CEPT ECC
Electronic Communications Committee

ECC Report 354

Defining and Calculating Availability of Space in Cable Ducts

approved 28 November 2023

0 EXECUTIVE SUMMARY

This Report provides an overview of current practices in CEPT countries regarding the determination of availability of space, calculation methods and other aspects relevant to the shared use of ducts, which can become a reference for other countries in case of similar regulation implementation.

While all respondents answered that access to ducts is regulated in their countries, only half regulate the subduct use for underground cable installation. Furthermore, the number of cables and their diameter in underground cable duct for network planning and construction is not regulated in the majority of the replying countries.

Although the methods used to determine the availability of space in ducts vary between CEPT countries, including formulae, guidelines, case-by-case assessment, and ordinance, they are similar. The requirements for shared use of underground cable ducts also vary between symmetrical, asymmetrical, and a combination of both.

Based on the responses to the questionnaire, the provisions of Directive 2014/61/EU [1] establishing minimum requirements relating to civil works and access to physical infrastructure seem to have been transposed in most of the CEPT countries into national legislation. This and sectoral regulation (EECC) should inter alia enable an efficient deployment of new physical infrastructure and reduce the cost of deploying high-speed electronic communications networks.

A more consistent approach regarding the determination of availability of space, calculation methods and other aspects relevant to the shared use of ducts could be envisaged in the future.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
ANACOM	Autoridade Nacional de Comunicações (Portugal)
ANSI	American National Standards Institute
BMVIT	Austrian Ministry of Transport, Innovation and Technology
BNetzA	Federal Network Agency (Germany)
CEPT	European Conference of Postal and Telecommunications Administrations
CRC	Communications Regulation Commission (Bulgaria)
DSLAM	Digital Subscriber Line Access Multiplexer
ECC	Electronic Communications Committee
ECN	Electronic Communications Network
EIA	Electronic Industries Association
EU	European Union
FOE	Fibra Ótica Escura (Dark optical fibre)
FTTx	Fiber to the x
FTTP	Fiber to the Premises
MAN	Metropolitan Area Networks
MEO	Portugal's incumbent telecoms operator
NGA	Next Generation Access
NGN	Next Generation Network
NRA	National Regulatory Authority
ORAC	Oferta de Referência de Acesso a Condutas (Duct Access Reference Offer)
RO	Reference Offer
SMP	Significant Market Power
TIA	Telecommunications Industries Association
TKG	Telekommunikationsgesetz
WIK	Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste

1 INTRODUCTION

This Report describes possible considerations in case an alternative operator requires access to ducts for cable installation by pulling technique and the ducts owner (or a ducts access provider) claims that there is no space available in ducts.

In this case, it is possible to use a mathematical formula to calculate the amount of free space available in a duct (e.g. based on the diameter of cables, on the diameter of ducts).

Another matter is the definition by the competent authorities of additional duct capacity during the construction work for the accommodation of cables. Both matters are described in this Report with the aim to further develop a set of recommendations.

This Report was based on a questionnaire addressed to CEPT countries. More recently, during the editing of this Report, several countries updated their responses.

2 DEFINITIONS

Term	Definition
Duct	An underground pipe or conduit used to house (fibre, copper or coax) cables of either core or access networks (Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU) [2].
Subduct	A constructive auxiliary element inserted into the duct and in which one or more cables are inserted by means of cable pulling, blowing or other methods.
Availability of space	The criteria[1], which define the free capacity in a duct/subduct for the installation of cabling for the provision of electronic communications.
Additional capacity	Additional space of duct/subduct reserved during planning and construction or operation of ducts/subducts for other wholesale or retail electronic communications service providers' cable installation.
Cable installation technologies	A cable installation technique that ensures cable positioning in the cable duct such as pulling, blowing.
Blowing	Cable installation into a pre-installed duct by using high speed air flow combined with additional mechanical pushing force.
Pulling	Cable installation into a pre-installed duct by manual pulling or by using a puller machine with the help of a pre-installed rope inside the duct.

[1] The criteria can be the diameter of cable which is possible to install in duct/subduct or free space of duct/subduct for installation of cable or maximum filling factor of duct/subduct for the cross section of duct/subduct between of 20% and 40% for installation of cable.

3 THE OBJECTIVES OF THIS REPORT

The objective of this Report is to summarise current practices by CEPT countries when defining and calculating the availability of free space in ducts which are used for cable installation by pulling technology and to promote a more consistent and harmonised approach in the future. To this end this Report provides:

- a summary of general application of ducts, general information on planning, construction and shared use of ducts in CEPT countries;
- a summary of the current situation of calculation of availability of space in the ducts for pulling installation technologies regulation in CEPT countries;
- a summary of the current situation on the additional duct capacity for pulling installation technologies during the construction work and further duct maintenance in CEPT countries;
- conclusions and recommendations for defining and calculating availability of space in the ducts for pulling installation technology in CEPT countries.

4 A SUMMARY OF GENERAL APPLICATION OF DUCTS, GENERAL INFORMATION ON PLANNING, CONSTRUCTION AND SHARED USE OF DUCTS IN CEPT COUNTRIES

This section is based on a summary of the responses to a questionnaire of CEPT administrations on the provision of comparable information on Defining and Calculation Free Space in Cable Ducts. Responses from 18 CEPT administrations were received. Several administrations provided updates to their responses, which are also reflected in this section.

4.1 GENERAL QUESTIONS ABOUT DUCTS

4.1.1 Use of ducts

All 18 respondents answered that underground cable duct infrastructure is used in their countries.

4.1.2 Cross-sectional forms of ducts

In CEPT countries, the typically used duct cross-sectional form is round (17 respondents, 94% of respondents) (see Figure 1). The ducts with other cross-section forms (e.g. polygon and rectangle) are also used. Such case was described by Germany, where round cross-section ducts and polygon cross-section ducts are used. In Malta and Romania, rectangle cross-section ducts are used. In Switzerland, rectangle and polygon cross-section ducts are used. In Spain, round and other cross-sectional duct forms are used.

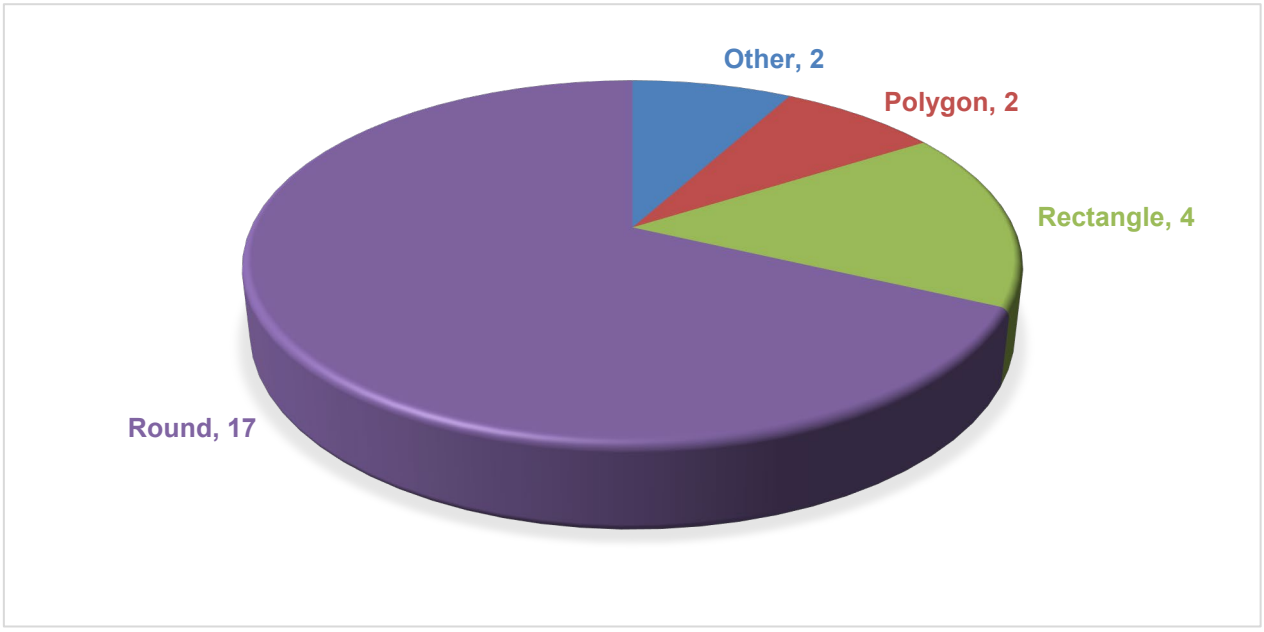


Figure 1: Responses to Question 2
"Which underground cable duct cross-section forms are typically used in your country?"

4.1.3 Cable installation technologies in ducts

17 from 18 respondents (94% of respondents) answered that pulling and blowing cable installation technologies are used in their countries (see Figure 2). In Bulgaria, the pulling technology is the only technology used for cable installation.

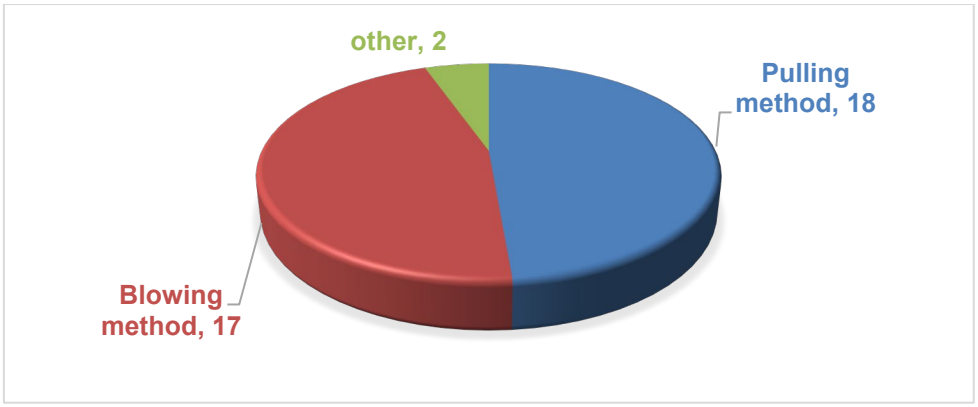


Figure 2: Responses to Question 4 "Which underground cable installation technologies are used in your country?"

4.1.4 Use of subducts

Most respondents answered that subducts, including micro ducts and micro duct bundles, are used for cable installation in their countries (see Figure 3 and Figure 4).

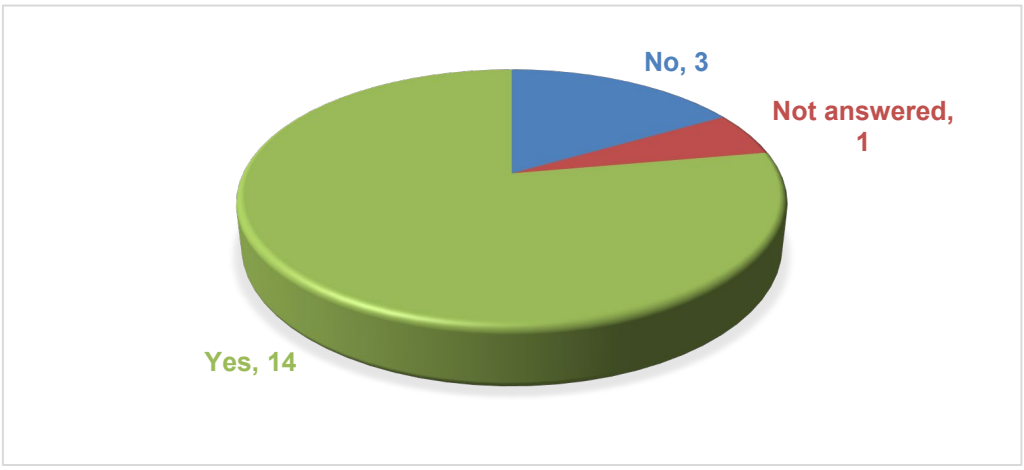


Figure 3: Responses to Question 5 "Are subducts used for underground cable installation?"

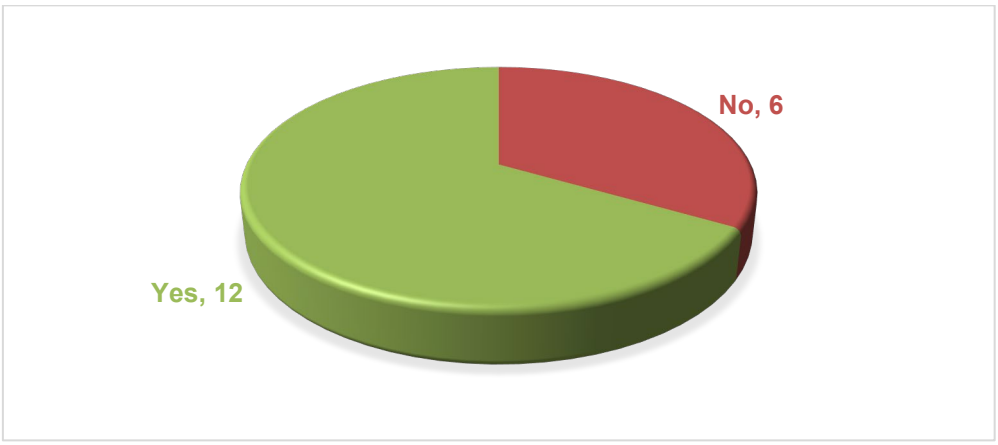


Figure 4: Responses to Question 7 "Are micro duct bundles (microcassettes) and micro ducts used for blowing technology in your country for underground cable ducts?"

4.2 NETWORK PLANNING AND CONSTRUCTION OF DUCTS

4.2.1 Regulation of access to ducts

All 18 respondents answered that access to ducts is regulated in their countries.

4.2.2 Regulation of use for access to subducts

9 from 18 respondents (50% of respondents) answered that subduct use for underground cable installation is regulated in their countries (see Figure 5). 7 from 18 respondents (39% of respondents) answered that subduct use for underground cable installation is not regulated in their countries.

Figure 5: Responses to Question 11 "Is subduct use for underground cable installation regulated?"

4.2.3 Regulation of number of cables and their diameters in duct

14 from 18 respondents (78% of respondents) answered that the number of cables and their diameter in underground cable duct for network planning and construction is not regulated in their countries (see Figure 6). 4 from 18 respondents (22% of respondents) answered that the number of cables and their diameter in underground cable duct for network planning and construction is regulated in their countries.

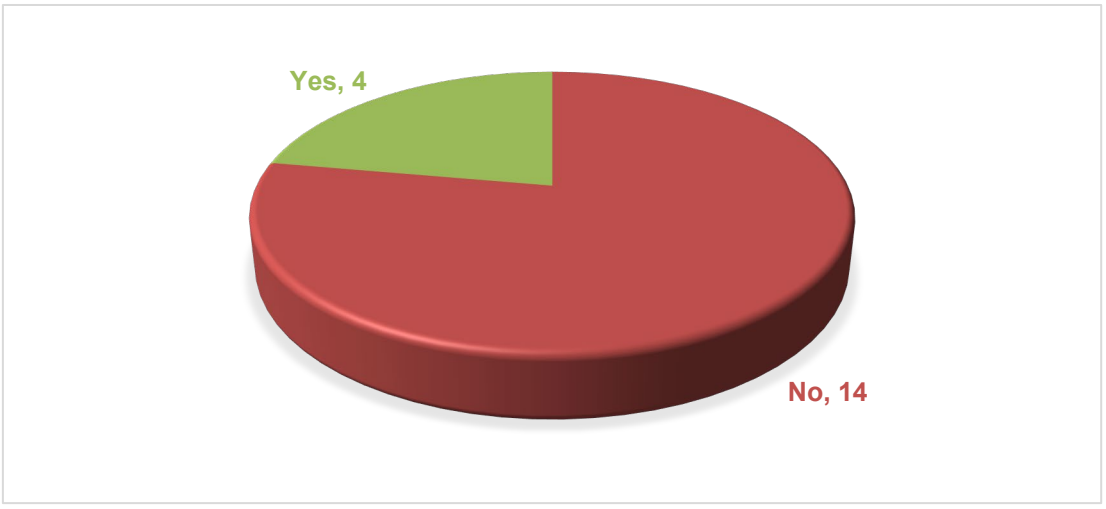


Figure 6: Responses to Question 12 "Is the number of cables and their diameters in underground cable duct for network planning and construction regulated?"

4.3 SHARED USE OF DUCTS

4.3.1 Transposition of Directive 2014/61/EU

15 from 18 respondents (83% of respondents) answered that the provisions of Directive 2014/61/EU [1] for sharing of suitable infrastructure are transposed in full into national legislation (see Figure 7). 3 from 18 respondents (17% of respondents) answered that the provisions of Directive 2014/61/EU for sharing of suitable infrastructure are not transposed into national legislation.

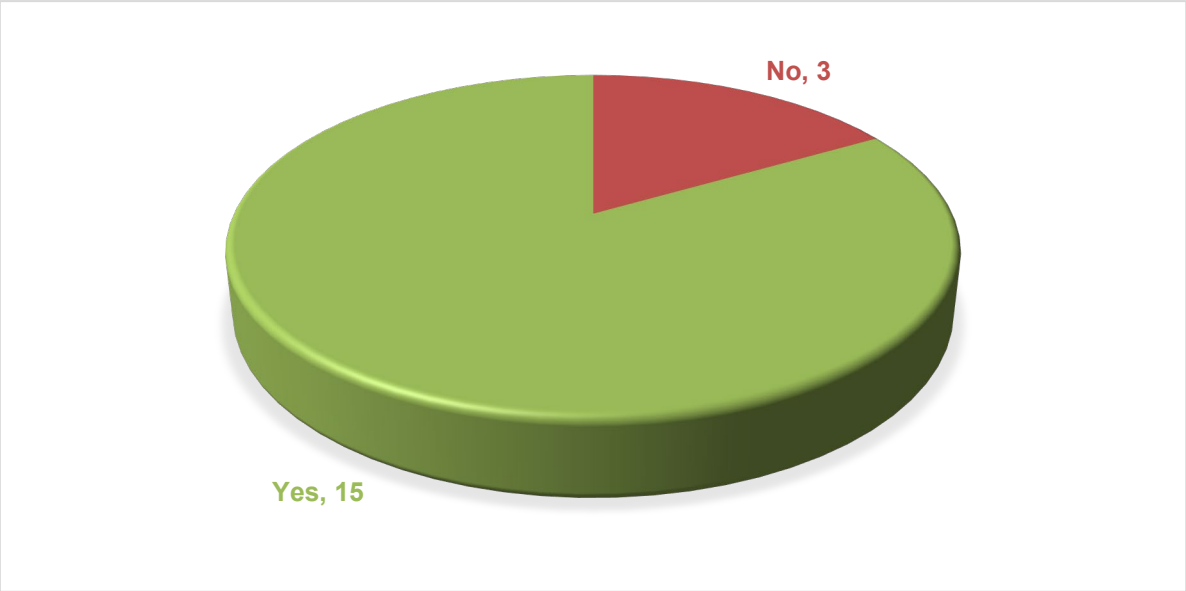


Figure 7: Responses to Question 13 "Are the provisions of Directive 2014/61EU for sharing of suitable infrastructure transposed in full into national legislation?"

4.3.2 Symmetrical and asymmetrical requirements for shared use of ducts

Only symmetrical requirements for shared use of ducts are in Austria, Czech Republic, Malta and Romania. Only asymmetrical requirements for shared use of ducts are in Bulgaria, Switzerland and Croatia. Both, symmetrical and asymmetrical, requirements for shared use of ducts are in Lithuania, Portugal, Latvia, Finland, Germany, Montenegro, Greece, Spain and Slovenia (see Figure 8).

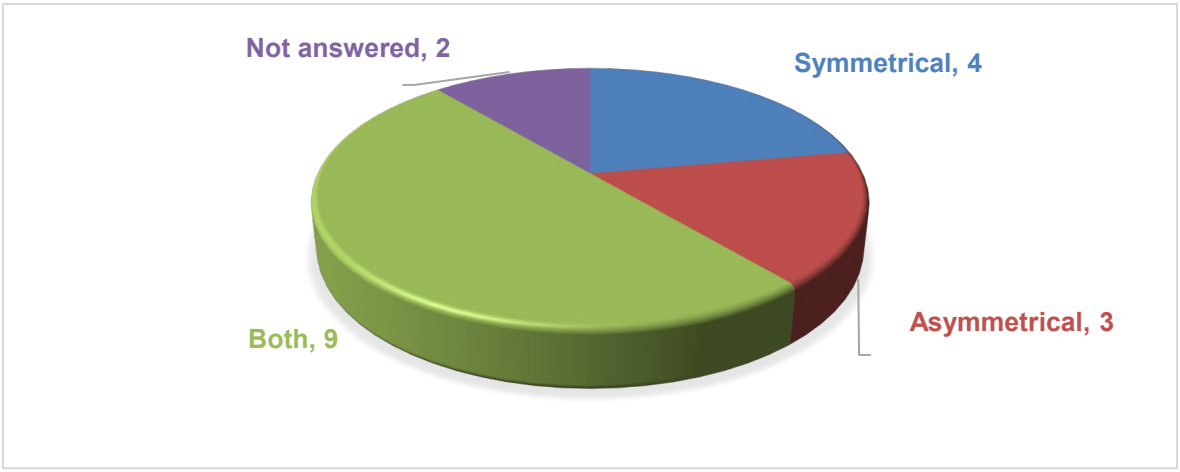


Figure 8: Responses to Question 14
"Are underground cable duct shared use requirements symmetrical or asymmetrical?"

4.3.3 Competitive authority for regulation of shared use of ducts

Shared use of ducts is regulated by the National Regulatory Authority (NRA) in Lithuania, Portugal, Austria, Germany, Bulgaria, Czech Republic, Romania, Greece and Luxembourg. Shared use of ducts is regulated by NRA and Relevant Ministry in Russian Federation, Latvia, Croatia and Spain. Shared use of ducts is regulated by NRA and National Law in Finland, Montenegro, Switzerland and Slovenia. Shared use of ducts is not regulated in Malta (see Figure 9).

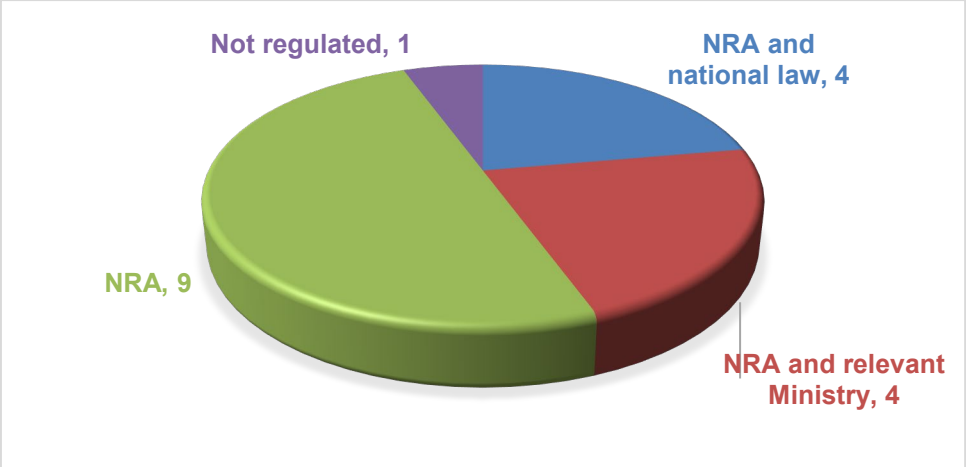


Figure 9: Responses to Question 16 "Which authority regulates the shared use of underground cable duct?"

4.3.4 The determination of availability of space in ducts

Availability of space in ducts (as shown in Figure 10) is determined:

- by formula and guidelines in Lithuania, Latvia, Montenegro, Portugal and Switzerland,
- by formula – in Bulgaria,
- by guidelines – in Russian Federation,
- by case-by-case bases – in Malta, Austria, Germany, Czech Republic, Romania, Finland, Greece and Spain,
- by Ordinance on Manner and Conditions for Access and Shared Use of Electronic Communications Infrastructure and Associated Facilities – in Croatia .

Figure 10: Responses to Question 17 "How is space availability in the underground cable ducts determined? Please specify"

5 A SUMMARY OF THE CURRENT SITUATION OF CALCULATION OF AVAILABILITY OF SPACE IN DUCTS FOR PULLING INSTALLATION TECHNOLOGIES REGULATION IN CEPT COUNTRIES

This section is based on a summary of the responses to a questionnaire of CEPT administrations on the provision of comparable information on Defining and Calculation Free Space in Cable Ducts which was circulated from June until October 2018. Responses from 18 CEPT administrations were received.

5.1 APPROACH OF CALCULATING AVAILABILITY OF SPACE IN LITHUANIA, LATVIA AND MONTENEGRO

The criteria for assessing the availability of space in telecom ducts for the accommodation of electronic communications networks cables, is achieved by calculating the free space and occupied space in each duct segment. The calculation takes into account the length of duct, the shape memory effect of cables caused by the way in which they have been stored and transported. Therefore, it considers that there will be some places where it is physically impossible to occupy the space. It is therefore essential to establish a clear means of measuring the capacity of the duct pipes to accommodate cables. According to the Latvian construction standard LBN 262-15 on “Electronic communications networks” [9], the following formula is used:

$$D = K\sqrt{d_1^2 + d_2^2 + \cdots + d_n^2 + d_p^2},$$

Where:

- *D*: the internal diameter of the duct pipe, which is required to install a cable with diameter d_p, if it already has n cables of diameters from d_1 to d_n;
- *K*: is the factor chosen in accordance with the conditions set out in Table 1.

By mathematically transforming this formula, one obtains a formula by which the availability of space d_p cable duct is calculated:

$$d_p = \sqrt{\frac{D^2}{K^2} - d_1^2 - d_2^2 - \cdots - d_n^2 - d_p^2},$$

Notes:

- all diameters in formulas are in millimetres with an accuracy of one decimal place; n is a natural number;
- the results of the calculations are not applicable as criteria for the installation of a cable at the cable duct with bends.

Table 1: Values for factor K
(Source: Latvian construction standard LBN 262-15 on "Electronic communications networks" [9])

Length of cable ducts in which the cable is intended to be installed (L)	The planned number of cables in the cable duct	Coefficient (K)			
		If the internal diameter of the duct pipe is < 41 mm	If the internal diameter of the duct pipe is 41 mm to 53 mm	If the internal diameter of the duct pipe is 54 mm to 60 mm	If the internal diameter of the duct pipe is > 60 mm
L≤50 m	1 or 2	1.5	1.45	1.45	1.45
	3 or more	1.5	1.4	1.3	1.25
50 m <L≤150 m	1 or 2	1.65	1.55	1.55	1.45
	3 or more	1.65	1.55	1.45	1.35
150 m <L≤300 m	Regardless of the number of cables	1.8	1.75	1.7	1.65

5.2 APPROACH OF CALCULATING AVAILABILITY OF SPACE IN PORTUGAL

The criteria for assessing the availability of space in Altice/MEO ducts (i.e. the former PT Comunicações, S.A. - operator identified with Significant Market Power (SMP) in the former wholesale M3a/2014, now M1/2020 performed by the Portuguese NRA – ANACOM), is achieved by calculating the free space and occupied space in each duct segment. The calculation takes into account the length of duct, the shape memory effect of cables caused by the way in which they have been stored and transported. Therefore, it considers that there will be some places where it is physically impossible to occupy the space. It is therefore essential to establish a clear means of measuring the capacity of the duct pipes to accommodate cables. More information can be found in ORAC (Reference Offer to access Ducts)[2].

Where:

- d_1, d_2, …., d_n: represent the various nominal external diameters in millimetres of the n cables installed in the pipe in the duct;
- D Pipe: Represents the nominal internal diameter of the pipe needed for the coexistence of the n cables under technically acceptable conditions, in accordance with the following formula:

$$D\,Pipe = 1.6 \times \sqrt{d1^2 + d2^2 + ... + dn^2}$$ [3]

  - Taking into account the calculation of the pipe diameter required for the accommodation of a set of cables, one is able to identify:
  - The term free space means the difference between the total space in the duct/subduct and the occupied space in the duct/subduct;
  - $Total\ space = \pi r^2$, where r = Diameter of the duct/subduct/2;
  - Occupied space in the $\text{duct/subduct} = \pi(DPipe/2)^2$.

After calculating the diameter of the pipe necessary to accommodate a set of cables, one can then identify:

- Occupied space in the duct pipe: This is the section corresponding to D Pipe, calculated in accordance with the cables already installed in a duct pipe;

[2] https://ptwholesale.pt/en/servicos-nacionais/infraestruturas/Pages/orac.aspx

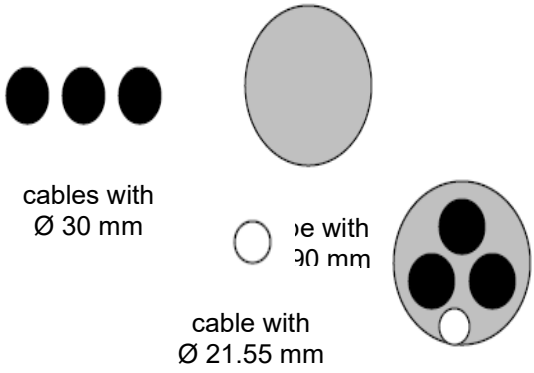
[3] determination of May 26, 2006 - https://anacom.pt/render.jsp?contentId=370426

- Percentage of occupied space in the duct pipe: This corresponds to the ratio between the occupied space in the duct pipe and the internal section of the pipe where the cables are installed;
- Free space in the duct pipe: This corresponds to the difference between the internal section of the pipe where the cables are installed and the section corresponding to D Pipe;
- Occupied space in the duct: This is the sum of the occupied space in all the pipes contained in the duct;
- Percentage of occupied space in the duct: This corresponds to the ratio between the total amount of occupied space in the pipes contained in the duct and the total of the internal sections of the pipes contained in the duct;
- Free space in the duct: This corresponds to the difference between the total of the internal sections of the pipes contained in the duct and the total amount of occupied space in the pipes contained in the duct;
- Space available for occupancy in the duct: This is the free space in the duct, less the space necessary for maintenance work and the space required for future development of MEO's networks. The space in the duct intended for cable maintenance and repair corresponds to the free space available in each section of duct;
- The term free space means the difference between the total space in the duct/subduct and the occupied space in the duct/subduct.

Example of the calculation of space:

Data:

- Pipe with internal diameter of 90 mm;
- 3 cables with diameter of 30 mm.



Information calculated:

- D Pipe = 83.14 mm;
- Occupied space in the pipe = 5428.67 mm²;
- Percentage of occupied space in the pipe = 85.3%;
- Free space = 933.05 mm²;
- Maximum diameter of the cable which can be laid in the pipe = 21.55 mm.

5.3 APPROACH OF CALCULATING AVAILABILITY OF SPACE IN BULGARIA

In developing the formula for calculating the occupied space Communications Regulation Commission (CRC)[4] (NRA of Bulgaria) has used the good practice of NRA of France, Portugal and Spain. The formula is based on the application of the American National Standards Institute (ANSI) standard Telecommunications Industries Association (TIA)/Electronic Industries Association (EIA) 569-A "Commercial Building Standard for Telecommunication Pathways and Spaces". In the standard, a maximum filling factor of between 20% and 40% is recommended for the cross section of each duct of the passive infrastructure. The capacity should be determined by dividing the cross-section of all cables in a given subducts by the percentage of fill, with a chosen maximum value of 40%. The same approach applies when determining occupied space by a single cable or subducts in a given duct from the passive infrastructure. CRC has reflected the recommendations of the standard in the formula for calculating the fill of the cable duct by choosing a maximum fill factor of 40%.

$$S = \{(D_{mp./k.} * 1{,}6)/2\}^2 * \pi$$

Where:

- S: is the cross-section of subducts or cable laid in a duct;
- $D_{mp./k.}$: diameter of the subduct/duct;
- $1{,}6$: coefficient determining the placement of subducts/ducts in the passive infrastructure under technically acceptable conditions;
- π: $3{,}14$.

[4] http://crc.bg/files/_bg/M4_5_BG_Final_nonconfidential.pdf (analyses year 2011of market 4 and 5 – available only in Bulgarian):

6 A SUMMARY OF THE CURRENT SITUATION FOR THE ADDITIONAL CAPACITY FOR PULLING INSTALLATION TECHNOLOGIES DURING THE CONSTRUCTION AND MAINTENANCE OR OPERATION WORK IN CEPT COUNTRIES

This section is based on a summary of the responses to a questionnaire of CEPT administrations on the provision of comparable information on Defining and Calculation Free Space in Cable Ducts which was circulated from June until October 2018. Responses from 17 CEPT administrations were received (exception in section 6.15).

6.1 PORTUGAL

Regarding cable diameters, in the context of ORAC, it is foreseen a cable catalogue (containing the characteristics of cables that can be used inside MEO's ducts) which the alternative operators must comply.

By ANACOM decision of 17 July 2004 which fixed the minimum elements of ORAC, it was determined that MEO should leave, to be used by the other Electronic Communications Network (ECN), in each duct pathway, an area corresponding to at least 20% of the internal area of each duct (or of each subduct in cases where ducts accommodate subducts). However, this rule was removed since ORAC9 and is no longer foreseen in the current version of ORAC (v12).

If an alternative operator has no space in a certain MEO's duct segment for installing its network (cables), there is the possibility for the alternative operator to rent dark fibre to MEO in such duct segment (if available) – accordingly with the service Dark optical fibre (FOE)-ORAC.

6.2 AUSTRIA

The involved parties are stating their opinions and requirements regarding occupied, reserved and free capacity. In case of disagreements, the factual situation is surveyed by the NRA.

In the case of state-aided infrastructures, sufficient third-party capacity is required by the special directives of the Austrian Ministry of Transport, Innovation and Technology (BMVIT).

6.3 LATVIA

The NRA regulates the number of cables and their diameters in underground cable duct for network planning and construction only for additional capacity. An additional capacity is intended for sharing of ducts with other electronic communications merchants. The NRA regulates the number of cables and their diameters in underground cable duct, in case of network planning and construction or reconstruction, for additional duct capacity only. If the electronic communications merchant is constructing or reconstructing cable ducts or a lead-in cable ducts it is obligatory to ensure additional capacity of the cable ducts for installation of cable networks of next generation access according to the procedures stipulated by the Regulator in cases when construction of back-up infrastructure is physically impossible or economically inefficient (in places where after performance of installation, construction or reconstructing works it is necessary to restore the covering of road carriageway or sidewalk, in places asphalting of which is planned in the subsequent two years, or in places in which the protection zone along the cable ducts for laying of one's own cable will make the creation of a parallel protection zone impossible for the electronic communications merchant, etc.). The electronic communications merchant, providing the additional duct capacity for other electronic communications merchants, shall comply with the following technical requirements and conditions.

In case of construction and reconstruction works for cable ducts meant for pulling method, the electronic communications merchant shall provide:

- an additional cable duct capacity for installation of at least two cables with a diameter of 17mm (except lead-in cable ducts);
- an additional cable duct capacity for lead-in cable ducts for installation of at least two cables with a diameter of nine mm;

The electronic communications merchant can use the supplied and unused extra channel duct space if two years and six months have passed after cable ducts are put into operation.

An electronic communications merchant that provides cable ducts shall publish the following information on its website about the additional capacity provided:

- applied cable installation technique;
- cable ducts section, in which additional capacity is provided along the entire length, identification numbers of both end points, address and location descriptions or X and Y coordinates of the end points;
- the merchant updates this information in case of changes, but not less than once a year, indicating the date of publication;
- within ten working days after the publication of this information on its website, the merchant submits to the NRA the exact location of the published information, as well as information about the changes made to it.

6.4 FINLAND

According to the Joint Construction Act 276/2016 [2], if there is space available, it has to accept the request of share use unless there is not legislative grounds to decline request. E.g. if it is reserved for own use.

6.5 GERMANY

The regulation depends on the kind of infrastructure to be accessed. Underground cable ducts that link the main distribution frames of incumbent Telekom Deutschland GmbH with the street cabinets are subject to SMP-related access regulation. In these cases, Telekom Deutschland has to offer access to a quarter of a duct, which is separated into quarters by a duct-divider (“Rohrteiler”). Deutsche Telekom is entitled to withhold a quarter of a duct as a reserve for maintenance and fault repair purposes. In case it claims that there is no space available, the party requesting access can initiate a process at the Bundesnetzagentur (BNetzA) in which the lack of space is checked. Deutsche Telekom is also entitled to terminate a lease of duct space if she has a need of her own for using that space but must provide access to dark fibre as an alternative to allow the access seeker to connect its Digital Subscriber Line Access Multiplexer (DSLAM) at the street cabinet to its network.

In all other cases that are addressed by the rules that transpose the Cost Reduction (77a ff TKG), conditions concerning use of space are decided by parties themselves. BNetzA gets only involved in cases of dispute resolution. The law itself only stipulates that access can be denied if there is either no space currently available or that the entity approached will need this capacity within five years for its own use, which has to be supported by sufficiently specific investment planning. BNetzA’s rulings had so far not to address this issue.

6.6 CZECH REPUBLIC

Availability of space is regulated by the transposition of Directive 2014/61/EU [1] in Act no. 194/2017 on measures to reduce costs for deployment on Next Generation Network (NGN) networks [5].

Additional space in underground cable ducts for other operators is ensured by additional ducts.

6.7 MONTENEGRO

There is the Rulebook on Shared Use of Electronic Communications Infrastructure and Associated Facilities [4] which prescribe the obligation for operators to increase the space availability in their underground cable ducts. In that aim operators are obliged to undertake different activities that are prescribed within the article 14 of the noted Rulebook which relates to increasing the availability of free capacities of electronic communication infrastructure.

Additional space in underground cable ducts for other operators is ensured by larger size of the duct and additional ducts.

6.8 SWITZERLAND

The operator has to give access to the cable ducts in a transparent and non-discriminatory manner, which applies also for evaluation whether additional space is available.

Additional space is not ensured, since the respective article 11 of the Telecommunications Act [6] says that access is only granted in case of sufficient capacity.

6.9 GREECE

Metropolitan Area Networks (MANs) are being deployed in Greece, leaving one remaining cable duct free for future connectivity.

Additional space in underground cable ducts for other operators can be ensured (not obligatory) through additional ducts.

Greece has developed a Digital Registry System for broadband networks monitoring across the country.

6.10 ROMANIA

Additional space in underground cable ducts for other operators is ensured by larger size of the duct and additional ducts.

6.11 CROATIA

The infrastructure operator must allow to the beneficiary operator, for a fee and on the basis of a concluded contract, access to and shared use of its electronic communications infrastructure and associated facilities provided that the relevant conditions for access and shared use laid down in the Ordinance on Manner and Conditions for Access and Shared Use of Electronic Communications Infrastructure and Associated Facilities [7].

Additional space in underground cable ducts for other operators is ensured by larger size of the duct and additional ducts.

6.12 LUXEMBOURG

Additional space in underground cable ducts for other operators is ensured by additional ducts.

6.13 SPAIN

The number of cables and their diameters in underground cable ducts and cable duct size are regulated for shared use in the case of the wholesale access obligations under the market offer (Telefónica).

6.14 SLOVENIA

Access to ducts in Slovenia is regulated as a part of Relevant Market 1: Wholesale local access provided at a fixed location by concerns of the significant market power regulation (SMP regulation) and additionally by the symmetric regulation defined in the Electronic Communications Act.

Firstly, in the case of SMP regulation, the formula for defining and calculating availability of space in cable ducts is part of the reference offer that the designated operator (now: incumbent operator Telekom Slovenje d.d.) with the significant market power on the Market 1 is required to publish as a part of the access obligation.

The maximum occupancy limit for a single cable duct is given by the following equation:

$$D_{pipe}=K*\sqrt{d_1^2 + d_2^2 + \ ... \ + d_n^2}$$

Where:

- D_{pipe} - the internal diameter of the pipe (in mm) required for the insertion of the cables;
- $d_{1,2..n}$ - diameters (in mm) of existing cables, technical reserve, development reserve, reservation, and cables to be foreseen for additional insertion by the operator;
- K - a factor, the value of which shall be chosen from Table 2:

Table 2: Options for K factor

Length of hose between shafts	Number of cables in Pipe	Coefficient K	Coefficient K
		Pipe inner diameter < 50 mm	Inner diameter of pipe > 50 mm
L<50 m	up to 3	1.65	1.60
	4 and more	1.70	1.65
L>50 m	up to 3	1.75	1.70
	4 and more	1.80	1.75

Any refusal of shared use must be based on objective and transparent criteria, such as the availability of space, including the network operator's future needs for space which must be adequately demonstrated (e.g. confirmed investment plan). The SMP operator must provide all relevant documentation, including planned future needs for space, upon request by the access seeker.

Second, in the case of symmetric regulation, the formula is recommended to be published by the infrastructure operator.

Any refusal of shared use must be based on objective, transparent, and proportionate criteria, such as the technical suitability or availability of space, including the network operator's future needs for space that are sufficiently demonstrated.

In the case of technical unsuitability due to specific infrastructure circumstances there are the specific circumstances defining the conditions for technical suitability in relation to the infrastructure to which access is requested may be limitations and constraints of a mechanical, physical or legal nature, such as physical constraints, static loads, electromagnetic compatibility, physical loads, power supply limitations, and the like.

The technical characteristics of the infrastructure elements referred to in the previous paragraph shall be laid down in national or international standards, technical regulations and specifications and in previously published internal acts of the infrastructure operator. The technical characteristics which do not conflict with such standards, technical regulations and specifications and which are specific to the network elements to which access is requested and which are in force at the time of the request for access.

6.15 UNITED KINGDOM, FRANCE AND SPAIN

This information derives from the Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste (WIK) Consult Report “Best practice for passive infrastructure access” [8].

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.

In France, Orange has established in its Reference Offer (RO)[5] 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 Fiber to the Premises (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 3: Principle of non-saturation in Orange reference offer

		Very dense zones		Less dense zones	
		Ducts	Poles	Ducts	Poles
FTTx	Mutualised cables	1 + 0	1 + 0	1 + 0	1 + 0
	Non-mutualised cables	1 + 1	1 + 1	1 + 1	1 + 1

In contrast, Reference Offers in Spain and the United Kingdom 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.

[5] https://www.orange.com/sites/orangecom/files/documents/2022-01/Offre_unique_iBLO_31janvier2022.pdf

7 CONCLUSIONS AND RECOMMENDATIONS

This Report provides an overview of current practices in CEPT countries regarding the determination of availability of space, calculation methods and other aspects relevant to the shared use of ducts, which can become a reference for other countries in case of similar regulation implementation.

While all respondents answered that access to ducts is regulated in their countries, only half regulate the subduct use for underground cable installation. Furthermore, the number of cables and their diameter in underground cable duct for network planning and construction is not regulated in the majority of the replying countries.

Although the methods used to determine the availability of space in ducts vary between CEPT countries, including formulae, guidelines, case-by-case assessment, and ordinance, they are similar. The requirements for shared use of underground cable ducts also vary between symmetrical, asymmetrical, and a combination of both.

Based on the responses to the questionnaire, the provisions of Directive 2014/61/EU [1] establishing minimum requirements relating to civil works and access to physical infrastructure seem to have been transposed in most of the CEPT countries into national legislation. This and sectoral regulation (EECC) should inter alia enable an efficient deployment of new physical infrastructure and reduce the cost of deploying high-speed electronic communications networks.

A more consistent approach regarding the determination of availability of space, calculation methods and other aspects relevant to the shared use of ducts could be envisaged in the future.

ANNEX 1: LIST OF REFERENCES

[1] DIRECTIVE 2014/61/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications network. Available here.

[2] Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA)

[3] Finnish Act on the Joint Construction and Use of Network Infrastructure (276/2016)

[4] Montenegro Rulebook on Shared Use of Electronic Communications Infrastructure and Associated Facilities. Available here.

[5] Czech Telecommunication office: Act No. 194/2017 Coll., on Measures to Reduce the Costs of Deploying High-Speed Electronic Communications Networks and on the Amendment to Some Other Acts. Available here.

[6] Swiss Confederation: "784.10 Telecommunications Act of 30 April 1997 (TCA)". Available here.

[7] Croatian Post and Electronic Communications Agency – Ordinance on Manner and Conditions for Access and Shared Use of Electronic Communications Infrastructure and Associated Facilities. Available here.

[8] WIK-Consult Report: "Best practice for passive infrastructure access", April 2017. Available here.

[9] Latvian construction standard LBN 262-15: "Electronic communications networks". Available here.