric regulation; (ii) operational practices; and (iii) pricing, and compare the outcomes for take-up of infrastructure access and resulting infrastructure competition in five countries in order to identify best practice.

The countries analysed are France, Germany, Portugal, Spain and the UK. These countries were selected because asymmetric and in some cases symmetric obligations have been in place for some time (since 2008-2011), but different outcomes can be seen in terms of take-up of duct and pole access and infrastructure competition in FTTH/B.

We firstly developed a standardized template for data collection. Data for each of the countries was then collected through a review of NRA decisions, draft decisions and reference offers. Interviews were also conducted with local Vodafone representatives, or other users of infrastructure access (where Vodafone is not present).

Key findings from the data collection and resulting detailed case studies are summarized in this report. We conclude by discussing the implications for (i) the proposed Electronic Communications Code; and (ii) initiatives for NRAs.

1.3 Structure

The report is structured as follows:

- Chapter 2 describes regulatory approaches, operational practices and prices for duct and pole access
- Chapter 3 discusses approaches towards in-building wiring
- Chapter 4 compares outcomes in the five countries considered; and
- Conclusions and recommendations are presented in chapter 5

2 Duct and pole access

In this chapter we describe the components of duct and pole access, and compare regulatory approaches applied through SMP remedies as well as symmetric obligations. Thereafter, we discuss operational practices and prices set out in the Reference Offers for SMP duct and pole access.

2.1 Technical description

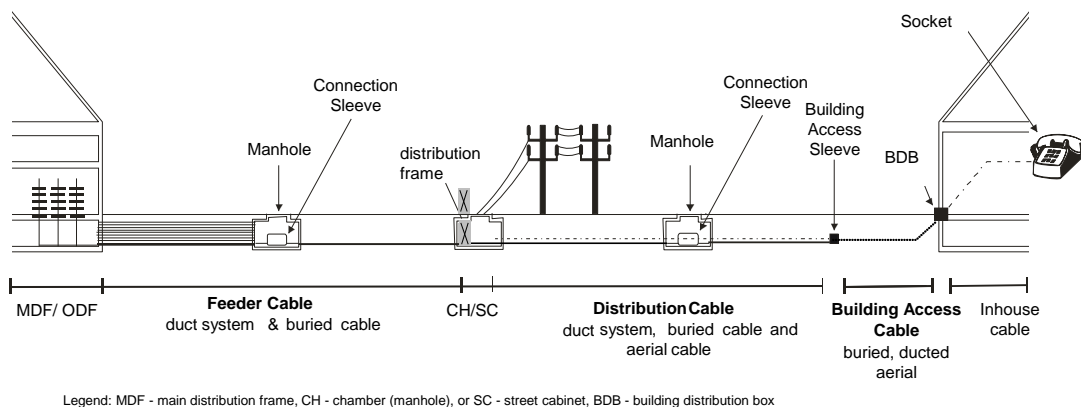
In this section, we describe physical infrastructure access from a technical perspective.

SMP duct and pole access is typically mandated at least for the access network, although under the Cost Reduction Directive, access to the higher network layer ducts (used for the backbone network) is also mandated and the distinction between the two is becoming blurred.¹³

Cables in the access network can be deployed aerially (e.g. on poles), directly buried into the ground or installed in ducts. A combination of all three deployment forms may occur along an access line to the end customer.

2.1.1 Physical infrastructure access terminology

Figure 2-1: Access network elements, overview



Source: WIK

Figure 2-1 illustrates the elements of a ducted access network. There is a *feeder* network segment between the MDF and a street cabinet or a larger chamber hosting a distribution frame which allows access lines to be ‘patched’ (connected) to any copper

¹³ For example, CNMC notes that “there can be no clear and stable separation between the concepts of ‘access network’ and ‘backbone network’. They are overlapping concepts.

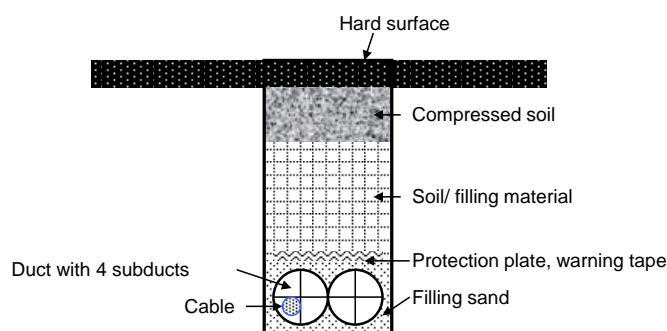
or fibre strand in the feeder cable. Several cabinets may be cascaded, forming a chain of cabinets¹⁴. The segment between the Cabinet and the end customer premise is called the *distribution* segment.

Underground cables are accessible at underground manholes or handholes, which can host branching sleeves. Alternatively these sleeves can be directly buried. The cable segment between the last branching sleeve and the end-customer premise is sometimes also called *building access cable*. It is typically terminated by a building distribution box (BDB). In the BDB, the in-house cabling is connected to the outdoor access network cables.

Aerial deployment follows the same principle, but instead of manholes, handholes or directly buried branching sleeves are hosted in boxes at the top of the poles (see Figure 2-5).

Underground cables are either directly buried in the trenches or installed inside ducts (see Figure 2-2). Small diameter ducts may host only one cable while larger ducts may be subdivided into subducts or constructed so as to include subducts. Ducts are used because they facilitate later exchange or upgrade of cables. When a new cable is installed, all previous connections are shifted to this cable and the old cable can be pulled out. In order to allow this operation, at least one spare subduct is typically kept for repair, known as an operational spare subduct. Additionally, spare duct capacity may be reserved for future use. Access to existing ducts is only possible if space exists or can be made available.

Figure 2-2: Trench and duct, profile¹⁵



Source: WIK

¹⁴ A need for this depends on the spatial access line distribution and the need for aggregating the farther distance segments into one feeder cable or running these feeder segments in separate cables.

¹⁵ The figure shows a duct subdivision in an already existing duct (ie of 100 mm diameter, which also might already host one or two cables, when the subdivision is pulled in. This is an ex post capacity enhancement allowing of (old) copper and (new) fibre cables to coexist. For new builds dedicated for fibre use typically small minitubes are installed in a major duct in advance of the duct installation, These can be used for blowing in one fibre cable per minitube on demand (not shown here)

If there is no free duct space available (even after 'reorganisation' of the cables to reduce space) or if the cable is directly buried, in some countries access to a spare dark fibre is mandated instead.

2.1.2 Where are ducts and aerial deployments used?

Aerial cabling infrastructure with poles in Europe is typically deployed only in the access network segment in less densely populated and rural areas. It is used predominantly in the final (distribution) cable segment between the cabinets and the end customer premises.

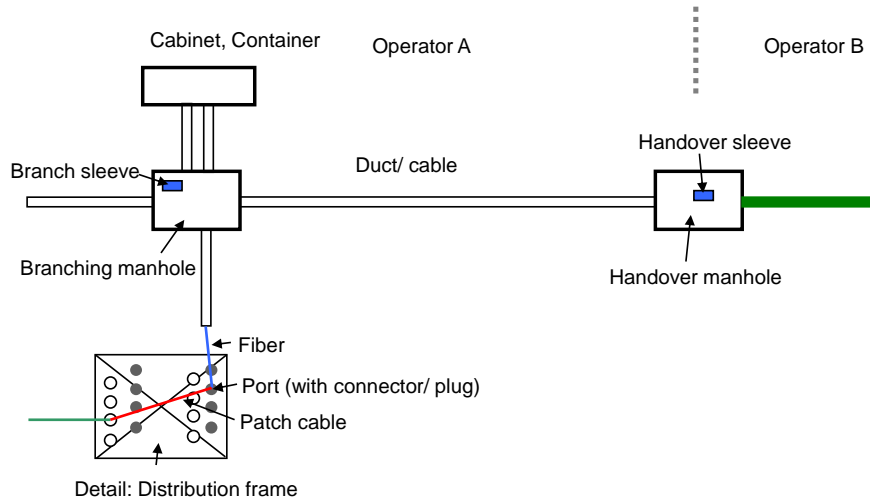
Ducts are typically deployed in higher network layers between network nodes (for the backbone). Ducts are often also deployed in the access segment in urban areas (and often share the same trenches and ducts as the network). However, the degree of ducting in the access network segment differs from country to country. For example, there is a high degree of ducting in urban areas in Portugal, while directly buried cables are more common in Germany. In cases where cables are directly buried, access to existing ducts cannot be made available.

In populated areas, typically the higher network layer cables share the same trenches and ducts as access network cables, although the cables are often separated and not shared. In these shared network elements duct (and pole) access could in principle be used also for backbone infrastructure.

2.1.3 Access points

Access to underground infrastructure (such as ducts, cables) can be provided at the endpoints of an access line (e.g. LLU) or at the street cabinet (SLU) and at the intermediate (man- or hand-)holes (chambers) and branching sleeves (Figure 2-3).

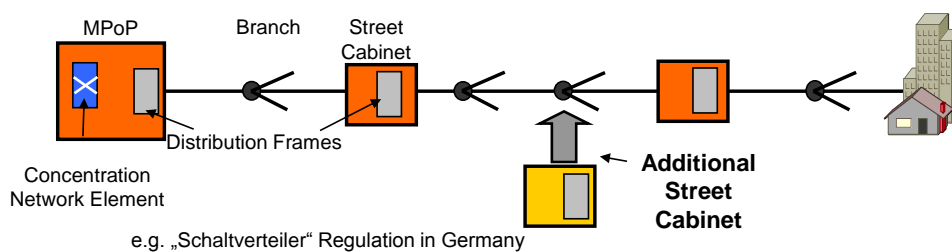
Figure 2-3: Access to duct and fibre cabling, schematic view



Source: WIK, green, other operator, red: patch fibre, blue: fibre strand, Thick line: cable, thin line: fibre strand

In some countries there is an option to access the underground infrastructure at any point along the line, so also at cabinets, holes or branching points. The creation of a new branching point may require the installation of a manhole. In the case of FTTC deployment in Germany a new cabinet (“Schaltverteiler”) may also be installed at a location convenient to the access seeker (Figure 2-4).

Figure 2-4: Construction of intermediate cabinets



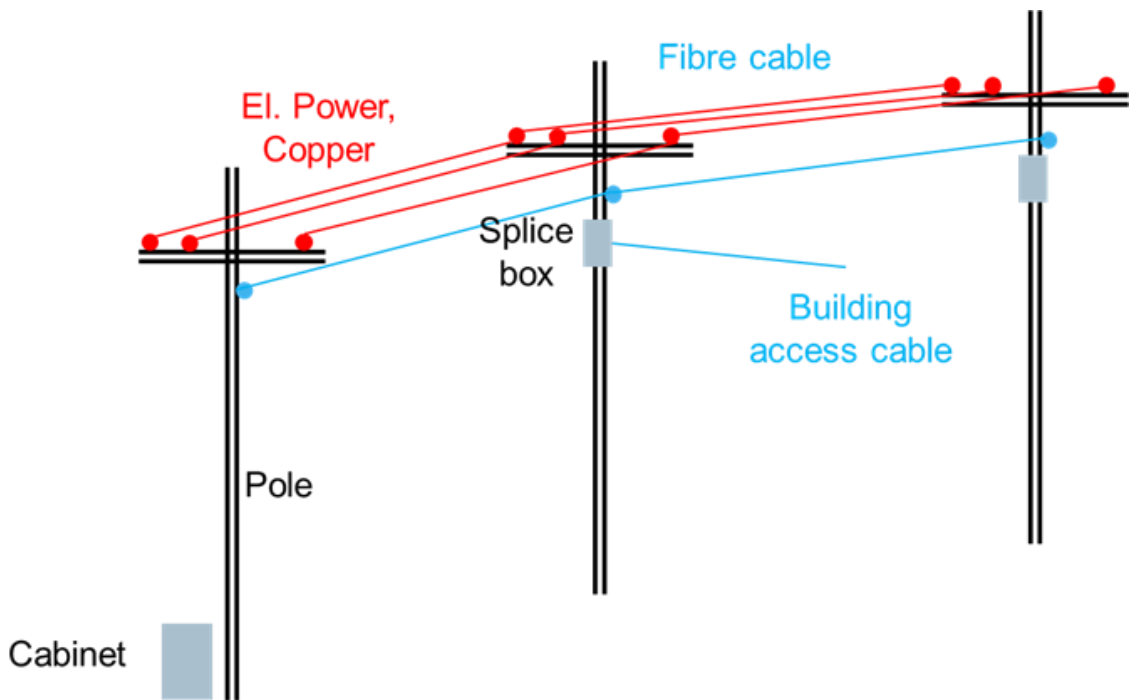
Source: WIK

Cables in a duct system consume underground space in the ducts and holes, especially when sleeves have to be installed.

In the case of aerial deployment access can only be granted at the poles. Typically, cables access the aerial infrastructure from an additional cabinet at the bottom of a pole or through an additional splice box at the top (Figure 2-5). Fibre lines and cables are insensitive to electro-magnetic interference and thus may run in parallel with electrical power lines. Installation security guidelines must be followed, but there is no need for

insulation or minimum distances from other utility infrastructure. However, there may be constraints and obligations in relation to the other utilities' requirements.

Figure 2-5: Access to aerial cabling, pole access principles, for low voltage (400V) distribution/access networks



Source: WIK

Fibre cables are significantly smaller and lighter than copper cables, be they electrical power lines or telephone lines. However, additional cables added as a result of pole sharing add additional load to a pole, not only because of the weight of the cable, but because of additional wind- and snow-load, where relevant. Thus, while it is straightforward to assess if a duct is empty by assessing whether there is free capacity, on a pole this assessment can be more complex. In both cases it is important to remove unused cables to provide maximum capacity.

2.2 Regulatory approaches

In this section we describe and compare the approaches taken to regulation of duct and pole access respectively under SMP obligations and symmetric measures including those applied as a result of the 2014 EU Cost Reduction Directive.

2.2.1 Asymmetric (SMP) obligations

SMP regulatory obligations have been in place in all countries considered for duct and - with the exception of Germany- pole access since 2008-2011. It is notable that in all cases, since 2015 NRAs have either made revisions to improve the application of the SMP remedy (Spain and Portugal) or its pricing (Germany), or have issued consultations with the aim of doing so (UK and France).

The current SMP obligations for duct and pole access are summarised in the following table. The main elements considered are (i) the scope of the access obligation (which part of the network is covered); (ii) whether there are restrictions on how access may be used; (iii) the approach to price regulation, including the treatment of reusable assets and asset lifetimes; and (iv) the approach to enforcing non-discrimination.

Table 2-1: SMP Regulation for duct and pole access Feb 2017

Regulatory conditions	UK	FR	DE (ducts only)	PT	ES
Basis for decision	2010 WLA market review, maintained in 2014 review. 2016 Ofcom launched consultation on improvements to remedy.	ARCEP's Decision n°2008-0835 of 24 July 2008, complemented and amended by decision n° 2010-1211 of 9 November 2010. Current regime based on 2014 market analysis. Consultation Feb 2017 on revisions.	Relevant market is 3a. Last Decision (on pricing) made in summer 2016 (Nr 1870), based on the Regulierungsverfügung BK 3g - 09/085 from 03/2011	Initial obligations under 2009 market 4 review. Updated in review of market 3a in 2017.	Initial obligations from market 4 review 2009. Updated in review of market 3a 2015.
Portion of network	Local access network (for NGA) as defined by BT architecture	Local access network: meaning customer premise to altnet ODF	Street Cab to MDF site only (feeder segment). No pole regulation	Whole network	Local access network (for NGA) as defined by access seeker - backbone in specific circumstances
Restrictions on use	Not usable for leased lines, core network, backhaul (except for SLU)	Only for deployment of optical fibre - use for fixed/mobile backhaul permitted	For backhauling from street cabinet in connection with SLU or street cabinet VULA	No restrictions	Only for NGA (i.e. fibre and HFC, but not copper) public networks; use for fixed/mobile backhaul is allowed
Price regulation approach	Required to be cost-oriented - but no explicit charge control set by NRA	Cost-oriented based on top down model; duct costs attributed to copper vs fibre based on take-up; volume based charge in dense area, flat-rate less dense	BU-LRIC+ cost model	Top-down HCA estimation based on accounts - pricing segmented for Lisbon and Oporto vs other areas	Cost-orientation. In practice top-down cross-checked through BU-LRIC. BU-LRIC drawing on parameters from accounts also possible
Treatment of reusable assets	Pre 1997 assets treated at HCA with RPI uplift - others CCA	CCA	Fully depreciated re-usable assets excluded from model	Depreciated assets excluded (HCA)	CCA
Asset lifetime	40 years ducts	50 years ducts, 25 years poles	40 years ducts	40 years ducts	40 years ducts
Non-discrimination	ND obligation, no KPIs reported yet (volumes too low), no Eol	Eol with KPIs	General ND obligation, no KPIs, no Eol	Eol. Enforcement by ANACOM possible following dispute	EoO monitored through KPIs. NRA has access to incumbent IT system for regulated services to confirm

2.2.1.1 Scope of the access obligation

A first important point is that the scope of the access obligation (the extent of the network for which the obligation applies) differs between countries.

While in Portugal, the whole of the PT network is subject to duct access obligations (stemming not only from the SMP obligation, but a more general legal requirement for the designated universal service provider to offer duct access), in other countries only the access network or portions thereof are required to be made available.

There are further differences in how the 'access network' is defined.

The UK, France and Spain define the access network as extending from the end-user to the serving exchange for the purposes of offering NGA. This is a greater portion of the network than the access network associated with copper-based services, which runs between the end-customer and MDF site. Furthermore, NRAs in France and Spain have clarified that the scope of the NGA access network can be defined by the access seeker's access network architecture and is not necessarily restricted to that chosen by the SMP operator.¹⁶

In contrast, in Germany the duct access obligation is limited to the network portion between the MDF site and street cabinet (the feeder segment). This stems from its status as an ancillary remedy to subloop unbundling (SLU) or cabinet VULA rather than as a remedy intended to allow the installation of FTTH/B infrastructure by alternative operators.

2.2.1.2 Restrictions on use

There are also significant differences in how flexible the regulation is as regards the use of access to ducts and poles.

In Portugal there are no restrictions on use. In France and Spain, use is restricted to high speed broadband deployment (optical fibre only in France, or also HFC in Spain), but infrastructure access may be used for leased lines or the deployment of fixed or mobile backhaul.

However, in the UK, there are greater restrictions, with a prohibition on use of duct and pole access for leased lines and backhaul (except backhauling in connection with SLU). These restrictions are currently under review by Ofcom.¹⁷ One option under

¹⁶ In its Decision dated 28-0716 https://www.cnmc.es/sites/default/files/982155_11.pdf CNMC clarifies that the alternative operator's network does not have to follow Telefonica's

¹⁷ Ofcom December 2016 consultation: initial proposals to develop effective PIA remedy <https://www.ofcom.org.uk/consultations-and-statements/category-2/wholesale-local-access-market-review-proposals-PIA>

consideration is to allow leased line deployment provided this is in combination with a mass-market FTTx residential deployment. Full relaxation allowing any usage within the local access area is a preferred option in enabling the widest scope of competition.

The most restrictive arrangement is in Germany, where duct access may only be used for backhauling in connection with SLU or cabinet VULA.

2.2.1.3 Approach to price regulation

In general, NRAs have required duct and pole access to be made available on the basis of cost-orientation. However, there are several important differences in the way these obligations have been applied.

Top-down models based on incumbent accounting records or estimates have been used to set charges in France, Portugal and Spain, while a BU-LRIC+ model is used by the German NRA BNetzA to set charges, and as a cross-check by the Spanish NRA.¹⁸ In the UK, BT is required to price duct and pole access on the basis of cost-orientation (a so-called 'basis of charges obligation'), but no explicit charge control has yet been applied by Ofcom, although this is under consideration following the December 2016 consultation.

In line with the Commission's 2013 Recommendation on cost-methodologies and non-discrimination, fully depreciated reusable assets are effectively excluded from the cost base in the UK, Germany and Portugal.¹⁹ However, such assets are still included in the model, valued at current costs, in France and Spain.

All countries studied have used an asset lifetime of 40 years for ducts, with the exception of France. In 2012 ARCEP published a decision²⁰ which extended the economic lifetime of civil engineering from 40 to 50 years. This was implemented by increasing the lifetime of civil infrastructure by 1 year, every year from 2012 to 2021. ARCEP justified this change on the basis that there had been lower than expected investment in civil engineering. The asset lifetime for poles was left at 25 years.

Other noteworthy aspects of the pricing regime for ducts in France are that:

- In non-mutualised high density zones, where ARCEP expects infrastructure competition to develop, the access prices in the transport and distribution segment are volume based, reflecting the need to provide incentives for efficient

¹⁸ The recent market 3a review by CNMC states that the future approach will be based on BU-LRIC drawing on parameters from regulatory accounts

¹⁹ The method differs. In the UK, Pre-1997 assets are valued on the basis of HCA as of FY2004/05 and subject to an RPI uplift. The Portuguese calculation is based on HCA estimates for all assets. BNetzA has excluded fully depreciated reusable assets from those used to set the BU-LRIC+ cost-based charges

²⁰ Decision n° 2012- 0007 of 17 January 2012

usage of space. In contrast, the duct access prices in mutualised (less dense) zones, where ARCEP considers that economics render network duplication difficult, are charged on a flat-rate basis, in order to encourage infrastructure sharing.²¹

- The duct cost is allocated between copper and fibre based on the respective take-up of copper vs fibre access. This means that while fibre take-up remains low in the initial deployment phase, the majority of duct cost would be allocated to copper-based retail access and LLU, leaving the duct asset base used for the calculation of duct access for fibre deployment to be relatively low.

2.2.1.4 Approach to non-discrimination

Non-discrimination obligations apply to duct access in all studied countries. However, the degree of enforcement varies.

Equivalence of Input obligations are applied in France and to be implemented in Portugal. Such obligations imply that the incumbent should use the same systems and processes for its own duct and pole usage as that provided to third parties. In the event of concerns around the application of the non-discrimination principle in Portugal, disputes may be referred to ANACOM. Orange France is also required to publish detailed KPIs which distinguish actual timeframes for service delivery to Orange Retail from those provided to third parties – an illustration is shown below.

²¹ http://www.arcep.fr/index.php?id=8571&L=1&tx_gsactualite_pi1%5Buid%5D=1331&tx_gsactualite_pi1%5BbackID%5D=1&cHash=30fb7a7d5e

Figure 2-6: Extract from Orange’s monthly service quality indicators for duct access (December 2016)

Common indicators					
Order type	Indicator	Contractual deadline (days)	Volume (month)	Alternative operators	Orange retail
Prior information (plans)	Average delivery time	10	5755	4.7	2.9
	Rate of compliance with the contractual deadline			96%	99%
Prior information (wiring plan)	Average delivery time	15	69	13.7	12.5
	Rate of compliance with the contractual deadline			73%	97%
Declaration/ Statement of studies	Average delivery time	2**	5349	0.5	0.6
	Rate of compliance with the contractual deadline			96%	100%
Accompaniment/escort by Orange’s agent	Average delivery time	2**	61	0.8	
	Rate of compliance with the contractual deadline			95%	
	Compliance rate of the date requested by the operator			61%	
Loan of key	Average delivery time	5	4	12.3	
	Rate of compliance with the contractual deadline			0%	

Source: Orange²²

Although there is no EoI obligation in Spain, application of the non-discrimination obligation is also monitored through KPIs. KPIs are defined for:

- (i) application process (number of submitted requests, number of responses of Telefonica, share of viable / not viable requests) ;
- (ii) provisioning (number of accepted / rejected requests, number of conducted surveys, number of alternative routes, number of passive elements (ducts, subducts, manholes, poles) occupied by access seeker;
- (iii) quality of service (SLA times met), including failures;
- (iv) fault repair time

²² The latest list can be found on Orange’s website under “indicateur de l’offre d’accès aux installations de genie civil”: <https://www.orange.com/fr/Innovation/Les-reseaux/Documentation>

The non-discrimination enforcement mechanism is less developed in the UK, potentially due to low volumes of duct and pole access. There are currently no published KPIs, and EoI was initially considered by Ofcom to be disproportionate. However, according to the December 2016 consultation, Ofcom is reviewing this approach and has proposed to require BT to use the same processes and systems – effectively consuming PIA itself as far as practicable, when installing fibre in its own ducts for scale deployment of ultrafast broadband services.

2.2.2 Symmetric obligations

Symmetric obligations for duct and pole access have been applied in Portugal under national law since 2009.²³ These obligations predate the 2014 EU Cost Reduction Directive. In the other countries, symmetric obligations requiring access to ducts (not limited to telecom ducts) which are capable of housing high speed broadband infrastructure were imposed in 2016, in the context of the transposition of the CRD into national law. A summary of the symmetric measures is shown in the table overleaf.

²³ Law decree 123/2009

Table 2-2: Summary of symmetric measures for access to existing infrastructure

Regulatory approach	UK	FR	DE	PT	ES
Legal basis	Access to Infrastructure Regulations 2016	Ordonnance No 2016-526 included in Telecom law effective since July 2016	DigiNetz-Gesetz Nov 2016 included new paragraphs into Telecom law TKG § 77	Law decree 123/2009 - (predates CRD) duct & pole obligations not applicable to PT	Real Decreto 330/2016 (Sept 2016)
Information	Only information held will be required - no specific provisions for centralised system	Information has to be granted within 2 months of request - no specific provisions for centralised system. The access seeker may also request the disclosure of such information from public entities holding it electronically in the course of their duties	Central system Infrastrukturatlas managed by BNetzA. Existing infrastructures recorded - made available on request. Public infrastructure owners, state aid recipients must provide data	Central system (SIC) - launched Jan 2016 run by NRA - for ducts same system to be used by PT for SMP regulation, poles are not included in SIC	Information should be available regarding: a) location and infrastructure design, b) type and current occupation, c) point of contact to address
Timeframe for access provision	Agreement should be reached on fair and reasonable access within 2 months	Acceptance or denial of access to be communicated within 2 months	Offer within 2 months of request	20 working days	Any denial of access to be communicated within 2 months
Price regulation approach	Ofcom will ensure that infrastructure owner recovers at least incremental costs associated with access incl reasonable return. Ofcom will compensate for 'impact on business plans' e.g. reduced profitability arising from competition	Fair and reasonable terms	The telecommunications companies pay a fair and reasonable fee to the infrastructure operators (commercial)	Cost-orientation, taking into account costs associated with the construction, maintenance, repair and improvement of infrastructures under consideration.	Fair and reasonable terms
Timeframe for dispute resolution	Proof of good faith negotiations required. 10-15WD to confirm whether will proceed to dispute resolution. Conclusion within 4 months	2 months	Decision within 2 months	15 working days	4 months

While some countries such as the UK have applied a de minimis application, which broadly mirrors the provisions of the CRD with additional procedural provisions, others have very detailed requirements and systems relating to symmetric access to ducts and poles.

The strictest symmetric obligations (predating the CRD) apply in Portugal. The NRA ANACOM launched a central information system (SIC) in January 2016, which should²⁴ provide information about:

- Who is to be addressed in case of a request for access to ducts and poles
- Elements to be named in the request
- The timeframe for access and usage rights, procedures and renewal conditions
- Contractual terms, forms and description of elements and information which must be part of the process
- Prices
- Technical instructions
- Penalties
- Other relevant aspects for the provision of access

It is envisaged that information concerning PT's ducts would ultimately be integrated into this system, although there are no concrete plans for this transition as yet. The Portuguese law requires duct owners to respond to a request for access within a period of 20 working days, which is less than the 2 months provided for in the CRD, while disputes should be resolved within 15 working days (again less than CRD requirements of 4 months). Moreover, access to infrastructure is required to be cost-oriented, taking into account costs associated with the construction, maintenance, repair and improvement of the relevant infrastructures. In contrast, the other countries require access to be made available on 'fair and reasonable terms'.

The only other country from those studied which includes a centralized online system for information on duct availability is Germany. The German provisions on symmetric access require BNetzA to manage the Infrastrukturatlas, which permits registered users to access information about existing infrastructures and make contact with infrastructure owners. It is however understood that this would not include details about contractual terms and prices.

2.3 Operational practices for SMP infrastructure access

In this section we discuss, based on a review of reference offers, operational practices for infrastructure access mandated as a remedy on SMP operators in the context of market reviews. Whereas regulatory obligations are essentially the same for duct and

²⁴ Vodafone indicates that not all aspects of such information are available today - in particular, prices are not always transparent

pole access in the countries studied, operational conditions differ. We therefore report operational practices for duct and pole access separately.

The main elements we consider are (i) how information is provided concerning the location and availability of ducts and poles; (ii) what rules are applied regarding space reservation for the incumbent and/or potential access seekers; (iii) what approach is taken towards decongestion of ducts and poles and construction of infrastructure to bypass congested ducts; (iv) who can install cables and under what conditions; (v) what are the timeframes for provisioning and repair and associated compensation for failing to meet these timeframes.

2.3.1 Duct access

A summary of the operational conditions for duct access in the assessed countries is shown in the table overleaf. Thereafter, we discuss each of the issues in turn.

Table 2-3: Operational conditions for duct access February 2017

Operational processes	UK	FR	DE	PT	ES
Information concerning location and availability	Manual (online database from mid-2017)	Online request system and online file exchanges but no real time info yet. Obligation envisaged in the ongoing market review.	Manual system. ANOs have data on SC locations - capacity info available on request at extra charge following capacity test at the location	Yes - via automated central system for ducts. PT duct info will be integrated with central system under symmetric regulation	Yes - via automated central system. Errors reported by altnets should be addressed within 1 month
Incumbent space reservation	1 duct: biggest cable in the duct bore, less than 3 ducts: half a duct, more than 3 ducts: 1 duct	No set rule. According to ARCEP, in general conduits are deployed with spare capacity. When deploying FTTx downstream of the mutualisation point operators must leave at least as much space unoccupied as they use (1+1 rule).	No set rule (DT can determine - altnet can challenge). SMP duct access not used in practice	Incumbent must reserve 20% usable internal duct capacity for provision of duct access, except when the installed capacity is incompatible with this limit from the start or when MEO needs additional capacity for USO provision	Common Operational Reserve (ROC): 2 ducts: 1/3 (= 1 subduct) 3-7 ducts: 1 or 1/3 (depending on the size of the largest cable); more than 8 ducts: 1 duct
Decongestion approach	Altnets may undertake decongestion work using approved kits and duct or request from Openreach for a fee. The access seeker may also request the removal of redundant BT cables, subject to a fee - which is payable whether or not space is released.	Orange covers costs for study and removal/reorganisation of cables only in case of objective saturation (this covers only FTTx deployment downstream of the mutualisation point). In all other cases the access seeker pays.	To be paid by access seeker	Altnet can reorganise cables themselves - after informing MEO, or request to MEO. MEO may accompany. For obsolete cables, owner is responsible for the cost of their removal. Deadline for removal of obsolete cables is 30 CD - if owner does not remove, MEO to remove and charge	Access seeker can require removal of unused cables or reorganising of cables within 12 days (paid by access seeker); after this period the access seeker is allowed to do the work itself but has to inform Telefonica in advance about time and location of the works

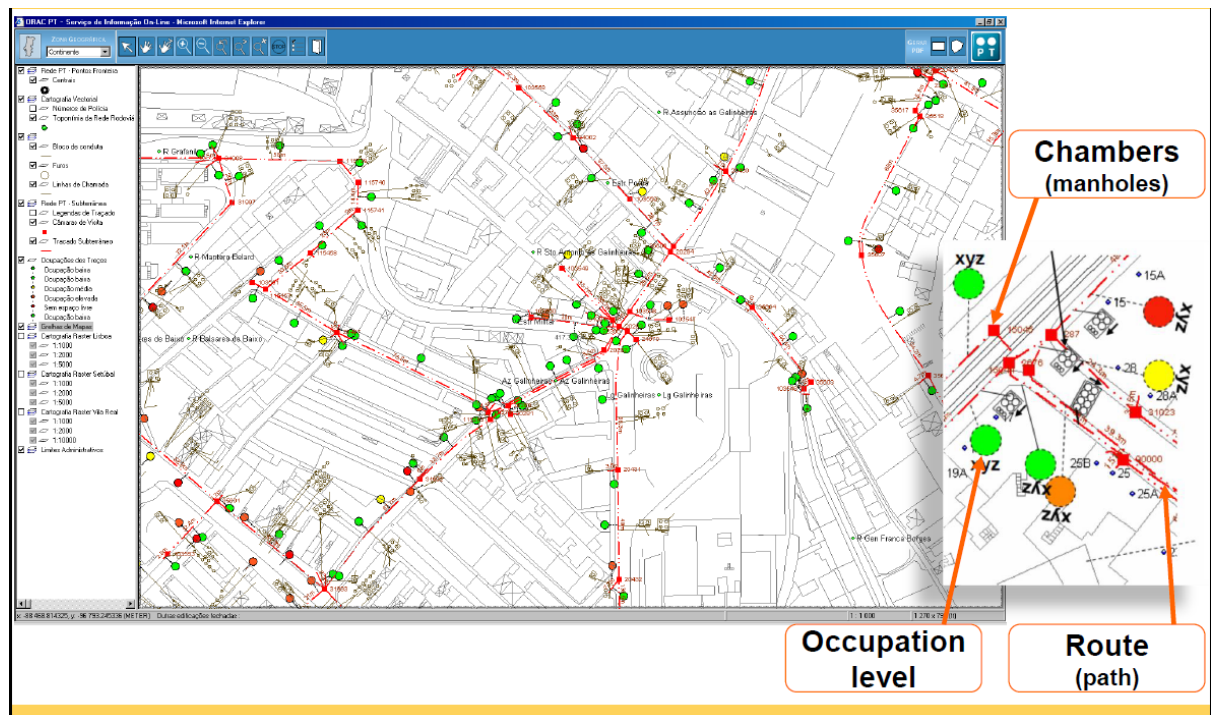
Operational processes	UK	FR	DE	PT	ES
Commitments concerning entrant access to new duct	Altnets may augment the network themselves (with BT's agreement) or request BT to undertake the work (subject to a charge). If the new duct lies between Openreach chambers ownership reverts to BT on completion of the work.	In the case of lack of space, the altnet can construct new duct and connect them to Oranges ducts or ask Orange to construct a new subduct between two chambers at the altnet's expense.	If there is no available duct space, a fibre strand may be offered, if there is no fibre, the altnet must construct itself. It may connect to the DT duct system at the SC or MDF, but not at intermediate locations		In case of lack of space and if there is no alternative route the access seeker can build a branch or bypass to avoid the saturated section; alternatively the incumbent can carry out the construction at the altnet's cost
Who can install cables?	Accredited individual (can be unsupervised, but notice must be given)	Access seeker following Orange engineering rules. Can in most cases be unsupervised but notice must be given; supervision is required for cutting into chambers, work in secured chambers, accessing visitable sewers	Access seeker under supervision	Accredited access seeker possibly accompanied by MEO. For installation of cables and equipment access seeker has to send an installation request. ANACOM has proposed to permit altnets to undertake work on already installed cables and equipment without intervention request - would inform PT after	Accredited access seeker - can be unsupervised, but notice must be given at least 24 hours in advance of the works
Timeframes for provisioning	10WD route-based info (20WD area), order acknowledgement 1WD, technical validation of survey plan 2WD, acknowledge customer plans for approval 1WD - approval of customer plans 5WD route-based, or 20WD exchange	Acknowledge order 2 days, information 10 - 15 days, feasibility study by altnet within 12 months, construction (differs depending on the access request) , final report within 30 days after the completion of work, Orange processes report within 30 days.	No set timeframes. There is no reference offer mandated for duct access. The following steps are however observed (i) request information; (ii) capacity at the requested location (joint DT/ANO survey); (iii) planning and installation; (iv) provision and completion	1 WD information request, (optional 10 days response to feasibility analysis), 5WD deadline for financial proposal for deobstruction request (if needed), 5 WD response to access and installation request. Deadline for PT to attend standard intervention 24h after request, for urgent intervention 4h, availability of accompanying service 95%	Validation of access seeker request: 10 days; (Optional joint survey: 30 days; documents sent by operator: 10 days after survey; confirmation: 5 days after documents are sent;) installing: 6 months after confirmation.

Operational processes	UK	FR	DE	PT	ES
Compensation	None	The penalties for Orange are 0.34 € or 0.69€ for each working day of delay of confirmation of receipt for different orders, provision of infrastructure plans, notification of a broken conduit.	N/A There is no Reference offer for duct access nor publicly available information	€50 per day for non-availability of extranet, delays in responding to information request, non-appearance of technician (for accompanying), feasibility analysis, access and installation request or request for budget for decongestion. 60WD max	5% of the one-off fee per day of delay
Timeframes for repair	4 hours to respond to fault report (unless otherwise agreed), BT to contact altnet if fault not repaired within 48 hours	There are no contractual timeframes for Orange to repair damages to its infrastructure	N/A There is no Reference offer for duct access nor publicly available information	No specific requirements, unless there are consequences for the access seeker e.g. prevented from reaching its equipment	fault repair within 8 hours; repair of cables at the central office: 24 hours; +30% if not on a working day
Compensation	None	None	N/A There is no Reference offer for duct access nor publicly available information	None	50% of the annual charge for relevant segment per hour of delay

2.3.1.1 Information concerning location and availability of ducts

Information on the location and availability of duct space is provided via automated central systems in Portugal and Spain. The following figure shows how in Portugal, the state of occupation of the ducts is shown using a colour coding system.

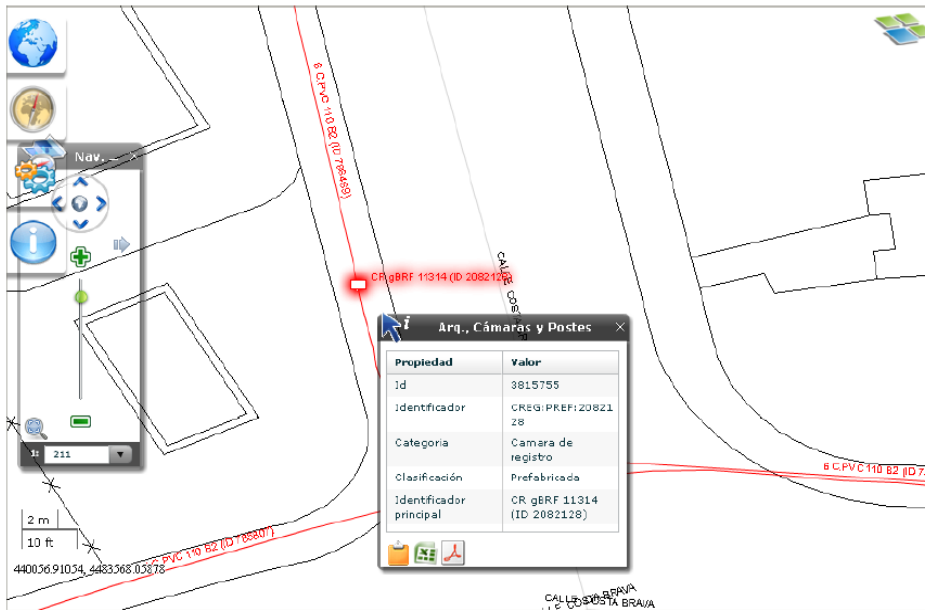
Figure 2-7: Screenshot of PT extranet with infrastructure information:



Occupation level (light colours):

- Red 100% (no space, duct access not viable)
- Orange 76-99% (high occupation, duct access viable)
- Yellow 51-75% (medium occupation, duct access viable)
- Green 0-50% (low occupation, duct access viable)

In Spain, since 2012, information has been displayed using the NEON platform and ESCAPEX database. The operator selects in NEON the province / central office where access is required and fills in information on the type of infrastructure, specification of cables or other passive elements. A screenshot from ESCAPEX showing the location of a manhole and corresponding information is shown below.



Information regarding location and spare capacity of the infrastructure must be kept up to date by Telefonica. If the access seeker finds any inaccuracies in the information provided, he can require Telefónica to clarify it within one month. Moreover, the last modification of the offer in October 2016 included an SLA of 1 month for updating the database and also defined a direct interface and a specific procedure.

In contrast, information on duct and pole locations and availability is currently only available in the UK and Germany through a manual system, while in France, there is an online request system and online file exchanges, but no real time information as yet. There are however developments in the UK and France. Ofcom has highlighted the need for effective information systems in its December 2016 consultation and noted that BT is developing an online database which should be functional from mid-2017, while ARCEP has proposed to introduce an obligation on this issue in its ongoing market review.

2.3.1.2 Approach to space reservation

In order to avoid unreasonable denial of access by the SMP provider and to mitigate incentives to construct ducts which do not provide sufficient scope for infrastructure competition, it is important to have transparent rules in place concerning the availability of duct space for alternative operators, at least in areas of the network where infrastructure competition could be expected to develop. The incumbent will also likely wish to ensure sufficient capacity for its own future use and for maintenance work.

The incumbent in Portugal is required to reserve 20% of the usable internal space in the duct for alternative operators, unless the installed capacity is not compatible with this limit from the start or when the incumbent requires additional capacity for the provision of universal service.

In France, Orange has established in its RO a principle of non-saturation for ducts and poles. Depending on the circumstance, there is a “1+1” rule which means that the operator has to leave at least as much space as he used himself in the civil engineering infrastructure and a “1+0” rule which means that the operator does not have to leave space available. The following applies for FTTx deployment (distinct from FTTP deployment for business purposes). In general, installing operators are not required to leave space for other infrastructure providers in network segments where the network is expected to be ‘mutualised’ (shared on the basis of co-financing offers), but must normally leave space in areas where infrastructure-based competition is expected to emerge.

Table 2-4: Principle of non-saturation in Oranges reference offer

		Very dense zones		Less dense zones	
		Ducts	Poles	Ducts	Poles
FTTx	Mutulised cables	1+1	1+0	1+0	1+0
	Non-mutulised cables	1+1	1+1	1+1	1+1

In contrast, Reference Offers in Spain and the UK do not have specific requirements concerning space to be reserved for alternative operators, but limit the incumbent’s own space reservation to around 1 duct in cases where there are three or more ducts available, with a reduced reserve (1 subduct in the case of Spain) if capacity is less.

There are no set rules in place for duct space reservation in Germany. This means that in practice the duct owner would set its own conditions and the NRA might be called upon if disputes arise. However, as duct access is not extensively used in Germany, this issue has not been tested to our knowledge.

2.3.1.3 Approach to decongestion and new duct construction

A common problem when duct access is requested is that space could be available, but requires the reorganization of cables or removal of unused cables. A key question in this context is who is permitted to conduct the decongestion work, and who is responsible for covering the costs.

In the UK and Portugal, alternative operators can undertake decongestion work themselves after informing the incumbent, or request the incumbent to undertake such work. In Spain, alternative operators must first request the incumbent to reorganize cables, but can proceed to undertake the work itself if the incumbent has not carried out

the decongestion within 12 days. In these cases, as well as in Germany, the access seeker is liable for the costs of reorganizing cables or other decongestion, whether it conducts the work directly or requests it to be conducted by the incumbent.

The costs of removing unused cables also fall to the access seeker in Spain and the UK, but not in Portugal, where the removal and associated cost is the responsibility of the cable owners and must be conducted within 30 calendar days.

In contrast, in France, Orange is required to cover the cost of a survey and the removal or reorganization of cables in the specific case of 'objective saturation'. Objective saturation refers to the case where there is a lack of space for the access seeker to install FTTx downstream from the mutualisation point.²⁵ In other cases, the access seeker must cover the cost.

A further option exists in case there is saturation of duct space that cannot be readily addressed. In the UK, France and Spain, alternative operators may build a branch or bypass to avoid the saturated section or request the incumbent to build it. However, the alternative operator must meet the cost, and it is clear, at least in the case of the UK, that the new duct section becomes the property of the incumbent following construction and is incorporated into its network.

Ofcom acknowledges in its December 2016 consultation that the fact that costs are passed upfront to access seekers for the decongestion or enlargement of the BT duct system does not match the way which BT would recover those costs when it needs to create space for its own deployments. Ofcom has therefore proposed that the charging approach for build and decongestion works should be changed so that these costs would be recovered across all products that use Openreach's physical infrastructure.²⁶

2.3.1.4 Responsibility for installing cables

In all surveyed countries, cables may be installed by the access seeker. However, there are differences as regards whether the engineers must be supervised and whether they need to be accredited to have permission to install cables in the incumbent infrastructure.

In the UK, France and Spain, the access seeker may generally install cables unsupervised, but they need to give advance notice to the incumbent. Unsupervised installation with advance notice is also possible in Portugal, although the Portuguese incumbent retains the option to accompany the access seeker. Supervision is necessary in Germany, and in some cases in France.²⁷

²⁵ The mutualisation point is the point at which access to the terminating segment of the fibre line is provided. Beyond this point, duplication of the fibre line would not be expected

²⁶ Ofcom Dec 2016 consultation – paragraphs 5.30 and following

²⁷ Work in secured chambers, surveys on and works to cut into a chamber, accessing visitable sewers

Although it would not apply to cable installation, the Portuguese NRA ANACOM has proposed to permit alternative operators to undertake work on cables and equipment which are already installed without an advance 'intervention request'. Instead, they would only be obliged to inform PT after the works are complete.

Those working with duct and pole access must be formally accredited, in the case of the UK, Spain and Portugal. A recent development in the UK is that accreditation now applies to the individual, rather than the company seeking to install cables in rented duct. This reflects the fact that in the UK, as in other countries, installation and civil works are often performed not by telecom operators' own staff, but by specialist contractors, which may be used by multiple organisations. In France, no formal accreditation is required, but operators making use of duct access must agree to follow Orange's engineering rules.

2.3.1.5 Processes, SLAs and associated guarantees

Duct access is unlike other wholesale access products in that it provides the option for access seekers to install their own infrastructure rather than renting a line or service from the incumbent. This means that the 'provisioning' steps typical for other forms of access are not applicable for duct access. Rather, after an initial step of signing the RO and obtaining any necessary accreditation (or sourcing accredited contractors), applicable processes for the access provider for which timeframes may be attached in the SLA include:

- (i) Supply of information about infrastructure location and availability
- (ii) Acknowledgement and approval of the specific order for duct access (i.e. the route or area to be covered);
- (iii) Completion of a (joint) survey/viability analysis or approval of the access seekers' survey plans (where the access seeker itself performs the survey)
- (iv) Deadline to provide a quotation and if relevant perform decongestion, removal of unused cables or other enabling works; and
- (v) Deadline to respond to requests by the alternative operator to access the duct infrastructure for installation or repair of their cables (where the duct owner may accompany the access seeker or must give its approval).

Generally, the greater the automation of information provision and autonomy provided for the access seeker, the less need for SLAs from the incumbent on each of these steps. The duct access offer in Germany does not include any committed timeframes for information or provisioning. However, the other countries studied do provide guidelines or commitments as follows:

- Spain and Portugal provide certain information about the location and availability of ducts directly through an online database. This system ensures the fastest

timeframes for **information delivery** of basic information²⁸. In contrast, in the UK and France, which operate mainly manual systems, information is available between 10-20 days.²⁹

- **Approval of the customer's plans** for duct access is provided in 5 working days in the UK³⁰ and Portugal and 10 days in Spain.
- Current practice in the UK, Spain and France is to permit access seekers to conduct their own **survey/feasibility assessment**.³¹ In Portugal, the incumbent must provide a viability analysis within 10 days of a request, but following an intervention by the NRA, there is no longer a requirement for the access seeker to request a viability analysis before proceeding with installation. The reason for permitting autonomy for the access seeker in these cases are to avoid delays. For example, in Spain, although the option remains to conduct a joint survey, it involves several steps over a relatively long timeframe. Telefonica must propose a date for the joint survey within 10 days, and conduct the joint survey within 30 days after the request. The access seeker sends the survey report 10 days after the survey and Telefonica's operational unit must confirm it 5 days after the survey documents are sent (i.e. a total period of 45 days)
- Most countries reviewed now permit or are planning to permit the access seeker to conduct **decongestion work** or bypass. There is therefore no need for a specific SLA in this context. However, in Portugal there is a target of 5 working days for the incumbent to provide a financial proposal for the decongestion of a duct for those cases where the access seeker requests its support.
- In cases where the incumbent reserves the right to attend interventions, an important condition is to set a **maximum period within which the incumbent commits to be present**. In Portugal, the incumbent has a deadline of 24 hours in which to accompany access seekers for standard planned interventions, and 4 hours for urgent interventions. The SLA requires the accompanying service to be available 95% of the time.

The table below shows the service level agreement for the Portuguese reference offer for duct access.

28 PT must additionally supply formal documentation within 1 WD, while in Spain the access seeker may use the optional Vacancy Information Service prior to the access request providing the most precise and punctual information on the availability of spare capacity in ducts. If the operator requests this service Telefonica must provide this information within 10 working days.

29 Route-based information is available within 10WD in UK and area information in 20WD. Information in France is provided by Orange within 10-15 days.

30 20 working days for area-based proposal

31 In Spain and the UK, survey requires accreditation. In Spain this option is not available for manholes located at the Central Office

Table 2-5: Service level agreement in the Portuguese duct access reference offer

Parameter	Level
1. Deadline for information request	1 working day
2. Deadline for response to viability analysis	10 consecutive days
3. Deadline for accompanying standard (planned) interventions	24 hours
4. Deadline for urgent (unplanned) interventions	4 hours
5. Availability of accompanying service	95%
6. Deadline for response to access and installation request	5 working days
7. Deadline for financial proposal (budget) for deobstruction request	5 working days

Compensation is due if these parameters are not met, as follows. There is also a penalty of €50 per day for non-availability of the extranet.

Table 2-6: Service level guarantees in the Portuguese duct access reference offer

Parameter	Penalty per request	Maximum penalty (cap)
1	d x 50 €	60 working days
2	d x 50 €	90 calendar days
3	h x 25 €	n/a
4	h x 50 €	n/a
6	d x 50 €	60 working days
7	d x 50 €	60 working days

Spain and France also set penalties for delays in meeting required service levels for providing information and responding to requests from the access seeker in the required timeframe. However, there is no defined compensation in the UK or German reference offers.

Specific service levels and associated compensation for the incumbent to repair its duct infrastructure are less common. There are no contractual timeframes for Orange or Deutsche Telekom to repair damage to its infrastructure. In the UK, BT commits to responding to fault reports within 4 hours and contacting the access seeker if the fault is not repaired within 48 hours. However, there is no associated compensation if these timeframes are not met. Duct access providers may have a self-interest in the repair of their infrastructure in cases where it also houses their own cables. However, incentives are likely to be weaker in cases where only third parties occupy the ducts.

Reference Offers also typically include deadlines by which access seekers must provide notice of their intention to conduct works (e.g. 24 hours) and set a deadline for access seekers to occupy the duct space they have reserved. This is set for example at 6 months in Spain. Access seekers are also required to file a report after the installation is complete.

2.3.2 Pole access

It is notable that on the whole, the operational conditions for pole access are significantly less well developed than those for duct access. A summary is shown in the table below.

As pole access is not mandated in Germany (and use of poles for telecommunications is very limited), Germany is not covered in this comparison.

Table 2-7: Operational conditions for pole access

Conditions	UK	FR	PT	ES
Information concerning location and availability	Manual (online database from mid-2017)	Online request system and online file exchanges but no real time info yet. Obligation is envisaged in the new market review. Maps show usage of Enedis' poles (electricity provider).	Manual - pole information not included in centralised system. MEO provides geo referenced paths of aerial cables and with relevant poles and if possible cartographic information to facilitate the location of the paths	Info on space between poles or between poles and manholes not covered in automated system.
Incumbent space reservation	No set rule. BT advises that there is limited space available. Incumbent indicates availability case by case, taking account of capacity required to meet Universal Service Obligations and maintenance	Software available to assess whether pole is full - available also to altnets. Downstream of the mutualisation point the operator must leave at least as much space unoccupied as it uses (1+1 rule).	No space reservation specified	No set rule
Decongestion approach	Altnet may conduct (with BT approval) or request BT to conduct. As regards dropwire, Ofcom has proposed that altnet should be able to request Openreach to replace copper dropwire with hybrid - Openreach would own - it would be rented by altnet	The pole can be decongested at the altnet's cost .	No decongestion approach in RO concerning unused or obsolete cables on poles. The access seeker is allowed to remove his own cables and equipment, following authorisation by MEO (response deadline 5 days). MEO can accompany the removal.	No information in RO on decongestion approach for poles
Commitments concerning entrant access to new poles	Altnets may augment poles themselves (with BT's agreement) or request BT to undertake the work (subject to a charge). If the new pole is connected to Openreach poles, ownership reverts to BT on completion of the work.	Pole reinforcement and new poles paid by altnets, subject to fixed compensation by Orange of 93€ in case of 'objective saturation'. In the new market review ARCEP has proposed that Orange cover costs for reinforcement of poles and new poles	According to law decree article 10 the access seeker must pay the percentage of the investment cost which corresponds with the cost differential resulting from its association in the investment	A cost-sharing mechanism was introduced, so that the first operator to deploy its network can recover the investment made for replacement/adaptation of poles: second operator pays 50% of the full cost, next operator pays 50% of the remaining cost etc.
Who can install cables?	Accredited individual (can be unsupervised, but notice must be given)	Access seeker (following the rules of engineering)	Access seeker, may be accompanied by MEO. Should apply for permission and agree schedule	Accredited access seeker - can be unsupervised, but notice must be given at least 24 hours in advance of the works

Conditions	UK	FR	PT	ES
Timeframes for provisioning	Same as for ducts, but in addition, a joint survey must be conducted with Openreach to assess route stability.	See ducts	10 days respond information request, 30 days response to viability analysis. Viability analysis is compulsory for poles. MEO must be available to accompany access seeker within 24 hours (standard interventions) or 12 hours (urgent)	Same as for ducts, but joint survey is mandatory and there is a requirement for engineering project for examination of poles (to confirm viability), installation or replacement of poles should be concluded within 20 days of permit grant
Compensation	None	See ducts	€50 per day for failure to respond to information request or respond to viability analysis. 60WD max	5% of the fee per day of delay
Timeframes for repair	4 hours to respond to fault report (unless otherwise agreed), BT to contact altnet if fault not repaired within 48 hours	There are no contractual timeframes for Orange to repair damages to its infrastructure	None, unless consequences for alternative operator	Fault repair within 8 hours; repair of cables at the central office: 24 hours; +30% if not on a working day
Compensation	None	None	No penalties specified in the reference offer	50% of the annual charge for relevant segment per hour of delay

2.3.3 Information concerning pole location and availability

In contrast with ducts, where some automated systems exist, there is limited or no automated information available on poles. In Portugal, pole information is not included in the central system, while in Spain, information on the space between the poles or between poles and manholes is not included in the automated system.

There is also no automated up-to-date information on pole access currently available in the UK and France, although online file exchange is available in France and includes information on where Orange uses Enedis³² poles. However, Ofcom's 2016 consultation on PIA suggests that BT is planning an online database from mid-2017, while French NRA ARCEP has indicated that there are plans to introduce an obligation for real-time information provision in the ongoing market review.

2.3.4 Space reservation rules

Unlike ducts, where there are rules regarding space reservation for the incumbent or alternative operators in most cases, there are no clear rules on space reservation for poles in most of the countries considered. This means that availability, and rights to reserve space for future use, is determined on a case by case basis either by the incumbent alone or in the context of a joint survey.

France is one case where access seekers may conduct their own survey of pole suitability. In France, software is available to alternative operators as well as to Orange to assess whether a pole is at full capacity. There are also rules concerning space that must be made available in reserve in the deployment of FTTx on poles. Upstream of the mutualisation point (i.e. the termination segment), those deploying FTTx do not need to leave additional space for further installation (the 1+0 rule), but must leave as much space as they occupy downstream from the mutualisation point in order to enable additional infrastructure competition ("1+1"-rule).

2.3.5 Approach towards decongestion and installation of new poles

Decongestion works must typically be paid for by the access seeker and can be performed directly by the access seeker in the UK, but a challenge in countries such as Portugal is that there is no requirement for the incumbent to remove its unused cables from poles. This creates particular challenges for availability in the 'drop-wire' segment – between the last pole and building in which fibre is to be installed.

32 Enedis, formerly ERDF, is an electricity provider in France

The UK NRA Ofcom has proposed a solution aimed at addressing congestion in the final segment, whereby the access seeker should be able to request that the incumbent replaces its existing copper dropwire with a hybrid, copper/fibre dropwire. The incumbent would continue to own it, but it would be available for rent by the alternative operator.

Augmentation of existing poles or installation of new poles can be conducted by and must be paid for by access seekers in the UK (subject to BT's approval), but ownership of the augmented or new pole reverts to BT on completion of the works. In contrast, mechanisms exist in France and Spain for such works to be compensated. In France, there is a fixed compensation by Orange of €93 per pole in case of objective saturation (and proposals in the market review for Orange to cover the full cost of reinforcement or new poles), while in Spain, the access seeker must pay for pole installation costs, but a cost-sharing mechanism has been introduced such that the first operator to improve the network can recover costs from subsequent users of the network.³³

2.3.6 Installation and accreditation

In Spain, France and the UK, access seekers may install cables on poles themselves subject to accreditation (in Spain and the UK) or following engineering rules (France) and after giving notice to the incumbent (e.g. 24 hours in the case of Spain). In Portugal, the access seeker may also install cables, but may be accompanied by the incumbent.

2.3.7 Timeframes for provisioning, repair and associated compensation

Provisioning procedures and associated timeframes for pole access are generally the same as for duct access, except that in addition, information must be provided manually and surveys or viability analyses performed solely by or jointly with the incumbent are required. This may add a significant period of time to the provisioning process.

For example, in Portugal information concerning pole locations must be provided within 10 working days (90% of the time), and the 'viability analysis' takes a further 30 working days. Joint surveys are also required for poles in Spain (45 days) and an 'engineering project' must be conducted to confirm the viability of pole access at the access seekers' expense.

Penalties per day of delay apply in the case where SLAs regarding pole access are not met in France, Spain and Portugal. However, there no penalties applied in the UK. As with ducts, there are limited targets for fault repair (broken poles) and associated compensation in the studied countries.

³³ The second operator pays 50% of the full cost, third 50% of the remaining cost etc

2.4 Benchmarking prices for SMP infrastructure access

In this section, we describe the methodology by which we calculate prices for duct and pole access in the considered countries, and summarise the resulting charges for a standardized deployment.

The pricing approaches for using physical infrastructure like ducts and poles vary widely both as regards one-time fees and the rental capacity. Charges may vary depending on the cable size, on manholes passed, on the network segment the infrastructure belongs to (feeder or distribution segment) etc., and all depend on the length of the infrastructure used. The different price structures in the considered countries make any comparison of the price components challenging due to the variance in both pricing structures and levels. Therefore, instead of comparing single components, in order to benchmark prices, we calculate the cost of deploying a defined cable which is deployed over the same length in each of the countries considered.

For the rental charges, we consider a cable with a size of 2.5 cm² (outside coat) and length of 1,500 m. In case there is a different price scheme for the feeder and the distribution segment of the network we use a weighted average between feeder and distribution segment (assuming a line length of 800m for an average feeder line and 700m for an average distribution line)³⁴.

For the one-time fees, we take into account any fees for compulsory services such as fees for access to information or a survey where relevant (e.g. for ducts). The costs for accreditation are not however reflected, since increasingly operators make use of external contractors to duct works. We assume space is available and therefore that there is no need to pay for decongestion or bypass works. We assume a long term installation, so all one-time fees are depreciated over 40 years for ducts and 20 years for pole access, both discounted with a WACC of 7%.

Using the methodology described above results in benchmark prices for SMP duct and pole access per metre as follows. The tables below show the monthly price (€ per metre) for duct and pole access split in the components:

- one-time fees (distributed over 40 and 20 years respectively),
- monthly charges for ducts or poles
- and monthly charges for ancillary services where relevant. We only consider ancillary charges for those components which are necessary in order to get access to the infrastructure (e.g. manholes rental in Spain and in-line splice and cable coil hosting in UK).

³⁴ Data for the length distribution has been taken from: Elixmann, D; Ilic, Dragan; Neumann, K.-H.; Plückebaum, T.: The Economics of Next Generation Access; Report published by ECTA, Brüssel, 16. Sept. 2008

Table 2-8: Price benchmark for duct access (monthly price (€ per metre))

Country	One-time fees, € per month and metre	Monthly charge (ducts), € per metre	Monthly charge (ancillary), € per metre	TOTAL, € per month and metre
France	0.0034	0.0688		0.072
Germany	0.0069	0.0400	0.0026	0.050
Portugal	0.0002	0.0461		0.046
Spain	0.0033	0.0280	0.0522	0.084
UK	0.0005	0.0587	0.0186	0.078

Table 2-9: Price benchmark for pole access (monthly price (€ per metre))

Country	One-time fees, € per month and metre	Monthly charge (poles), € per metre	Monthly charge (ancillary), € per metre	TOTAL, € per month and metre
France	0.0056	0.0688		0.074
Portugal	0.0041	0.0463		0.050
Spain	0.0015	0.0140		0.016
UK	0.0006	0.0533	0.0186	0.073

- France: Prices for access in high density areas from MDF to building (mutualisation point inside the building). Prices for ancillary services included in a separate Reference Offer.³⁵
- Germany: Ancillary charge for duct access consists of administrative monthly cost per active cabinet
- Portugal: Prices for Lisbon/Porto
- Spain: Ancillary charge for duct access consists of monthly rental for manholes.
- UK: Monthly charge for duct access is based on single bore: €0.065 if an average of charges for single, 2 and 3+ bore is taken. Ancillary rental charge includes In-line Splice hosting and distribution joints (per joint box splice) and Cable Coil Hosting - small (per manhole).

Variations in prices can be seen both for ducts, where total prices range from €0.046-€0.084 per metre and for poles where prices range from €0.016-€0.074 per metre. The charges exclude 'optional' expenses such as charges for blockage clearance. However, it should be noted that in some cases such expenses could have a significant impact on the total price. For example, including blockage clearance in the UK charges would result in prices of €0.123 for ducts and €0.129 for poles.

³⁵ Reference Offer available at https://www.orange.com/fr/content/download/3265/28427/version/8/file/Offre_hebergement_de_NRO_2016-03-15.pdf. Orange offers to host equipment in its optical local network: hosting active equipment in a Subscriber Connection Node (SCN) or hosting in an Optical Connection Node (OCN).

3 In-building wiring and terminating segment access

In this section we describe the legislative provisions and operational conditions for in-building wiring access in three countries which have developed detailed regimes for such access – France, Portugal and Spain.

The table overleaf summarises the main characteristics of the in-building wiring regimes. We then discuss each aspect in further detail with a focus on:

- (i) The legal basis
- (ii) Information and transparency obligations
- (iii) The location of the connection point
- (iv) Requirements concerning architecture
- (v) Pricing approach and cost-sharing
- (vi) Non-discrimination

Table 3-1: Regulatory approaches to in-building wiring

Regulatory approach	FR	PT	ES
Legal basis	Law n ° 2008-776 of 4 August 2008, • Law n ° 2009-1572 of 17 December 2009, • Decisions of the Authority No. 2009-1106 • Decisions of the Authority No. 2010-1312	Law decree 123/2009 -(predates CRD)	Law 38/1999 of 5 Nov 1999 Law decree 1/1998, of 27 Feb 1998 Ministry regulation for buildings with ICT: decree 346/2011 of 11 March 2011; NRA obligation in place since 2009 (excl. buildings with ICT); symmetric sharing access obligation for every building (with and without ICT) imposed via Telecom Act 2014 (Art. 45.4)
Information	FTTP installing operator notifies listed operators of installation within one month of agreement. Building operators should provide ordering tool which offers access to information as stipulated by ARCEP	ANACOM provides information on ITED projects on its website (restricted access)	Buildings w/o ICT ³⁶ : first operator to provide updated information on buildings with fibre within 1 month after installation; draft regulation requires the publishing of an offer, if the operator has more than 100,000 buildings passed
Connection point	Very dense areas (base of building or point aggregating 100 households for low density pockets). Less dense areas (point aggregating 1000 households - may be through connection of 300 households with backhaul)	The multioperator chamber (CVM) is located outside the building but belongs to the building infrastructure, the building wiring has to be connected by ducts to the multioperator chamber which is the point of interconnection with the network of the electronic communications provider or with the urbanisation network (e.g. of the condominium)	Pol is the distribution point (Building Distribution Box - "Caja Terminal") installed in the building; in certain circumstances access is mandated at points located further away from the building (e.g. boxes, cabinets or other infrastructural elements)
Architecture	In very dense areas, if several operators request access to the building before installation - up to 4 parallel lines per home can be installed - operators cover a proportional share of the installation cost. In less dense areas, one fibre is deemed sufficient from home to first concentration point.	The first operator to reach an existing building must install at least 2 fibres per home and associated infrastructure to be shared by other operators (vertical infrastructure and ODF). FTTP operators must follow ITED manual for installation, maintenance and alteration of equipment and systems	At least 2 fibres per home; 2 connections (each with 2 fibres) for business premises

³⁶ In Spain buildings constructed after 1998 have to be equipped with in-building wiring (ICT i.e. Common Telecom Infrastructure) by law. In that case the infrastructure belongs to the owner of the building. The remaining 80% are older buildings (built before 1998) where wiring was installed by network operators. In that case the operator owns the wiring.

Regulatory approach	FR	PT	ES
Price regulation approach	Commercially agreed, but with potential for ARCEP to determine following dispute. ARCEP Regulations state that providers should publish access offer, and that prices should be justifiable according to the cost of relevant network elements adjusted for risk. ARCEP has published draft cost model to assist in commercial negotiations and disputes. Operators installing in-building wiring must be able to provide ARCEP with documents supporting the investments made from the concentration point to customer premises	Prices should be cost-oriented, regulator can be asked to intervene ex-post	Fair and reasonable prices. Prices were determined by the NRA following a dispute brought by Orange and Vodafone in 2013
Sharing of in-building wiring costs	Proposition by ARCEP: Very dense areas: First operator bears 90% cost, remainder by co-financing operators. Less dense areas: First operator bears full cost, subsequent operator pays fee to previous operator	No defined rule	No defined rule; pricing for next operators should enable cost recovery of the first operator
Sharing of terminating segment costs	IRUs available for rights to use 5% lines. Should in principle be cost-oriented with risk premium which is lowest for co-investment before installation, higher for co-investment after installation and higher still for rental	N/A	N/A
Non-discrimination	Information must be made available in non-discriminatory manner. RO to be published on website. Installing operator must give three months notice before concentration point becomes operational - or 6 weeks in case of new buildings. FTTP Building operators with at least 10,000 potential end-users must supply quarterly KPI data to NRA. Penalties apply for delayed deployment and repair.	Yes, access to in-building wiring has to be provided in a non-discriminatory manner (by the owner or administrator of the building). Implementation/enforcement of the ND obligation not specified	The law requires operator to agree on the economic conditions for the use of terminating segments respecting the principles of objectivity, transparency proportionality and non-discrimination

3.1 Legal base - symmetric obligations

In all three countries regulation of in-building wiring and the terminating segment access is a symmetric obligation. It has been in place in France, Spain and Portugal since 2008-2011. In all countries the regulation of in-building wiring and the terminating segment access was introduced by one or more law decrees. These laws are complemented by regulatory decisions in France and Spain.³⁷ All these obligations predate the CRD.

One important difference between the three countries is that in France in the less densely populated areas the terminating segment is included in the in-building wiring access whereas in Portugal, Spain and in the dense areas in France the connection point is located in the premise or close to it³⁸.

The current symmetric regulatory obligations for in-building wiring are summarised in Table 3-1. The main elements considered in this section are (i) how information is provided concerning availability of in-building wiring to the access seekers; (ii) the approach to price regulation and the sharing of costs; and (iii) the approach to enforcing non-discrimination.

3.2 Provision of information

The provision of information regarding in-building wiring access is organised differently in each country. In Portugal the information on in-building wiring projects is provided via the NRA's website with restricted access whereas in France the information of planned FTTP deployment is provided by the installing operator to a predefined list of potentially interested operators. In France the information has to include:

- the address of the building in question;
- the name and address of the owner of the property or the condominium board representing the co-owners;
- the number of residential or office units in the building;
- the person whom other operators must contact to submit their request for access;

³⁷ There are two types of regulation for in-building wiring in Spain depending on the date of construction: Buildings constructed after 1998 have to be equipped with in-building wiring (ICT i.e. Common Telecom Infrastructure) by law. A different system applies to older buildings (built before 1998) where wiring was installed by network operators. In that case the operator owns the wiring. The symmetric obligation imposed by the NRA in 2008 only holds for these buildings. Although the regulation outlined is still applied, in this area is due to evolve following the implementation of the new Telecom Act, approved in 2014. Art. 45.4 of the Telecom Act mandates a symmetrical obligation to share vertical wiring for every building (with or without ICT).

³⁸ Further information can be found in section 3.2.

- the location of the concentration point (address, environment, means of access);
- the technical properties of the equipment installed at the concentration point and the processes for connecting to it; as well as
- information regarding modalities of the co-investment.

In Spain the first operator deploying its network in a building must provide other operators with updated information on the buildings where fibre has been installed according to the regulation imposed by the NRA for buildings without ICT. According to the Draft regulation implementing Art. 45.4 of Telecom Act 2014 a building operator with at least 100,000 buildings passed in total must publish an offer for sharing of fibre terminating segments, including technical and economic conditions and the processes to be followed by operators interested in sharing.

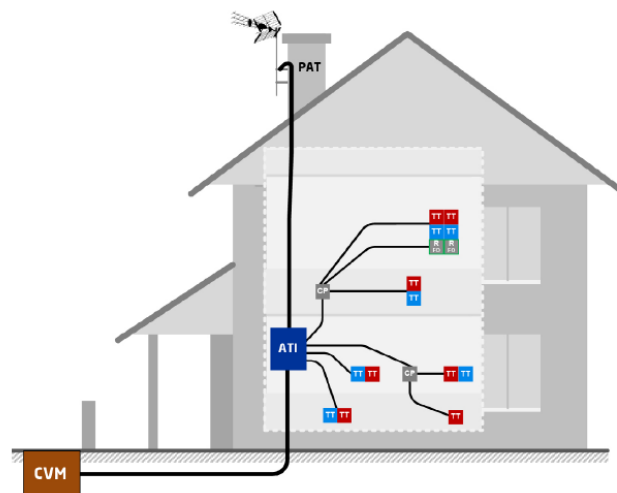
The offer must include SLAs and guarantees offered for the provision of services and fault repair (deadlines, penalties in case of non-compliance, etc.)

3.3 Location of the connection point

One important difference between the three countries is the location of the connection point for in-building wiring. In France and Spain, the connection point can be located inside or outside the building depending on the circumstances, whereas in Portugal the connection point is typically located outside the building.

In Portugal the multioperator chamber (CVM) is located outside the building but belongs to the building infrastructure. The building wiring has to be connected by ducts to the multioperator chamber which is the point of interconnection with the network of the electronic communications provider or with the urbanisation network (e.g. of the condominium). Figure 3-1 shows as an example the in-building infrastructure in a single dwelling unit in Portugal with the multioperator chamber outside but close to the premise.

Figure 3-1: In-building infrastructure in single dwelling unit in Portugal



Legenda dos dois esquemas anteriores:

- ATI: armário de telecomunicações individual
- ATE: armário de telecomunicações de edifício
- CVM: câmara de visita multioperador
- TT: tomada de telecomunicações
- RFO: espaço de reserva para TT de fibra ótica
- PAT: passagem aérea de topo
- CP: caixa de passagem
- TT em par de cobre
- TT em cabo coaxial
- TT em fibra ótica



Translation of legend:

- ATI: Individual telecommunications cabinet
 - ATE: building telecommunications cabinet
 - CVM: multioperator chamber
 - TT: telephone connection unit
 - RFO: space reserved for fiber
 - PAT: transition to roof area
 - CP: passage box
- Blue=copper, red=coaxial cable, green=optical fiber

In Spain the distribution point (Building Distribution Box - "Caja Terminal") is normally installed in the building. However, in certain circumstances access is mandated at points located further away from the building (e.g. boxes, cabinets or other infrastructural elements). These situations mainly arise in areas with lower levels of population density which would be more efficiently served with terminating boxes of suitable dimensions to serve several homes. These boxes may be located on public property.

The next figure shows both kinds of connection points (inside and outside the building) as defined in the CNMC decision on symmetric regulation. The first figure shows the Building Distribution Boxes installed in the building which is the normal case. In the

second figure, the connection point is located outside the building at the handhole serving more than one building.

Figure 3-2: Connection points for symmetric access to in-building wiring in Spain³⁹

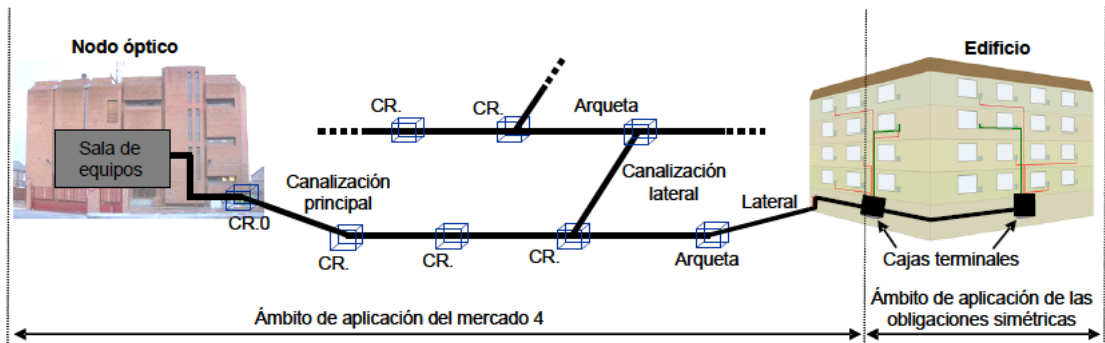


Figura 1. Ubicación del punto de compartición en el edificio.

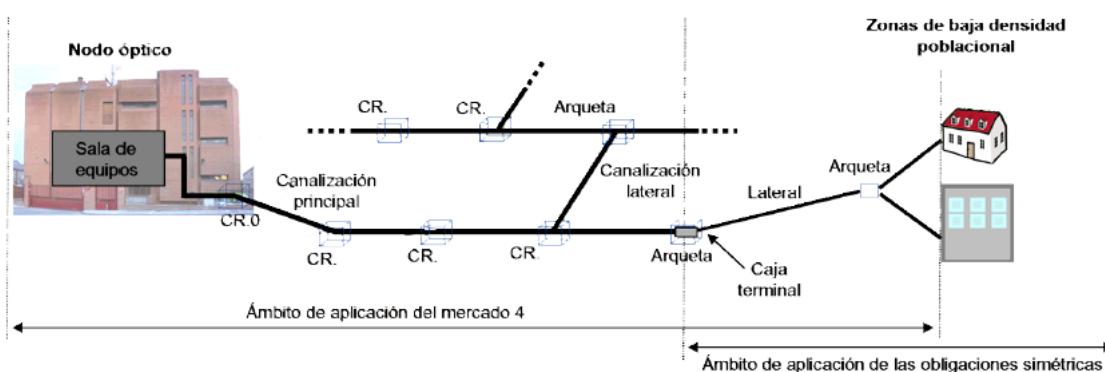


Figura 2. Ubicación del punto de compartición en dominio público (arqueta cercana a las edificaciones).

Definitions:

CR: manhole

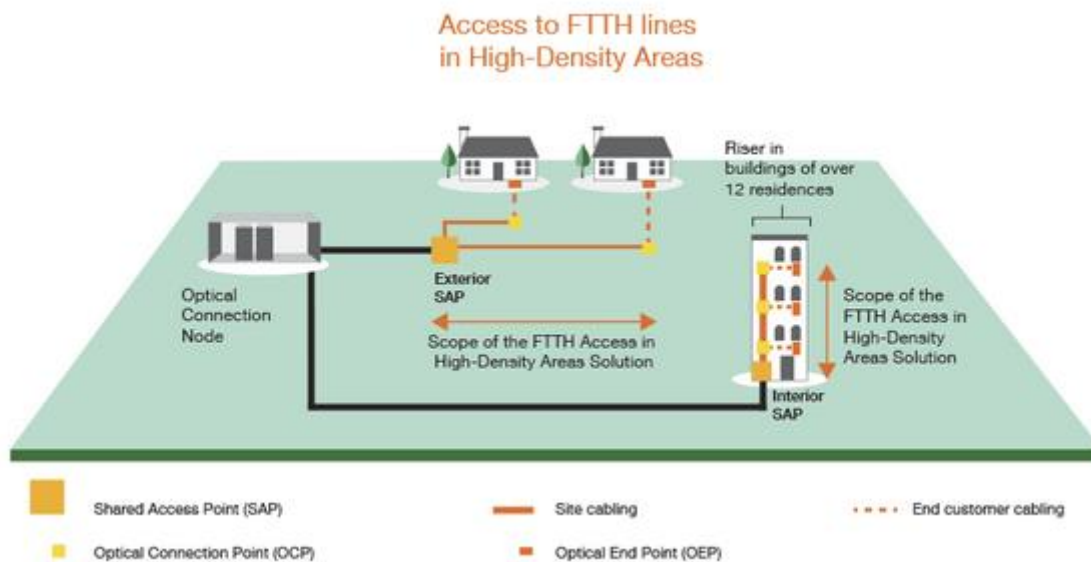
Arqueta: handhole

Caja terminal: Building Distribution Box

³⁹ Source: RESOLUCIÓN POR LA QUE SE APRUEBA LA IMPOSICIÓN DE OBLIGACIONES SIMÉTRICAS DE ACCESO A LOS OPERADORES DE COMUNICACIONES ELECTRÓNICAS EN RELACIÓN CON LAS REDES DE FIBRA DE SU TITULARIDAD QUE DESPLIEGUEN EN EL INTERIOR DE LOS EDIFICIOS Y SE ACUERDA SU NOTIFICACIÓN A LA COMISIÓN EUROPEA of 12.02.2009, p.17

In France the location of the connection point also depends on the area in which the building is located. There is a distinction between high-density and low-density areas; and the high density areas can also contain low-density pockets.⁴⁰ In high-density areas outside the low-density pockets for buildings with at least 12 residential or business units or accessible through a visitable sewer network the concentration point is located at the building entry point. In all other cases the concentration point is located outside the building. In high-density areas outside the low-density pockets for other buildings (i.e. fewer than 12 units and not accessible via visitable sewers) in general it is envisaged to have a concentration point of 100 single fibre lines in a cabinet. For isolated buildings there might be a multi-fibre concentration point (i.e. manhole, façade, terminal). In low-density pockets within the high-density areas 300 single fibre lines are aggregated at the concentration point (see Figure 3-3).

Figure 3-3: Access to FTTH lines in high-density areas in France



Source: Orange⁴¹

The connection point in lower density areas in France must be:

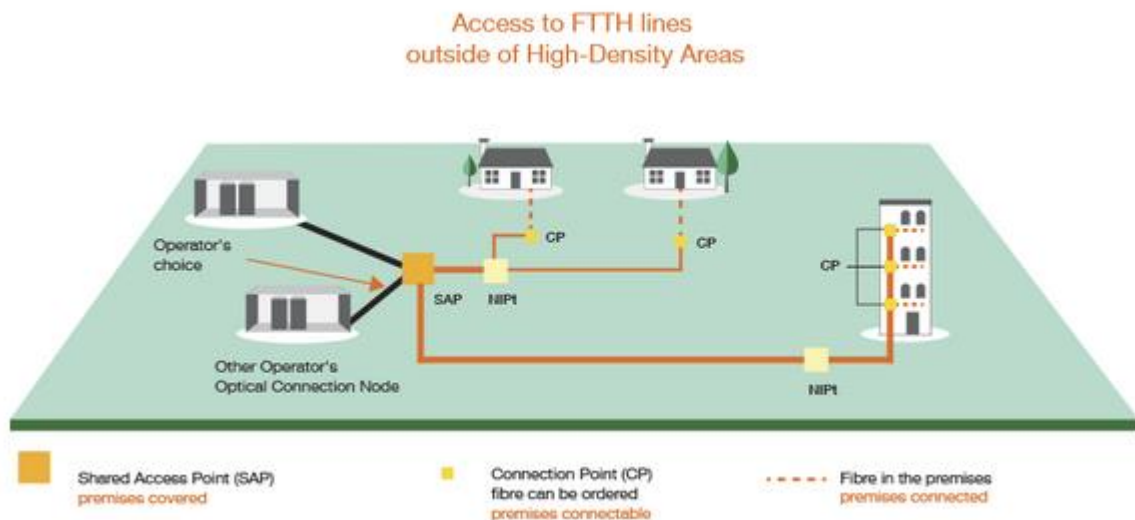
- At a point aggregating at least 1000 lines or;

⁴⁰ ARCEP defined the very dense zones in Decision No. 2013-1475. A list of the high-density areas can be found under: <http://www.arcep.fr/fileadmin/reprise/dossiers/fibre/annexes-2013-1475-liste-communes-ztd.pdf>

⁴¹ <http://wholesalefrance.orange.fr/en/Our-solutions/Customer-Fixed-Solutions/Offre-Solutions-Fixe-Grand-Public/Access-to-FTTH-lines-in-High-Density-Areas/Access-to-FTTH-lines-in-High-Density-Areas-summary>

- At a point aggregating at least 300 lines if the backhaul portion of the network is shared

Figure 3-4: Access to FTTH lines outside of high-density areas in France



Source: Orange⁴²

3.4 Approach to in-building architecture

The approach to in-building architecture differs slightly between the three countries. In Spain⁴³ and Portugal at least two fibres per home must be installed. In Portugal this also includes the associated infrastructure (vertical infrastructure and ODF) that must be shared with other operators. Two connections, each with two fibres have to be deployed for Spanish business premises.

In France there are different obligations for dense vs less dense areas. If several operators demand access to the building in advance of the fibre installation in the high-density areas, up to a maximum of 4 parallel fibres per home can be installed.⁴⁴ The operators cover a proportional share of the installation cost. In this case, no limitations on the use of access are expected. Outside these areas one fibre is deemed sufficient, which must be shared by all operators.

⁴² <http://wholesalefrance.orange.fr/en/Our-solutions/Customer-Fixed-Solutions/Offre-Solutions-Fixe-Grand-Public/Access-to-FTTH-lines-outside-of-High-Density-Areas/Access-to-FTTH-lines-outside-of-High-Density-Areas-summary>

⁴³ According to Chapter 3 of Annex II of decree 346/2011 for buildings with fibre ICT

⁴⁴ Installation d'un réseau en fibre optique dans les constructions neuves à usage d'habitation ou à usage mixte, Guide Pratique – 2016, <http://www.arcep.fr/fileadmin/reprise/dossiers/fibre/251116-Guide-Immeubles-neufs-BD.pdf>

3.5 Approach to pricing

In Spain the only guideline for pricing is that the prices should be fair and reasonable. The prices of access to in-building wiring are subject to commercial agreements but the regulator may intervene in the case of a dispute.⁴⁵ In Portugal and France prices should be cost-oriented with the option that the regulator can intervene in case of a dispute.

There was in principle a general rule in Portugal to share the cost of in-building wiring whereby the first operator pays 100% of the costs, the second operator reaching the building pays 50% of the costs incurred in the installation of the shared infrastructure and the third operator 33%. However, the NRA has indicated that it is not applied in practice.

In France two options are generally offered in both the dense and the less dense areas. The access seeker can either subscribe to a rental offer or take part in a co-investment scheme (either *ab initio* and *a posteriori*, whereby the risk premium for co-investment after the installation is higher than co-investment before the installation).

The French NRA envisaged the following cost sharing principle for in-building wiring costs: In very dense areas the first operator bears 90% cost, due to its first mover advantage, and the remainder by co-financing operators, in the less dense areas the first operator bears the full cost and the subsequent operator pays a fee to the previous operator whenever the operator serving the end-customer changes. For the terminating segment in the less dense areas ARCEP envisaged a co-investment regime whereby IRUs are available for rights to use 5% of lines. What Orange offers as co-investment in its RO is a little different, at least for in-building wiring in very dense areas. In very dense areas the co-investors share the construction cost between co-investors (1/N) and pay a fixed fee for a 30 year IRU plus a recurrent fee per active line. In the less dense areas, the incremental co-investment in steps of 5% with IRUs for 20 years plus recurrent fee per active line is applied.

3.6 Approach to non-discrimination

Non-discrimination obligations apply to in-building wiring and terminating segment access in all three countries. However, the degree of enforcement varies.

In Spain and Portugal there is no further specification regarding the implementation of the non-discrimination obligation.

However, in France in order to control for non-discrimination with regard to response and delivery times the operators which own infrastructure to serve at least 10,000 end customers must report their average response and delivery times on a quarterly basis to

⁴⁵ A dispute brought by Orange and Vodafone against Telefonica in 2013 has been resolved by CMT by settling the access prices.

ARCEP. Furthermore the installing operator must give three months notice before the concentration point becomes operational - or 6 weeks in case of new buildings.

4 Outcomes

In this section, we consider the outcomes for fast broadband deployment in the five benchmarked countries.

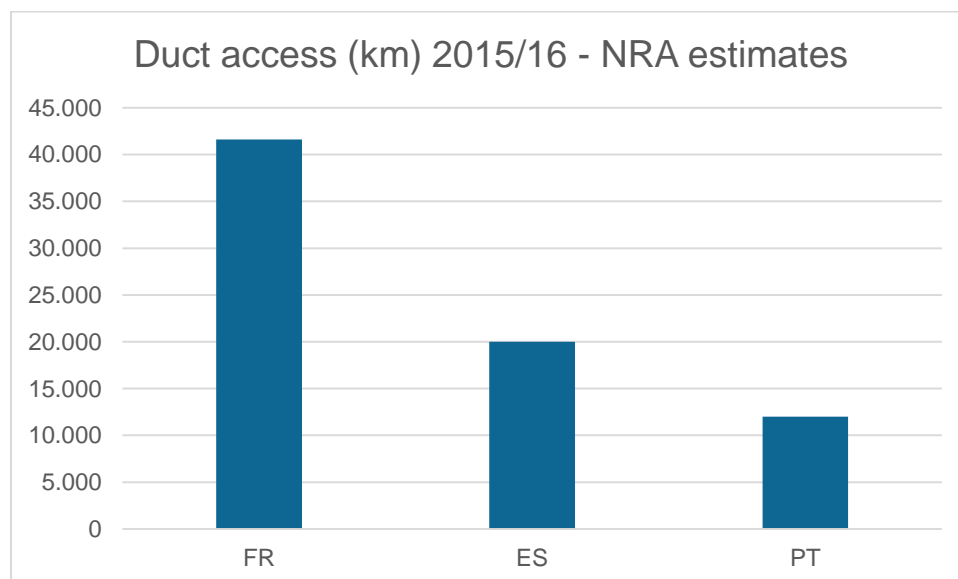
- Section 4.1 sets out the available data on take-up of infrastructure access
- Section 4.2 discusses implications for FTTH/B deployment and infrastructure competition

4.1 Take-up of infrastructure access

4.1.1 Ducts and poles

Only three of the studies countries provide data concerning the take-up of infrastructure access. These are the countries in which the operational conditions for duct and pole access are most advanced - France, Portugal and Spain.

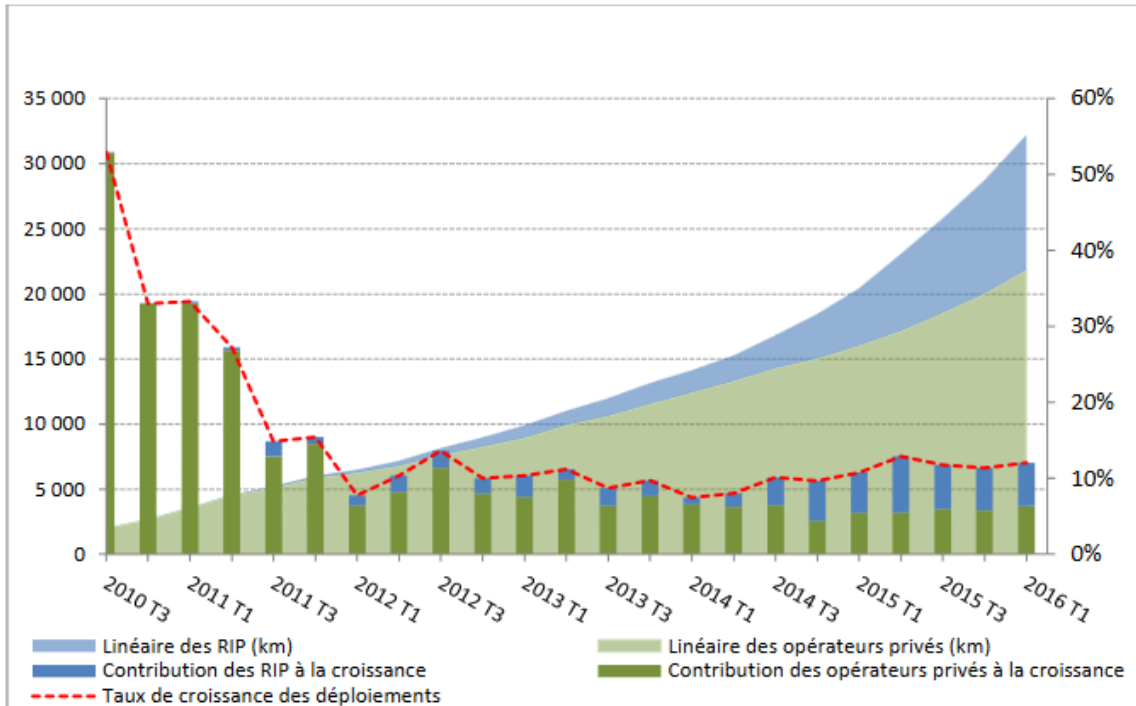
Figure 4-1: Duct access (km) 2015/16 NRA estimates



The highest absolute usage of incumbent duct access has been in France with 41,623km as of Q3 2016.⁴⁶ The chart below shows how duct access accelerated during 2014.

⁴⁶ http://www.arcep.fr/fileadmin/reprise/observatoire/hd-thd-gros/t3-2016/observatoire-HDTHD-deploiements-T3_2016.pdf

Figure 4-2: Contribution of public and private operators to the increase in alternative FTTH and FTTLA deployments in the duct infrastructure of Orange



Linéaire des RIP (km)	RIP lines (km); [RIP= Les réseaux d'initiative publique = Public initiative networks]
Contribution des RIP à la croissance	RIP contribution to growth
Taux de croissance des déploiements	Growth rate of deployment
Linéaire des opérateurs privés (km)	Lines of private investors (km)
Contribution des opérateurs privés à la croissance	Contribution of private investors to growth

Source: ARCEP July 2016 Public consultation market analyses 31,3b and 4

A similar increase in duct access can be seen in Spain during this period in the figure below. CNMC reported 20,000km of subducts in use in 2016.⁴⁷

⁴⁷ CNMC Press Release: <https://www.cnmc.es/2016-11-09-la-cnmc-mejora-las-condiciones-para-que-los-operadores-alternativos-puedan-desplegar>

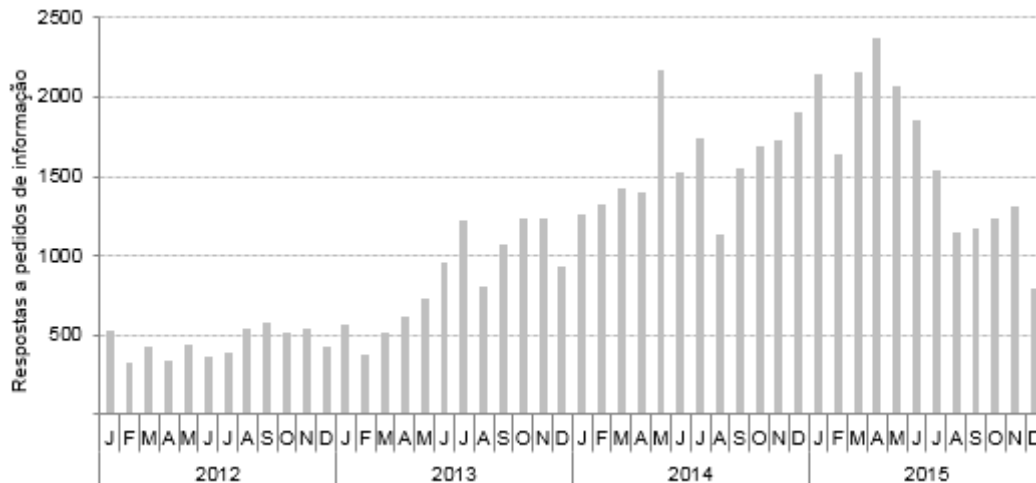
Figure 4-3: Accumulated km of occupied Telefonica subducts⁴⁸



It should be noted however, that proportionately, the greatest use of duct access can be seen in Portugal, which reported in January 2015 that around 12,000km of PT's 24,000km of ducts had already been made available to alternative operators (including the cable operator) as of 2006.⁴⁹

The high degree of usage of PT's ducts can also be seen in the number of information requests, which averaged around 1,000 per month during 2015.

Figure 4-4: Number of answers to information requests



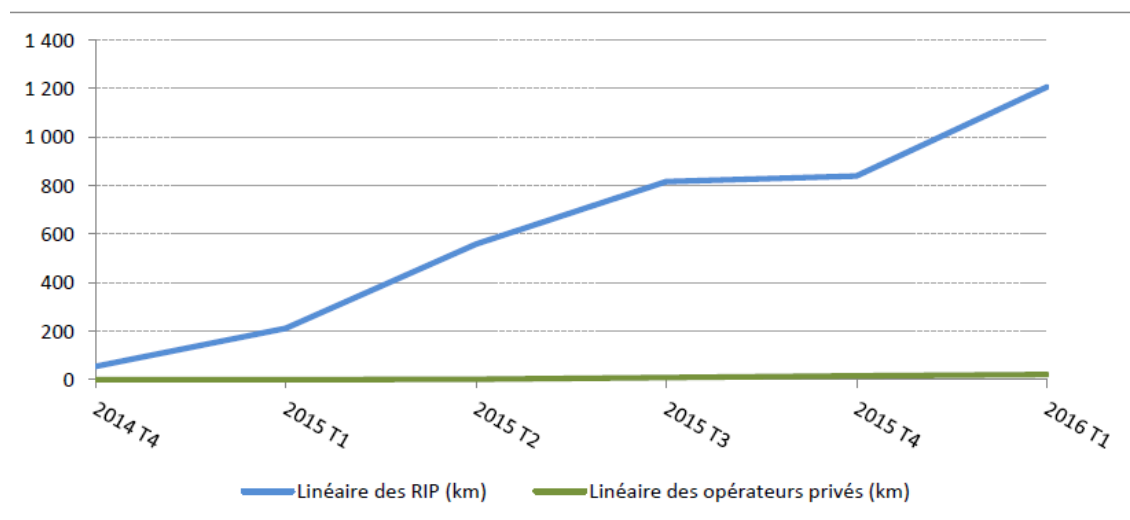
Source: ANACOM (2015): Fostering rollout of NGA networks - The Case of Regulation access to Portugal Telecom's Ducts

⁴⁸ Source: CNMC Market review (2015), p. 107. Around 90 % of the requests for duct access are allocated to three operators: Orange, Jazztel and Vodafone

⁴⁹ <http://organodivigilanza.telecomitalia.it/pdf/Seminario-UfficioVigilanza-14012015.pdf>

As regards pole access, figures provided by ARCEP (see below) suggest that there is growing use of Orange pole access in France by public initiative companies (RIPs). However, it is significantly less developed than use of duct access. As of Q1 2016, only 1,230km of very high speed broadband had been deployed using Orange aerial infrastructure. It is understood that a much greater proportion has been deployed using the electricity ducts of ERDF (now Enedis). ERDF reported in a 2014 presentation that 37% of the 550,000km of optical fibre in France (~200,000km) had been deployed using its pole infrastructure.

Figure 4-5: FTTH and FTTLA deployments by alternative operators in the aerial infrastructure of Orange



Linéaire des RIP (km)

RIP lines (km); [RIP= Les réseaux d'initiative publique = Public initiative networks]

Linéaire des opérateurs privés (km)

Lines of private investors (km)

Source: ARCEP July 2016 Public consultation market analyses 31,3b and 4

SMP pole access from PT as well as access to the poles of the Portuguese energy company EDG are also understood to be in use.

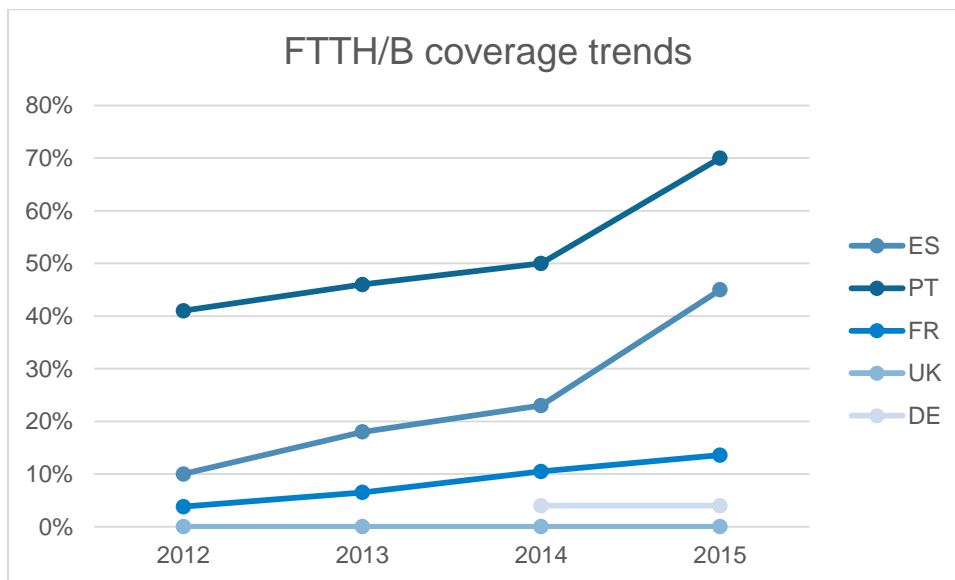
4.2 FTTH/B deployment and infrastructure competition

4.2.1 FTTH/B coverage

Data gathered by IHS/VVA for the European Commission shows that as of the end of 2015, FTTH/B was most developed in Portugal, reaching 75% of households. There have also been significant increases in FTTH/B coverage in Spain. Progress in France

has been more gradual, while in Germany and the UK, only minimal FTTH/B roll-out has occurred. Research conducted by WIK⁵⁰ suggests that existing infrastructure competition from cable, may be partly responsible for the differences in coverage between France (which has limited cable), Spain (moderate coverage) and Portugal (high coverage). However, the choice of incumbents in France, Spain and Portugal to move directly to FTTH/B (in preference to more incremental upgrades via FTTC), may have been influenced inter alia⁵¹ by the role that alternative operators such as Iliad in France, Sonaecom in Portugal and Jazztel in Spain played as disruptive investors in FTTH technology. In contrast, incumbents in Germany and the UK, which did not benefit from large scale alternative FTTH investments, have chosen a more gradual upgrade path.

Figure 4-6: FTTH/B deployment (% HH) IHS/VVA for EC



4.2.2 Infrastructure competition in very high capacity broadband

In addition to having more coverage of FTTH/B overall, the countries with effective duct and pole access have achieved a greater degree of infrastructure competition in FTTH/B than those countries studied (the UK and Germany) in which infrastructure access is limited.

Data from the 2016 market analysis conducted by ANACOM suggests that 70% of households live in an area where there is significant coverage (>50%) of at least one alternative NGA infrastructure, and 46% of households are in areas where there are at

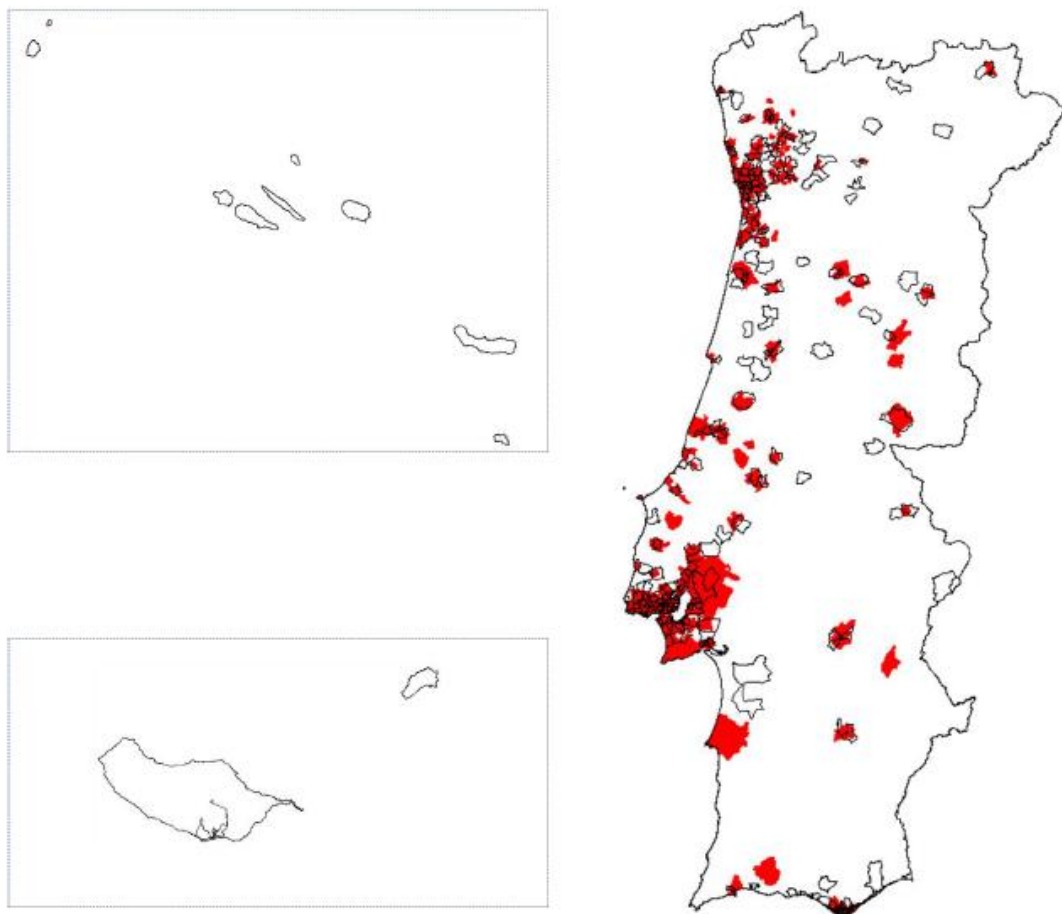
⁵⁰ See for example 2016 Regulatory in particular Access regimes for network investment in Europe http://bookshop.europa.eu/en/regulatory-in-particular-access-regimes-for-network-investment-models-in-europe-pbKK0216677/downloads/KK-02-16-677-EN-N/KK0216677ENN_002.pdf?FileName=KK0216677ENN_002.pdf&SKU=KK0216677ENN_PDF&CatalogueNumber=KK-02-16-677-EN-N

⁵¹ Other factors are also likely to have played a role – for example long subloops may reduce speed increases possible with FTTC/VDSL, and therefore make FTTH/B solutions relatively more attractive

least 2 alternative operators in addition to the incumbent with an NGA coverage of 50%. The areas with infrastructure competition are illustrated in the figure below. It is understood that a significant part of this infrastructure competition (including cable competition) is reliant on the system of duct and pole access.

Figure 4-7: Areas with alternative operators in Portugal

Figura 10. Áreas de central com operadores coinstalados (contorno a negro) e freguesias onde existem pelo menos dois operadores alternativos à MEO com cobertura superior a 50 por cento (áreas a cor)



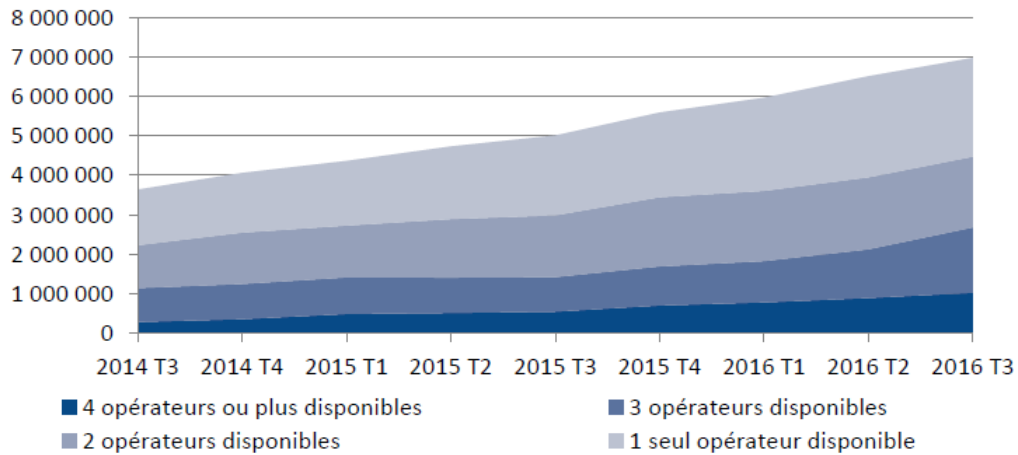
Source: ANACOM (2016) Market analysis markets 3a and 3b, p. 129⁵²

Data from the French NRA ARCEP (see figure below) also shows how, out of total of 6.95m fibre lines, 64% are served by at least two operators through the passive mutualisation regime, while over 40% have a choice of three or more operators. Many of the competitive served households are likely to be in very dense areas (~17%

⁵² http://www.anacom.pt/streaming/decisao30062016merc3a3b.pdf?contentId=1389742&field=ATTACHED_FILE

households), where duct access (or alternatives) is needed to deploy fibre to the base of the building. Duct and pole access are also likely to have been used in less dense areas to reach the terminating segment, or in some cases by alternative operators to act as first movers in the deployment of FTTH.

Figure 4-8: Households served by FTTH: number of operators present via the mutualisation scheme



Opérateur disponibles = available operator

Differences in the metrics used make direct comparisons between countries challenging, but CNMC concluded in its 2015 market analysis of market 3a,⁵³ that 66 municipalities covering 35% households benefited from three or more NGA networks in which each operator had at least 20% coverage.

⁵³ RESOLUCIÓN POR LA CUAL SE APRUEBA LA DEFINICIÓN Y ANÁLISIS DEL MERCADO DE ACCESO LOCAL AL POR MAYOR FACILITADO EN UNA UBICACIÓN FIJA Y LOS MERCADOS DE ACCESO DE BANDA ANCHA AL POR MAYOR, LA DESIGNACIÓN DE OPERADORES CON PODER SIGNIFICATIVO DE MERCADO Y LA IMPOSICIÓN DE OBLIGACIONES ESPECÍFICAS, Y SE ACUERDA SU NOTIFICACION A LA COMISIÓN EUROPEA Y AL ORGANISMO DE REGULADORES EUROPEOS DE COMUNICACIONES ELECTRÓNICAS (ORECE). (ANME/DTSA/2154/14/MERCADOS 3a 3b 4)

5 Conclusions

1. The European Commission has recognized the importance of physical infrastructure access (duct and pole access) in its proposed European Electronic Communications Code.
2. Experience with infrastructure access in countries such as France, Portugal and Spain has shown that it can be valuable in enabling infrastructure-based competition in FTTH/B in dense areas and (especially as regards pole access) the deployment of FTTH/B networks in rural areas
3. Regulatory controls in the countries which have effective duct access include robust mechanisms to guard against discrimination, including Equivalence of Input and/or SLAs, service level guarantees and associated published KPIs.
4. Price regulation for infrastructure access is typically based on cost-orientation. However, the methodologies differ. Not all countries studied exclude fully depreciated assets from the cost-base. Duct asset lifetimes are typically set at 40 years, but have been extended to 50 years in France.
5. In the countries where duct access is commonly used, there are few restrictions on its use. Usage is permitted for leased lines, fixed and mobile backhaul, in contrast with more restrictive conditions in the UK and Germany.
6. The relative success of infrastructure access in these three countries has been supported by specific measures to operationalize SMP duct access. Innovations in operational conditions in these countries include:
 - Accreditation for engineers accessing physical infrastructure
 - Availability of online systems containing up-to-date information on duct location and availability, with measures to ensure accuracy of such data
 - Removal of requirements for feasibility analysis
 - Measures to give access seekers more autonomy in accessing installed cables (e.g. notifying after access)
 - Mechanisms to allow access seekers to recover or defray the costs associated with improvements to the incumbent infrastructure
7. There appears to have been less use of SMP pole access to date than SMP duct access. For example, although there is some SMP pole access, the majority of pole access in France is based on commercial agreements with an energy firm which predates the Cost Reduction Directive.
8. The terms for pole access are in general less well defined than those for duct access, and provisioning takes longer. Areas in which conditions can be more restrictive than those for duct access include:

- Lack of real-time automated information on location and/or capacity, therefore requiring manual information provision
 - Mandatory surveys (potentially resulting from the lack of real-time information and rules regarding space allocation)
 - Lack of clear rules concerning space allocation and reservation and responsibility for removing unused cables
 - In some cases, alternative operators pay upfront for augmenting or installing poles
 - Lack of clear service levels and guarantees for repair
9. In-building wiring has received considerable attention in those countries which have sought to promote to infrastructure competition in very high capacity broadband. Symmetric regulation is typically used to address this issue. France, Spain and Portugal all have legislation on this issue which predates the 2014 Cost Reductive Directive and is significantly more detailed or elaborated through subsequent Decisions. Important aspects of this regulation include:
- The availability of information on in-building wiring installations and Reference Offers for such
 - The establishment of a connection point at an accessible and viable location - which may lie outside the building and aggregate households in some cases (less dense areas)
 - The requirement to install multiple fibres in case of demand
 - Guidelines on pricing – the principle of cost-orientation is applied in France and Portugal with ex post intervention by the NRA possible
 - Cost-sharing mechanisms whereby second and third-comers contribute to the in-building wiring costs
10. Those countries which have operationalized duct, pole and in-building wiring access have achieved greater deployment of FTTH/B and infrastructure competition in dense urban areas than those which have not pursued this strategy.
11. There are significant benefits to be gained more widely in Europe if detailed rules and operational processes are put in place concerning in-building wiring, and duct and pole access –where such infrastructure exists.
12. Experience suggests symmetric in-building wiring provisions coupled with duct access from the SMP operator is likely to be most relevant and useful in the deployment of VHC broadband. However, for pole access and in cases where there is limited duct infrastructure from the SMP operator (e.g. due to directly buried cables), symmetric obligations applying to non-telecom infrastructure could play an important role, building on previous successful cases of commercial co-operation.

5.1 Recommendations for national administrations and authorities

1. Operationalization of the physical infrastructure access remedy

NRAs could usefully specify non-discrimination obligations (through use of EoI and/or SLAs/SLGs and KPIs) and operationalize existing SMP duct and pole access by establishing certain requirements in line with best practice through the market review process and/or by reviewing Reference Offers.

NRAs should also consider lifting existing restrictions on the usage of duct access on the basis that it could provide an important impetus for competition across a number of retail markets (including business and mobile services). Where physical infrastructure access results in infrastructure-based competition, this could enable deregulation of downstream wholesale access in some areas.

An indicative list of best practices drawn from a review of the case studies is shown in the table below.

Table 5-1: Best practice SMP duct and pole access regulatory guidelines

Regulatory conditions	Best practice SMP duct and pole access regulation
Portion of network	Consider costs and benefits of applying access obligations to the whole physical infrastructure network. If limited to local access network - apply to 'NGA' access network extending to the optical elements of the access seeker rather than limiting to the legacy copper access network
Restrictions on use	Utilisation of physical infrastructure access for leased lines, fixed and mobile backhaul should be permitted
Price regulation approach	Cost-orientation (LRIC+) using top-down or bottom-up methods can be used. Consider apportioning duct costs to fibre (vs copper) in a manner which reflects low initial take-up. Exclude fully depreciated assets from asset base. Review asset lifetimes to reflect actual investment patterns.
Non-discrimination	Where proportionate, require EoI - same systems. Ensure SLAs, SLGs with detailed KPIs for each element of the SLA

Table 5-2: Best practice operational duct and pole provisions

Operational processes	Best practice operational duct and pole provisions
<p>Automated information systems</p>	<p>Automated centralised system providing up-to-date data concerning the location and availability of spare capacity should be available to the widest extent possible. Standardised data formats should be used for ducts, poles under the SMP and symmetric systems to enable future integration, but integration should not be compulsory to avoid unnecessary delay. Information providers should have responsibility for accuracy of the data. There should be a system to notify errors with requirement to rectify.</p>
<p>Clear rules concerning space reservation</p>	<p>There should be rules to require the incumbent (and potentially access seekers) to ensure that space is available for later entrants – at least in network segments where infrastructure competition is viable. Clearer guidelines are also needed concerning space reservation on poles and to define what constitutes a fully loaded pole.</p>
<p>Maximum autonomy for the access seeker</p>	<p>Engineers working on behalf of the access seeker should be able to conduct surveys, decongestion and augmentation works, install and repair cables unsupervised, providing they receive the necessary accreditation, or commit to following relevant guidelines, and inform the network owner concerning these works. NRAs should consider whether and if so in which circumstances advance notification of works by the access seeker is necessary. In other cases, notification after the event should suffice.</p>
<p>Freeing capacity and associated cost sharing</p>	<p>The owners of unused cables should be liable for the removal of such cables and associated costs. Removal could be conducted by the SMP operator if they have not been removed within a given deadline. In order to address capacity constraints in the final segment (drop cable) for poles, NRAs should establish a regime to allow a single (potentially hybrid) cable to be installed and the associated costs shared. Where there is need to augment or build poles or bypass ducts, access seekers should be entitled to conduct the work themselves or request the access provider to complete such work. The access seeker should not be liable for the full costs of improvements made to the physical infrastructure of the access provider. Reasonably incurred costs should instead be reimbursed and distributed amongst services and users of the network over time.</p>
<p>Service levels</p>	<p>SLAs applying to the incumbent should be kept to a minimum through taking advantage of automation and providing the greatest degree of autonomy for the access seeker. In this context, remaining core SLAs for the access provider might include 1) availability of the information system, deadlines for provision of any additional information and deadlines to correct any inaccurate information; 2) Deadline for approval of instalment/augmentation plans by altnet 3) deadlines for removal of unused cables or decongestion (where</p>

Operational processes	Best practice operational duct and pole provisions
	<p>not conducted by altnet), 4) deadlines for responding to an accompanying request (only where access provider attendance necessary)</p> <p>5) deadlines for repairing broken conduits or poles. Contractual requirements would also be needed for the access seeker, including the need to take due care and provide timely notice and/or reporting of works. Deadlines are also needed for the completion of installation and filing of the final deployment report.</p>
Compensation	<p>Compensation should be due for lack of availability of online information and failure to meet above SLA.</p>

2. Specification of principles and standards for in-building wiring

Member States and/or NRAs could with the involvement of industry groups, usefully expand on the CRD provisions to establish more detailed processes, principles and standards for the deployment of and access to in-building wiring, taking into account practices in France, Spain and Portugal (as well as developing international standards). Specifically, rules should be established concerning:

- Information concerning planned in-building deployments including co-investment/access conditions
- Multi-operator connection points which support accessibility of infrastructure and the potential for infrastructure competition; and
- Standards for in-building wiring including architecture and number of fibres which should be installed.
- Principles for cost sharing amongst operators to provide guidance in case of disputes

5.2 Implications for the EECC

The Commission has rightly recognised the importance of physical infrastructure access in the proposed European Electronic Communications Code, by placing it at the heart of the revamped market analysis process. However, our analysis of the regimes for physical infrastructure access across a number of EU countries suggests that a mere obligation to offer, even when required on non-discriminatory and cost-oriented terms, is not sufficient to make infrastructure access effective.

In order to ensure that the provisions on infrastructure access in the Code result in real deployment, we would recommend integrating into the Code key elements of best practice that have been established in countries with a strong record in infrastructure access.

Specifically, we recommend that article 70 of the Code should be amended to require that physical infrastructure access should be made available subject to conditions of transparency, non-discrimination and cost-orientation, and that a Reference Offer for Physical Infrastructure Access (ducts, poles and associated facilities) should be published which contains at least the minimum list of items included in an Annex, which could replace the existing Access Directive Annex II. Such Reference Offer conditions could be further elaborated following guidance by BEREC.

Minimum List of items to be included in a Reference Offer for Physical Infrastructure Access	
Products to be provided	Access to ducts, cable trays etc., manholes, handholes, cabinets, MDF locations, building entry facilities, mutualization points
Technical guidelines	Technical characteristics of the physical infrastructure elements, minimum number or size of network elements and technical and operational guidelines regarding access to physical infrastructure, installation of cables, decongestion, enhancement or installation of new physical infrastructure connected to the access provider's network, safety and security standards
Information	Details concerning the central information system by which access seekers can access information on the location and availability of physical infrastructure. Where proportionate, this system should be automated. All data should be up-to-date.
	Processes to ensure the accuracy of information and rectify any inaccurate or incomplete information.
Space reservation	Rules concerning the allocation of space, where this is limited including rules concerning the space that should be reserved by the access provider for potential access seekers.
	Conditions for access seekers to inspect locations at which physical infrastructure access has been refused on the grounds of lack of capacity
Conditions enabling unsupervised access to physical infrastructure	Conditions such as accreditation under which engineers working on behalf of the access seeker are permitted to access physical infrastructure unsupervised to conduct a survey, install or repair cables and conduct decongestion, enhancement or bypass works
Process and service levels for the access provider	Processes and associated timescales (SLAs) concerning at least: <ul style="list-style-type: none"> - Availability of the information system and/or provision of any additional information. Processes to ensure accuracy of information - (Where applicable) Approval of the survey plans of the access seeker or competition of a (joint) survey or viability analysis - Acknowledgement and approval of the specific order for infrastructure access (ie the route or area to be covered) - Removal or reorganisation of cables under the responsibility of the access provider - (Where applicable) Deadlines for responding to requests by the access seeker for permission to access the infrastructure - Providing confirmation of final installation plans - Repair of physical infrastructure under the responsibility of the access provider
Process and service levels for the access seeker	Processes and associated timescales (SLAs) concerning at least: <ul style="list-style-type: none"> - Advance or subsequent notification of works to conduct a survey, install or repair cables and conduct decongestion, enhancement or bypass works - Period within which construction must be completed - Submission of the final installation plan
Compensation	Consequences, including where relevant financial compensation, of failing to meet service level requirements (for the access provider) or installation and notification requirements (for the access seeker)
Pricing	Prices or pricing formulae for each facility, feature and function listed above
	Mechanism by which costs incurred by the access seeker for the augmentation or enlargement of the physical infrastructure network are compensated or shared

