

BEREC Guidelines on Common Approaches to the Identification of the Network Termination Point in different Network Topologies

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1 Introduction

1. These BEREC Guidelines, designed in accordance with Article 61(7) of the European Electronic Communications Code (EECC),¹ are intended to provide guidance to NRAs on common approaches to the identification of the network termination point (NTP) in different network topologies. NRAs shall take utmost account of these Guidelines when defining the location of NTPs². The Guidelines shall contribute to the harmonisation of defining the location of NTPs in the EU.
2. NRAs may allow an appropriate transitional period in case their definition of the NTP location differs from where the NTP is currently implemented in networks.

2 General aspects

2.1 The term 'NTP' refers to network access for end-users

3. The term 'NTP' refers to the point of access to the public network for end-users only.
4. The term 'NTP' is defined in the EECC (Art. 2(9)) as:

'NTP' means the physical point at which an end-user is provided with access to a public communications network; in the case of networks involving switching or routing, the NTP is identified by means of a specific network address, which may be linked to an end-user's number or name.'

and the term 'end-user' (EECC Art. 2(14)) as:

"end-user" means a user not providing public communications networks or publicly available electronic communications services.'

5. Therefore, the NTP is the physical point at which an end-user is provided with access to a public communications network and end-users, by definition, do not provide public communications networks or publicly available electronic communications services.

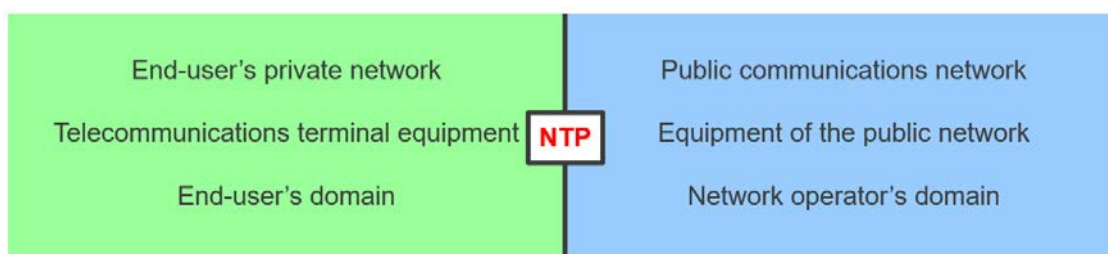
¹ Directive (EU) 2018/72 of the European Parliament and of the Council establishing the European Electronic Communications Code, OJ L 321/36 of 17 Dec. 2018

² As set out in Article 4(4) of Regulation (EU) 2018/1971 of the European Parliament and the Council of 11 December 2018 establishing the Body of European Regulators for Electronic Communications (BEREC) and the Agency for Support for BEREC (BEREC Office), amending Regulation (EU) 2015/2120 and repealing Regulation (EC) No 1211/2009, OJ L 321/1 of 17 Dec. 2018 and Article 61(7) of the EECC.

6. Previously, according to the definition in the Framework Directive (Art. 2(da))³ the term 'NTP' applied to access to the public network not only for end-users but also for network operators and service providers.

2.2 The NTP represents a boundary

7. According to the EECC (Recital (19), see Figure 1), the NTP represents a boundary, for regulatory purposes, between the regulatory framework for electronic communication networks and services on one side and the regulation of the telecommunications terminal equipment (TTE) on the other. Therefore, on one side of the NTP is the network operator's domain which includes the public communications network and the equipment of the public network; On the other side of the NTP is the end-user's domain which includes the end-user's private network and TTE.



Source: BEREC

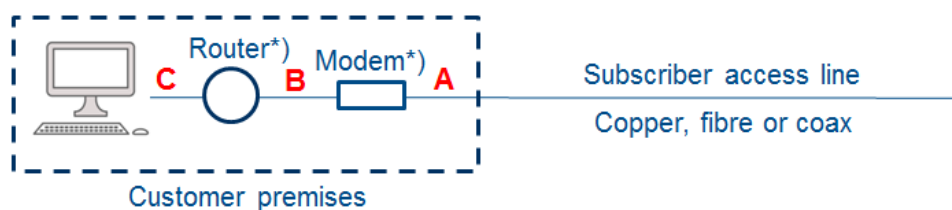
Figure 1: Location of the NTP

2.3 The NTP location has an impact on whether an equipment is part of the public network or part of the TTE

8. Since the NTP represents a boundary as described in paragraph 7 above, the NTP location has an impact on whether a piece of equipment is part of the public network or part of the TTE. In the example in Figure 2, an internet access service - depending on the location of the NTP, the modem and router are either part of the public network (NTP location 'C') or part of the TTE (NTP location 'A') or in the case of NTP location 'B', the modem is part of the public network with the router being part of the TTE.

³ Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services as amended most recently by Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009.

Internet access service



*) In case the NTP is at point A or C, router and modem may be integrated in one device.

Source: BEREC

Figure 2: Different locations of the fixed NTP in case of an internet access service

9. Further examples of the impact of the fixed NTP location on whether a piece of equipment is part of the public network or part of the TTE are shown in the annex.

2.4 Characteristics of the NTP

10. The characteristics of the NTP need to be defined and made publicly available (in the form of detailed interface specifications) in order to enable manufacturers of TTEs to produce compatible equipment to be connected to the NTP, and to enable end-users to connect their own TTE to the public network and use the communications services offered at the NTP.
11. Network operators have to define the (technical) characteristics of the NTP at which they provide access to their networks and services; End-users' TTEs have to comply with
 - a. the essential requirements of the applicable directives transposed into national law like Directive 2014/30/EU⁴ and Directive 2014/53/EU⁵; and
 - b. with the characteristics of the NTP to which they are connected if they want to receive the services they expect from their contract with the network operator and/or service provider.
12. According to Directive 2008/63/EC,⁶ network operators have to define the characteristics of the NTP in sufficient detail to permit the design of TTEs to be capable of utilising all services provided through the NTP.
13. Operators have the possibility to refer to published standards and, in cases where this is not sufficient or where proprietary equipment is used, to provide further details when

⁴ Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility, OJ L 96/79 of 29 March 2008

⁵ Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC, OJ L 153/62 of 22 May 2008

⁶ Commission Directive 2008/63/EC of 20 June 2008 on competition in the markets in TTE, OJ L 162/20 of 21 June 2008

defining the characteristics of the NTP. Any requirement may therefore be taken into account.

14. The characteristics of the NTP must be published according to Directive 2008/63/EC⁶ and kept up to date in case of change or evolution of the public network.

3 Location of the fixed NTP

15. NRAs shall take into account the following criteria when defining the location of the fixed NTP:

- a. Conformity of the definition of the fixed NTP location with the legal provisions (section 3.1);
- b. Impact on TTE market (section 3.2);
- c. Assessment whether there is an objective technological necessity for equipment to be part of the public network (section 3.3);
 - i. Interoperability between public network and telecommunications terminal equipment (TTE) (section 3.3.1);
 - ii. Simplicity of the operation of the public network (section 3.3.2);
 - iii. Network security (section 3.3.3);
 - iv. Data protection (section 3.3.4);
 - v. Local traffic (section 3.3.5),
 - vi. Fixed-line services based on wireless technology (section 3.3.6);

3.1 Conformity of the definition of the fixed NTP location with the legal provisions

16. The definition of the fixed NTP location needs to be conform with the legal provisions at EU and national level as long as the national legal provisions comply with EU law, in particular with the legal provisions presented in this section.

3.1.1 Access regulation in the EECC

17. The immediate context of the Guidelines in the EECC (Art. 61 (7)) is regulation of access and interconnection. From this follows that the competition issues, especially the bottleneck conditions in the access to networks, affect the methods to be used when defining the NTP location and interpreting the legal provisions that refer to the NTP.
18. Access regulation aims at overcoming specific obstacles to competition which cannot be addressed sufficiently by general competition law. Part of access regulation is the principle of unbundling which states that an access seeker does not need to access the infrastructure of the network concerned that he can deploy of his own, and the operator subject to access regulation need not grant access to such infrastructure. From this

follows that equipment like modem, router, media box are only part of the accessed infrastructure if there is an objective technological necessity.

3.1.2 Definition of the term 'NTP' in the EECC

19. The term 'NTP' is defined in the EECC (Art. 2(9)) and included here again as follows:

'NTP' means the physical point at which an end-user is provided with access to a public electronic communications network, and which, in the case of networks involving switching or routing, is identified by means of a specific network address and may be linked to an end-user's number or name.'

20. This definition of the term 'NTP' also includes information relevant for the NTP location. However, it does not define explicitly, e.g. whether modem and router, in the case of an internet access service, are part of the public network or part of the TTE.

21. BEREC understands the words 'by means of' in this definition such that it is not necessary for the specific network address to be implemented in the NTP itself. Therefore it is also possible to implement the network address at the beginning of the local loop at the MDF⁷ location (e.g. in case of POTS) or even after the NTP in an end-user equipment at customer premises (e.g. a dynamically allocated public or static fixed IP address).

22. BEREC understands this definition of the NTP such that in access networks (at least partly) without involving switching and routing, e.g. access networks based on a shared medium (e.g. passive optical networks, coax based access networks), the network is not able to establish a clear link between a network address and a defined physical point at the customer premises.

3.1.3 Definition of the term 'local loop' in the EECC

23. The term 'local loop' is defined in the EECC (Art. 2(30)) as follows:

'Local loop' means the physical path used by electronic communications signals connecting the NTP to a distribution frame or equivalent facility in the fixed public electronic communications network.'

24. The definition of the fixed NTP location, therefore, has an impact on whether a piece of equipment at the customer premises is part of the local loop. For example in the case of an internet access service, if modem and router are part of the public network both devices also form part of the local loop, if they are TTE they do not form part of the local loop.⁸

⁷ Main Distribution Frame

⁸ The definition of the NTP location does not prejudice whether a NRA designates the access obligation of an SMP operator to the segment of the local loop owned by the operator who is obliged to grant access.

25. This also has an impact on the infrastructure the access seeker has to rent from the network accessed (see paragraphs 17 and 18), which affects the prices for access, and whether the access seeker has to use infrastructure like modem and router of the access provider.

3.1.4 Regulation (EU) 2015/2120

26. Regulation (EU) 2015/2120⁹ states with regard to internet access services in Article 3(1) the following:

'End-users shall have the right to access and distribute information and content, use and provide applications and services, and use terminal equipment of their choice, irrespective of the end-user's or provider's location or the location, origin or destination of the information, content, application or service, via their internet access service.'

27. Therefore, in the case of an internet access service, end-users have the (legal) right to use the TTE of their choice. The TTE is the equipment which is (directly or indirectly) connected to the NTP according to the definition of the term 'terminal equipment' in Directive 2008/63/EC⁶ (Art. 1(1)) and to the definition of the NTP as a boundary in the EECR (Recital (19), see section 2.2).

28. The 2016 BEREC Guidelines on net neutrality rules (paragraphs 26 and 27)¹⁰ provide the following guidance for NRAs on the implementation of the obligations of Article 3(1) of Regulation (EU) 2015/2120:

'In considering whether end-users may use the terminal equipment of their choice, NRAs should assess whether an ISP¹¹ provides equipment for its subscribers and restricts the end-users' ability to replace that equipment with their own equipment, i.e. whether it provides 'obligatory equipment'.

Moreover, NRAs should consider whether there is an objective technological necessity for the obligatory equipment to be considered as part of the ISP network. If there is not, and if the choice of terminal equipment is limited, the practice would be in conflict with the Regulation.'

29. Therefore, in case of an internet access service, NRAs should consider whether there is an objective technological necessity for equipment which the end-users are not able to replace with own equipment to be considered as part of the public network when defining the fixed NTP location (see section 3.2).

⁹ Regulation (EU) 2015/2120 of the European Parliament and of the Council of 25 November 2015 laying down measures concerning open internet access and amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on public mobile communications networks within the Union, OJ L 310/1 of 26 November 2015

¹⁰ BEREC Guidelines on the implementation by national regulators of European net neutrality rules, August 2016 (BoR (16) 127)

¹¹ Internet service provider

30. This shows that, at least for internet access services, the principle that the infrastructure encompassed by the public network must follow from an objective technological necessity also from the perspective of the end-user and not only from that of the access seeker (see paragraphs 17 and 18).

3.1.5 Directive 2008/63/EC

31. The Directive 2008/63/EC⁶ aims at establishing competition in the markets in TTE. It therefore requests that Member States withdraw exclusive rights and '*ensure that economic operators have the right to import, market, connect, bring into service and maintain terminal equipment*' (Article 3).
32. In order to enable this, the characteristics of the NTP have to be published (Art. 4, Recital 10) as well as all technical specifications for TTE (Art. 5).
33. Its aim is to establish a competitive internal market for TTE and '*[...] that users must be allowed a free choice between the various types of equipment available [...]*' (Recital 3).

3.2 Impact on TTE market

34. Directive 2008/63/EC⁶ aims to foster competition in the TTE markets. A strong, competitive TTE market requires transparent technical specifications to be published (Recital 8, Articles 4 and 5).
35. The definition of the fixed NTP location has an impact on whether a piece of equipment at the customer premises is a part of the public network or a part of the TTE and therefore the definition has an impact on the TTE market and the effective application of Directive 2008/63/EC⁶ and Regulation (EU) 2015/1535¹² (see paragraphs 8 and 9).
36. In case equipment (e.g. modem, router, media box) is part of the TTE, it is also part of the TTE market. In case equipment is part of the public network (and therefore not part of the TTE), it is not part of the TTE market.
37. However, in practice, there is a market for customer premises equipment ('CPE') including the TTE and the equipment that is part of the public network and, therefore, the TTE market is a subset of the CPE market.
38. The definition of the fixed NTP location affects what types of equipment are subject to competition effects that result from the ability of end-users to choose their own equipment.

¹² Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services, OJ L 241/1 of 17 September 2015

3.2.1 Fixed NTP is located at point A

39. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point A, then the end-user and not the network operator¹³ decides which equipment (e.g. modem, router, media box) will be used.

40. In this case, the impact on the TTE market is as follows:

- a. Equipment like modem, router, media box are part of the TTE market.
- b. It has a relatively high number of customers (the end-users and network operators who offer non-obligatory equipment beyond their NTP) and each of them may have different needs (e.g. private and business requirements).
- c. Manufacturers and vendors may develop a variety of different devices in order to meet these customers' demand; operators will foster this effort to present an attractive range of non-obligatory equipment to avoid end-users opting for unknown customer-provided equipment (effect of market contestability).
- d. Then end-users would be able to buy devices on the free TTE market or from their operator which meet their individual needs to a comparatively large degree.
- e. This is likely to foster innovation and competition on the TTE market.
- f. The dependence of vendors and manufacturers on a few large customers may be lower.

41. The degree of the impact on the TTE market as described in paragraph 40 above depends not only on the extent to which end-users decide to use their own equipment and not the equipment provided by the network operator, but also on the contestability of the market on which network operators offer non-obligatory TTE to their customers.

3.2.2 Fixed NTP is located at point B

42. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point B, then the network operator¹³ decides which modem will be used and the end-users decide which other CPE (e.g. router, media box) is used.

43. The impact on the TTE market is as in the case where the NTP is located at point C (see section 3.2.3) but only with regard to the modem and not with regard to the other equipment at the customer premises.

¹³ In section 3, the term 'network operator' is used for the entity who provides the NTP to the end-user and to which the end-user connects his or her TTE.

44. The impact on the TTE market is as in the case where the NTP is located at point A (see section 3.2.1) with regard to the other CPE but not with regard to the modem, but may become like with point C in markets with a strong customer predilection for IADs.¹⁴

3.2.3 Fixed NTP is located at point C

45. If the definition of the fixed NTP location determines that the fixed NTP is located at point C, then equipment like modem, router and media box are part of the public network and the network operator¹³ and not the end-user decides which equipment will be used.
46. In this case, the impact on the TTE market is as follows:
- a. It does not comprise equipment like modem, router, media box.
 - b. Network operators may offer end-users to select between different types of equipment like modem, router, IAD, however, they may not offer the same variety of devices as end-users would be able to buy on the TTE market in case the equipment is part of the TTE (see section 3.2.1); there would be only little market contestability.
 - c. End-users would therefore only be able to use equipment which meet their individual needs to a lesser extent.
 - d. This may result in a lower level of innovation and competition for equipment like modem, router, media box, IAD.
 - e. Vendors and manufacturers may be dependent on a few large customers with regard to such equipment.

3.2.4 Conclusions

47. The degree that the NTP location fosters innovation and competition on the TTE market is highest for point A, lower for point B and still lower for point C.

3.3 Assessment whether there is an objective technological necessity for equipment to be part of the public network

48. The location of the NTP is where the public network ends and the TTE begins (see paragraph 7).
49. If there is an objective technological necessity for equipment to be considered as part of the public network, then such equipment needs to be part of the public network. If there is not, then there would be no need for the equipment to be part of the public network.

¹⁴ Integrated Access Device i.e. equipment that combines modem and additional functionalities into one single device.

50. Directive 2008/63/EC aims to enable end-users to use the TTE of their choice (see paragraph 33) and Regulation (EU) 2015/2120 (Art. 3(1)) stipulates that in case of an internet access service end-users have the legal right to use the TTE of their choice (see paragraph 26).
51. Equipment at the customer premises not being part of the public network also contributes to the fostering of innovation and competition in the TTE market and to the availability of TTEs in the TTE market that are tailored to end-users' needs to a higher degree (see section 3.2.4).
52. Therefore, it follows that equipment at the customer premises is part of the TTE unless there is an objective technological necessity for equipment to be considered as part of the public network.
53. Consequently, the TTE includes the maximum number of pieces of equipment at the customer premises possible and, therefore, end-users have the maximum freedom to use the equipment of their choice.
54. For these reasons and in accordance with paragraphs 26 and 27 of the 2016 BEREC Guidelines on net neutrality rules¹⁵ (as cited in paragraph 28), NRAs shall assess whether there is an objective technological necessity for equipment to be considered as part of the public network.
55. This assessment only needs to consider equipment which is provided by the network operator, where the network operator does not allow the end-users to replace it with their own equipment.¹⁶
56. NRAs shall in particular consider the criteria described and explained in this section in the assessment.¹⁷
57. The remainder of this section, and sub-sections, presents for each criterion basic aspects of the impact of different NTP locations and, based on this, the aspects which in particular need to be taken into account in the assessment whether there is an objective technological necessity for equipment to be part of the public network.
58. The impact is considered for the following three NTP locations (see annex):
 - a. Point A: The NTP is the point (e.g. physical connector) at which the subscriber access line ends at the customer premises where no active equipment is between the NTP and the subscriber access line.

¹⁵ BEREC Guidelines on the implementation by national regulators of European net neutrality rules, August 2016 (BoR (16) 127)

¹⁶ For equipment which is not provided by the network operator or which network operators allow end-users to replace it with own equipment, there is obviously no objective technological necessity to be part of the public network.

¹⁷ When applying these criteria, NRAs shall take into account that operators may provide end-user services based on wholesale access services (including open access) and that an objective technological necessity for equipment to be part of the public network may also arise from the wholesale level.

- b. Point B: The NTP is the interface at the end-users' side of the modem (e.g. traditional DSL modem, fibre modem, cable modem) which provides network termination but no further functionality (e.g. without switching, routing, NAT¹⁸, WLAN).¹⁹
- c. Point C: The NTP is the interface at the end-users' side of the CPE which provides not only network termination but also further functionalities (e.g. routing, WLAN).²⁰

59. If the outcome of the NRA assessment is that there is no objective technological necessity for any equipment at the customer premises to be part of the public network, then all equipment is part of the TTE and the fixed NTP is located at point A (see annex).

60. If the outcome of the NRA assessment is that there is an objective technological necessity for the modem but not for other equipment at the customer premises to be part of the public network, then all equipment except the modem is part of the TTE and the fixed NTP is located at point B (see annex).

61. If the outcome of the NRA assessment is that there is an objective technological necessity for the modem and further equipment, e.g. a router, to be part of the public network, then this equipment is part of the public network and the fixed NTP is located at the corresponding point, e.g. point C (see annex).

3.3.1 Interoperability between public network and TTE

62. Interoperability between the public network and the TTE is of paramount importance and needs to be ensured in order to enable network operators to provide communications services to end-users and to prevent end-users' TTEs from harming the public network.²¹

63. Network operators have the possibility to define any requirements their networks may have when defining the characteristics of the NTP (see section 2.4). TTE providers (e.g. modem, router, media box) must comply with these requirements.

64. In case TTEs which do not comply with the characteristics of a particular public network's NTP are connected to that public network, measures may be necessary to handle such situations properly.

65. In cases where it is found that a TTE harms the network (e.g. it affects the service of other end-users), national legal provisions or measures may already be in place or

¹⁸ Network Address Translation

¹⁹ Different technologies are possible for implementing the modem functionality (e.g. standalone modem, integrated access device which only provides modem functionality and has switched off all other functionalities).

²⁰ Depending on the functionality of the customer premises equipment point C may be at different locations (see annex case (6) locations C1 and C2).

²¹ In case the provision of a service uses a digital rights management (DRM) system also the interoperability of this DRM system needs to be ensured.

implemented by the NRA which permit network operators in such situations to disconnect the TTE in order to protect their networks.²² National legal provisions may provide such a permission to network operators without the need to pre-request it e.g. from the NRA, or only on request in case a TTE actually harms their networks.

- 66. National legal provisions or end-user contracts might stipulate that end-users who operate a TTE which harm the public network are liable for any damages their TTE causes to the public network.
- 67. It needs to be clarified who is responsible in case of faults (e.g. interoperability issues between modem, router or media box etc. and public network), the end-user or the network operator.
- 68. Disputes between end-users and network operators may arise about whether or not a TTE fulfils the NTP characteristics. For example, in case the service of the end-user does not work properly, a dispute between end-user and network operator may arise about whether the cause is that the TTE does not (completely) comply with the NTP characteristics.

3.3.1.1 Fixed NTP is located at point A

- 69. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point A, then interoperability between the equipment at the customer premises (e.g. modem, router, media box, see annex) and the public network needs to be ensured which includes the interoperability of the access technology used on the subscriber access line (e.g. G.fast, VDSL2 vectoring, DOCSIS 3.1, GPON).

3.3.1.2 Fixed NTP is located at point B or C

- 70. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point B, then interoperability between CPE other than the modem (e.g. router, VoIP adapter, media box²³) and the public network needs to be ensured. If it determines that the fixed NTP is located at point C, then interoperability between equipment other than those considered to be part of the public network (e.g. modem, router, VoIP adapter, media box) and the public network needs to be ensured.
- 71. In case the NTP is located at point B or C, the interoperability between the public network and the TTE does not need to be ensured with regard to the access technology used on the subscriber access line (e.g. G.fast, VDSL2 vectoring, DOCSIS 3.1, GPON) as this access technology is only used within the public network. At this level, the TTE only needs to interoperate with the modem (NTP at point B) or the router (NTP at point C).

²² In case an end-user connects a TTE to the NTP which only harms the service the network operator provides to this end-user (not the service of other end-users), then it is not necessary that the network operator disconnects the TTE in order to protect its network.

²³ Without integrated modem

3.3.1.3 Conclusions

72. The NRA assessment of whether there is an objective technological necessity for equipment to be part of the public network shall include the criterion 'interoperability between public network and TTE'.
73. This assessment shall take into account in particular the following:
- a. Network operators have the possibility to take into account any requirements their networks may have when fulfilling the obligation to define the characteristics of the NTP that the TTE has to comply with (see section 2.4, para 13).
 - b. Appropriate measures need to be in place which allow the network operators to adequately protect their networks in case TTEs are connected to the public network which do not comply with the NTP characteristics and harm the public network, and to resolve disputes between network operators and end-users.

3.3.2 Simplicity of the operation of the public network

74. The fixed NTP location may have an impact on the operation of the public network as considered in the following sub-sections.

3.3.2.1 Fixed NTP is located at point A

75. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point A, then the end-user decides which CPE (e.g. modem, router, media box) is used.
76. Different end-users may decide to use different types of TTE and, therefore, a variety of different modems, routers, media boxes etc. may be used and connected to the public network.
77. The use of a variety of different types of TTE not owned by the network operator could make network operations more complex compared to a case where only a few different types of own TTE are used.
78. For example, the modem needs to interwork with the network management system of the public network in order to operate the access technology used (e.g. VDSL2, DOCSIS, GPON). The public network has to manage a higher number of different types of modems²⁴, interoperability issues may occur more often and network operation needs to be coordinated with the end-user (see paragraph 79).
79. Repair of faults needs to be coordinated between the network operator, on the one hand, and the end-user, who may have support from the vendor of his or her modem/router, on the other hand. Fault repair is in the interest of the end-user and, therefore, the end-user

²⁴ Either standalone modems or modems which are integrated in other devices (e.g. router, media box).

may allow the network operator to access the modem, router, media box etc. in order to enable fault analysis and repair.

80. However, the operation of the public network does not depend on the electricity supply at customer premises since no equipment at customer premises (e.g. modem, router) is part of the public network and, therefore, there is no need for the network operator to coordinate with the end-user with regard to this.²⁵

3.3.2.2 Fixed NTP is located at point B

81. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point B, then the network operator¹³ decides which modem is used and the end-user decides which other CPE (e.g. router, VoIP adapter, media box²⁶) is used.
82. Simplicity of operation of the public network is as in case NTP is located at point C (see section 3.3.2.3) but only with regard to the modem and not with regard to other equipment at the customer premises.
83. Simplicity of operation of the public network is as in case NTP is located at point A (see section 3.3.2.1) with regard to the other CPE and as in case NTP is located at point C (see section 3.3.2.3) with regard to the modem.

3.3.2.3 Fixed NTP is located at point C

84. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point C, then CPE like e.g. modem, router or media box is part of the public network and the network operator¹³ decides which equipment is used.
85. The operator may decide to offer services to end-users only based on a limited variety of modems, routers, media boxes etc.
86. The use of a limited number of different types of equipment in the public network could make network operations less complex compared to a case where many different types of equipment are used which is not owned by the network operator.
87. In case of interoperability issues between modem, router or media box and public network, the network operator is solely responsible for resolving these issues since the equipment lies within its domain.²⁷

²⁵ An exception is reverse powering (e.g. ETSI TS 101 548) which may be used e.g. in case of the new access technology G.fast. In such case, equipment (e.g. G.fast distribution point unit) in the public network (not located at the customer premises) is powered by the electricity supply at the premises of the end-users. However, this does not imply, that the equipment at the customer premises which provides the power needs to be part of the public network.

²⁶ without integrated modem

²⁷ The network operator is also able to resolve such interoperability issues on its own, except in cases where the network operator needs to have contact with the end-user in order to be able e.g. to replace modem, router, media box etc. or repair or test them directly at the customer premises.

88. However, the operation of the customer-sided part of the public network depends on the electricity supply at customer premises which powers modem, router, media box etc. and, therefore, the network operator may have to coordinate with the end-user in this regard.

3.3.2.4 Conclusions

89. The NRA assessment whether there is an objective technological necessity of equipment to be part of the public network shall include the criterion 'simplicity of the operation of the public network'.

90. This assessment shall take into account in particular the following:

- a. The situation that many different types of modems, routers, media boxes etc. not owned by the network operator are used when end-users have the possibility to use their own equipment is inevitable.
- b. The degree to which the use of end-user owned equipment impairs the simplicity of network operations has to be substantial and the negative results have to evidently outweigh the potential benefits for end-users and competition on the TTE market to constitute an objective technological necessity.

3.3.3 Network security

91. Network security is important in order to ensure the proper operation of the public and private network and the definition of the fixed NTP location may have an impact on this.

92. For example, hackers could potentially utilise security vulnerabilities in the software used in the equipment at the customer premises (e.g. modem, router or other types of TTE²⁸) and introduce malware (e.g. computer viruses, worms, Trojan horses) or launch denial-of-service attacks causing damage to the public and/or private network.²⁹

3.3.3.1 Fixed NTP is located at point A

93. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point A, then the equipment at the customer premises (e.g. modem, router, media box) is part of the TTE and therefore the end-user is responsible for its proper operation.

94. The end-user needs to ensure that the software used in the TTE is no threat for network security e.g. by using appropriate software only, updating it regularly and using security software. To ensure this the end-user may have support from the TTE vendor.

²⁸ Notebook, printer, IoT devices like lamps, refrigerators

²⁹ For an EU-wide overview of telecom security incidents see ENISA's Annual Report Telecom Security Incidents (<https://www.enisa.europa.eu/topics/incident-reporting>)

95. End-users may use a variety of different types of TTE (see section 3.3.2.1) and, therefore, the number of end-users that deploy a certain type of TTE is comparatively small (compared to the situation in paragraph 106). This diversity of TTE devices limits the number of compromised devices in the event of a vulnerability being discovered in a particular device.
96. Security incidents caused by modem, router, media box etc. might impact the end-user's private network. However, since they are part of the TTE, the end-user is responsible for the prevention and effects of such incidents.
97. Security incidents caused by abuse of modem, router, media box etc. could also harm the public network. Since these devices are part of the TTE, network operators are not able to ensure the deployment of countermeasures against discovered vulnerabilities in these devices. However, network operators have the ability to take appropriate measures in their networks (e.g. at the edge of the core network) against the impact of such incidents on their networks.
98. National legal provisions may be in place which permit network operators in such situations to disconnect the TTE in order to protect their networks. National legal provisions may grant such a permission to network operators without the need to request it or only on request, e.g. from the NRA, in case a TTE actually harms their networks.
99. National legal provisions or end-user contracts may stipulate that end-users are liable for any damages their TTE causes in the public network and that the end-users might be required to pay compensation for any damage the TTE causes.

3.3.3.2 Fixed NTP is located at point B

100. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point B, then the network operator decides which modem is used and the end-user which other CPE (e.g. router, VoIP adapter, media box³⁰).
101. Network security is similar as in case NTP is located at point C (see section 3.3.3.3) but only with regard to the modem and not with regard to other equipment at the customer premises.
102. Network security is as in case NTP is located at point A (see section 3.3.3.1) with regard to the other CPE but not with regard to the modem.

3.3.3.3 Fixed NTP is located at point C

103. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point C, then equipment at the customer premises as e.g. modem, router, and media box

³⁰ Without integrated modem

are part of the public network and the network operator is responsible for their proper operation.³¹

104. The network operator needs to ensure that the software used in its equipment at the customer premises is no threat for network security e.g. by using secure software and updating it at regular intervals.
105. Network operators have legal obligations with regard to the security of their networks and services according to the EECC (Art. 40(1)) which determines that Member States shall ensure that network operators *'take appropriate and proportionate technical and organisational measures to appropriately manage the risks posed to security of networks and services.'*³²
106. Network operators might use only a few different types of modems, routers, media boxes etc. (see section 3.3.2.2) and, therefore, each of them is used for a comparatively high number of end-users (in comparison with the situation in paragraph 95). This lack of diversity of TTE models increases the number of compromised devices in the event of a vulnerability being discovered in the network operator's selected device(s).
107. If security incidents caused by modem, router, media box etc. nevertheless occur, the public network may be harmed by them. However, since this equipment is part of the public network, the network operator is responsible for the prevention and effects of such incidents.
108. Security incidents caused by the abuse of modem, router, media box etc. could also harm private networks. Since this equipment is part of the public network, end-users are not able to deploy any countermeasures against discovered vulnerabilities in the modem, router, media box etc. to prevent this. However, network operators have to fulfil their legal obligations (see paragraph 105) and, therefore, must ensure an appropriate level of protection against security threats.

3.3.3.4 Conclusions

109. The NRA assessment on whether there is an objective technological necessity for equipment to be part of the public network shall include the criterion 'network security'.

³¹ Since they are part of the public network, filtering functions (e.g. firewall) of modem and router may be constricted by the provisions of Art. 3(3) of Regulation (EU) 2015/2120.

³² These measures *'shall ensure a level of security appropriate to the risk presented'* and, in particular, measures *'shall be taken to prevent and minimise the impact of security incidents on users and on other networks and services'* (EECC, Art. 40).

110. This assessment shall take into account in particular the following:

- a. The measures that are in place³³ which allow the network operators to protect their networks against security incidents caused by abuse of modem, router, media box etc.
- b. If these measures are sufficient, then it would not be likely that there is an objective technological necessity that the modem, router, media box etc. at the customer premises need to be part of the public network from the perspective of network security.

3.3.4 Data protection

111. Data protection is important in order to prevent unauthorised access to personal data and infringements of confidentiality of communications³⁴. The definition of the fixed NTP location may have an impact on data protection as considered in the sub-sections below.

3.3.4.1 Protection of personal data and confidentiality of communications against access by network operators

112. Communication within the premises of an end-user (local traffic) takes place via the public network in case the NTP is located at point C and completely within the end-users' private network in case the NTP is located at point A or B (see section 3.3.5, Figure 3 and Figure 4).

113. Therefore in case the NTP is located at point C, personal data within this local communication is available in the public network which could compromise the protection of end-users' data.³⁵ However, network operators are legally prohibited from '*listening, tapping, storage or other kinds of interception or surveillance of communications*' in order to ensure the confidentiality of communications according to Directive 2002/58/EC (Art. 5(1)).³⁶

114. Communication between the premises of an end-user and the premises of other end-users (e.g. email, video conference) or a server in the public network (e.g. web server) always takes place via the public network irrespective of the NTP location.

³³ The measures are in place and, therefore, if only to be active temporarily, can be activated at any time when necessary. However, this does not mean that temporary measures are activated permanently.

³⁴ See Directive 2002/58/EC (Art. 5(1))

³⁵ Potentially an even broader view of the end-users' data can be accessed (e.g. by detecting other wireless devices) since the router is part of the public network.

³⁶ Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications), OJ L201/37 of 12 July 2002.

115. In case of this type of communication:

- a. The legal provisions mentioned in paragraph 113 apply as well. In addition, end-users may protect their personal data against unauthorised access by using encryption, e.g. email communication using an appropriate end-to-end encryption protocol (e.g. S/MIME³⁷) or communication with web servers based on Transport Layer Security (TLS).
- b. End-users may use a firewall in order to protect their private network. In case the NTP is located at point A or B, the firewall is in the domain of the end-users and, therefore, they have the possibility to configure the firewall according to their needs. In case the NTP is located at point C, the firewall is in the domain of the network operator and, therefore, the end-users have only the possibility to configure the firewall if the network operators allow this.³⁸

3.3.4.2 Protection of personal data and confidentiality of communications against access by unauthorised end-users

116. In public networks with an access network based on a shared medium (e.g. passive optical network, coax network), the same information is inevitably sent in the down link direction to all end-users connected to the same shared medium.

117. Therefore, the public network needs to apply appropriate measures (e.g. encryption) in order to protect the personal data of the end-users and to ensure that end-users only get access to the information which is intended for them.

118. The modem at the customer premises needs to be able to interwork with these measures (e.g. decryption) and to make only the information which is intended for the end-user accessible.

119. In case the NTP is located at point A, the modem is part of the TTE and therefore this interworking is part of the interoperability which needs to be ensured between TTE and public network (see section 3.3.1), and needs to be included in the technical characteristics of the NTP (see section 2.4). In case the NTP is located at point B or C, modem is part of the public network and therefore this interworking is not relevant at the NTP.

3.3.4.3 Conclusions

120. The NRA assessment of whether there is an objective technological necessity for equipment to be part of the public network shall include the criterion 'data protection'.

³⁷ Secure / Multipurpose Internet Mail Extensions

³⁸ In addition, the firewall functions may be constricted by the provisions of Art. 3(3) of Regulation (EU) 2015/2120.

121. This assessment shall take into account in particular the following:

- a. That there is no objective technological necessity of equipment (e.g. modem, router, media box) needing to be part of the public network with regard to the protection of personal data against access by network operators (see section 3.3.4.1);
- b. In case of network access based on a shared medium and the NTP is located at point A, the interoperability between TTE and public network (see section 3.3.1) and the characteristics of the NTP (see section 2.4) need to include the interworking of appropriate protection measures (e.g. encryption) in order to protect personal data against access by unauthorised end-users (see paragraph 119).

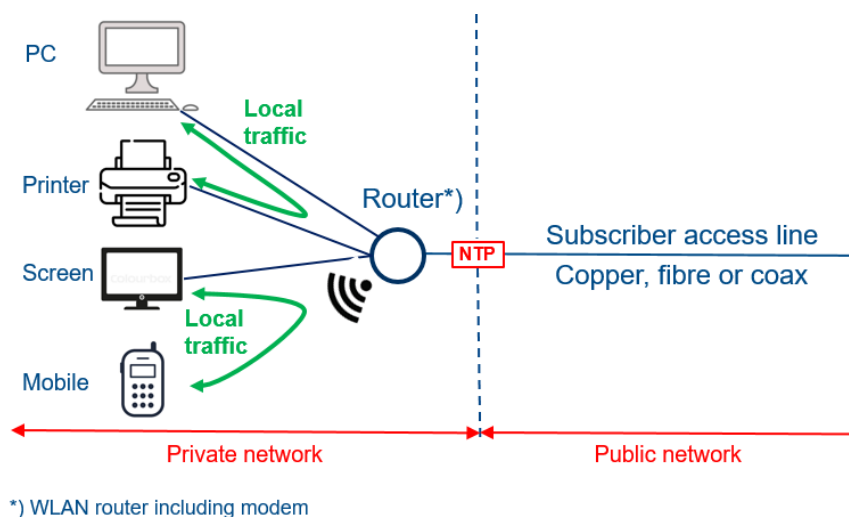
3.3.5 Local traffic

122. The switching and routing of local traffic at customer premises is done by equipment (e.g. router) at customer premises. For example, an end-user sends a document from his PC to his printer via his router, or an end-user sends a document from his mobile phone, which is connected via his WLAN router, to a large screen also connected to this WLAN router (see Figure 3 and Figure 4).

123. The definition of the fixed NTP location has an impact on the legal and regulatory considerations around local traffic at customer premises.

3.3.5.1 Fixed NTP is located at point A

124. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point A, then modem and router are part of the TTE and therefore local traffic remains completely within the end-user's private network (see Figure 3).



Source: BEREC

Figure 3: Local traffic in case modem and router are part of the TTE

125. This has the following consequences:

- a. The public network is not involved in local traffic at customer premises.
- b. Legal provisions which apply for public networks (e.g. with regard to net neutrality or lawful interception) do not apply to local traffic.
- c. Local traffic at customer premises remains completely private.

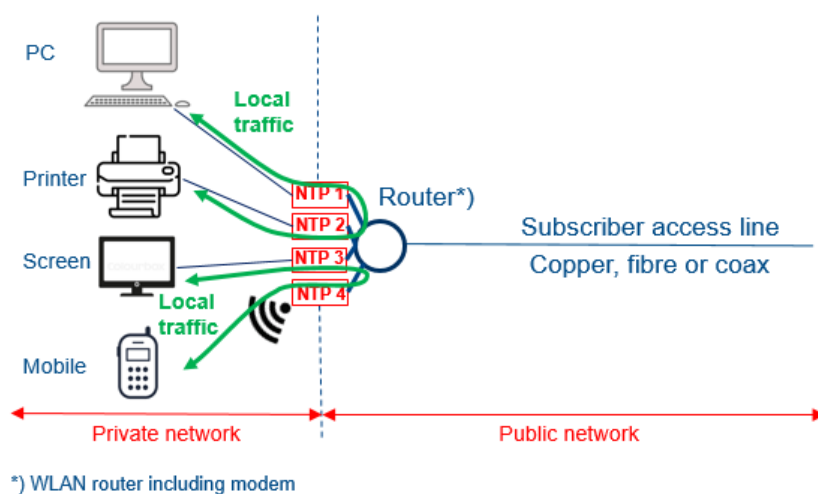
3.3.5.2 Fixed NTP is located at point B

126. If the definition of the fixed NTP location stipulates that the fixed NTP is located at point B, then modem is part of the public network and router is part of the TTE.

127. In case the NTP is located at point B, local traffic also remains completely within the end-user's private network (see section 3.3.5.1) since the modem provides network termination only but no further functionalities like e.g. switching.

3.3.5.3 Fixed NTP is located at point C

128. If the definition of the fixed NTP location determines that the fixed NTP is located at point C, then modem and router are part of the public network and switching and routing of local traffic at customer premises are done by the public network (see Figure 4).



Source: BEREC

Figure 4: Local traffic in case modem and router are part of the public network

129. This has the following consequences:

- a. Switching and routing of local traffic at the end-user premises may have to be considered to be a public communications service.
- b. Legal provisions public communications services have to fulfil (e.g. with regard to net neutrality, lawful interception) may also apply to local traffic.
- c. Local traffic of the end-user is accessible by the public network which may compromise the protection of end-users' data (see section 3.3.4, paragraph 113).

- d. The public network may not be able to identify each of the NTPs (NTP 1 to NTP 4) by means of a specific network address as demanded by the definition of the term 'NTP' in the EECC (Art. 2(9), as cited in paragraph 19).

3.3.5.4 Conclusions

130. The NRA assessment of whether there is an objective technological necessity of equipment to be part of the public network shall include the criterion 'local traffic'.

131. This assessment shall take into account in particular the following:

- a. Modem and router being part of the public network may have serious implications (see paragraph 129).
- b. No objective technological necessity that modem or router must be part of the public network results from the criterion 'local traffic'.

3.3.6 Fixed-line services based on wireless technology

132. Fixed-line services may be based on wireless technology and the definition of the fixed NTP location may have an impact on whether or not this is possible.³⁹

3.3.6.1 Example 1: Fixed-line voice service based on a mobile network

133. The fixed-line voice service is provided to the end-user based on a modem (including VoIP or voice telephony adapter) at the customer premises which is connected to a mobile network (e.g. 4G).⁴⁰

134. If the definition of the fixed NTP location stipulates that the modem (including VoIP adapter) is part of the public network (NTP location C, see annex case (3)), the fixed-line voice service is possible and provided at the fixed location of the port of the modem to which the end-user connects his or her telephone.

135. If the definition of the fixed NTP location states that the modem is part of the TTE, the fixed-line voice service may not be possible since the voice service is provided via the air interface between modem and mobile network and, therefore, it is no longer a fixed-line service (at a fixed location) but instead a wireless service.

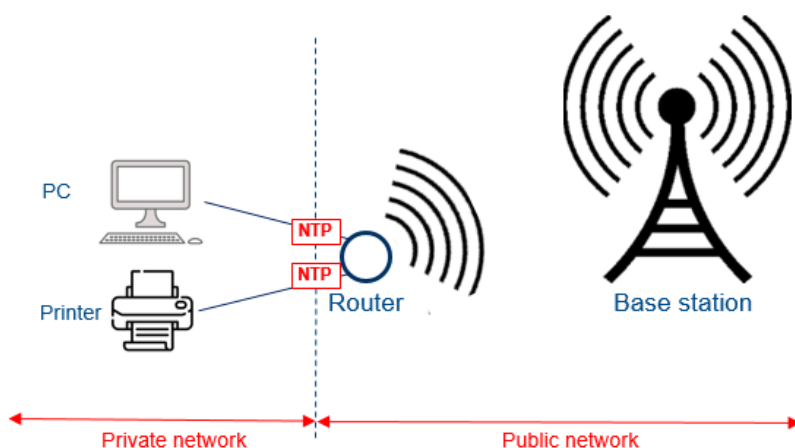
3.3.6.2 Example 2: Fixed-line internet access service based on a mobile network

136. The fixed-line internet access service is provided to the end-user based on a router at the customer premises which is connected to a mobile network (e.g. 4G).⁴¹

³⁹ The NRA assessment taking into account all criteria (section 3.3.1 to 3.3.6) has to be applied also in case of services based on both a fixed-line and a wireless connection ('hybrid' NTP). Depending on the outcome of this NRA assessment such services may be provided at one NTP (access to the network which already combines both types of connection) or two different NTPs (one NTP with access to the fixed network and one NTP with access to the mobile network).

⁴⁰ The modem also includes a transmit and receive unit in order to communicate with the base station.

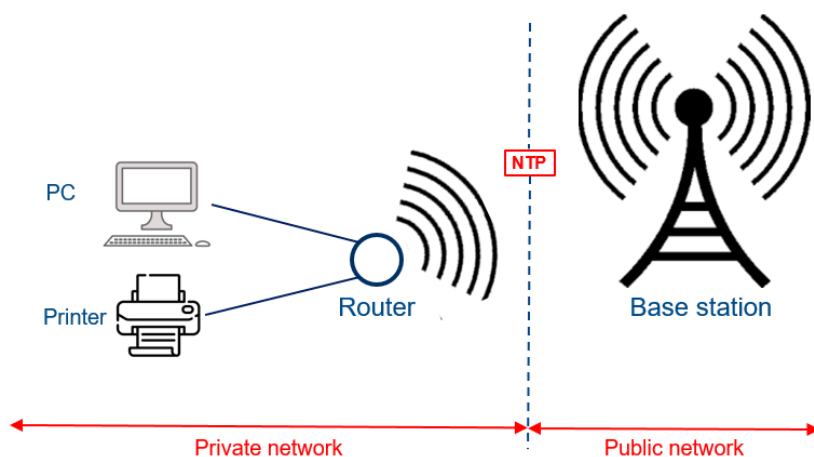
137. If the definition of the fixed NTP location stipulates that the router is part of the public network (NTP location C, see Figure 5), a fixed-line internet access service is possible and it is provided at the ports of the router to which the end-user's devices are connected (however, the criteria in section 3.3.5.3 needs to be considered).



Source: BEREC

Figure 5: Fixed-line internet access service based on a mobile network – the router is part of the public network

138. If the definition of the fixed NTP location determines that the router is part of the TTE (see Figure 6), a fixed-line internet access service may not be possible since the internet



Source: BEREC

Figure 6: Fixed-line internet access service based on a mobile network – the router is part of the TTE

⁴¹ The router includes a transmit and receive unit in order to communicate with the base station.

access service is provided via the air interface between router and mobile network and, therefore, it is no longer a fixed-line service (at a fixed location) but instead a wireless service.

3.3.6.3 Example 3: Fixed-line service based on wireless access and in-building cables

139. The fixed-line service is provided to the end-user based on some equipment (e.g. router) at the customer premises which is connected with in-building cables to a wireless base station at the roof of the building, which in turn is connected to the public network e.g. based on a (point-to-point) wireless access technology.

140. If the definition of the fixed NTP location stipulates that the equipment at the customer premises (e.g. router) is part of the public network (NTP location C), the fixed-line service is possible and provided at the fixed location of the ports of the router to which the end-user connects his or her devices (however, the criteria in section 3.3.5.2 needs to be considered).

141. If the definition of the fixed NTP location states that the equipment at the customer premises (e.g. router) is part of the TTE (NTP location A), the fixed-line internet access service is also possible and provided at the point where the in-building cable ends at the customer premises.

3.3.6.4 Conclusions

142. The NRA assessment on whether there is an objective technological necessity of equipment to be part of the public network shall include the criterion 'fixed-line services based on wireless technology'.

143. This assessment shall take into account in particular the following:

- a. In case it is necessary to enable fixed-line services based on wireless technology, there may be a need that equipment (e.g. modem with integrated VoIP adapter, router) is part of the public network.
- b. However, a router being part of the public network may have serious implications (see paragraph 129).

4 Location of the mobile NTP

144. Today, the end-users have the possibility to use their own mobile equipment in all 28 EU countries (see BoR(18)159).

145. This shows that there is no objective technological necessity for mobile equipment to be considered as part of the public mobile network (see paragraphs 48 to 61).

146. Therefore, NRAs when defining the mobile NTP location shall determine that the mobile NTP is at a location (e.g. the air interface between mobile equipment and base station) which permits end-users to (continue to) use their own mobile equipment.

Abbreviations

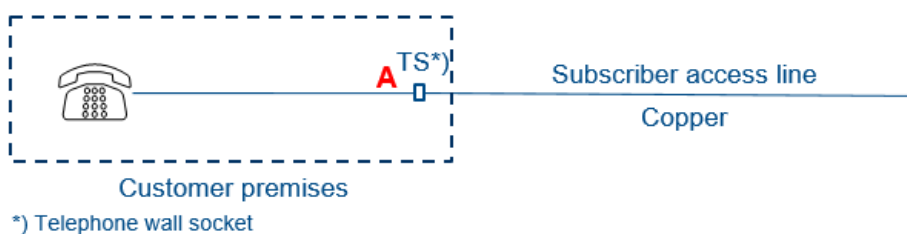
BEREC	Body of European Regulators for Electronic Communications
BoR	Board of Regulators
DRM	Digital Rights Management
EECC	European Electronic Communications Code
IAD	Integrated Access Device
IoT	Internet of Things
IP	Internet Protocol
ISDN	Integrated Service Digital Network
ISP	Internet Service Provider
MDF	Main Distribution Frame
NAT	Network Address Translation
NRA	National Regulatory Authority
NTP	Network Termination Point
POTS	Plain Old Telephone Service
SDH	Synchronous Digital Hierarchy
SHDSL	Single-pair High-speed Digital Subscriber Line
SIM	Subscriber Identity Module
TTE	Telecommunications Terminal Equipment
VoIP	Voice over Internet Protocol
WLAN	Wireless Local area Network

Annex

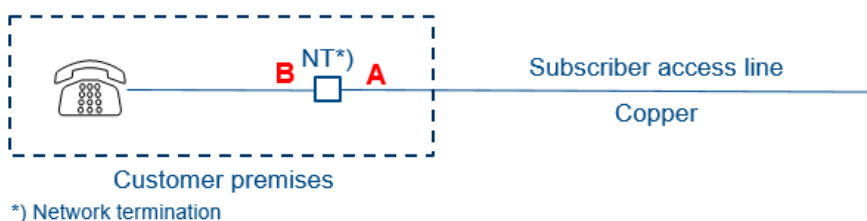
147. This annex illustrates for several (retail) services that the location of the NTP has an impact on whether an equipment is part of the public network or part of the TTE (see paragraph 8). The illustrations refer to three different NTP locations, point A, B and C (see paragraph 58).

148. In the examples below, the equipment shown on the left side of the NTP is part of the TTE and the equipment shown on the right side of the NTP is part of the public network. Therefore, depending on the NTP location, equipment at the customer premises is either part of the TTE or part of the public network.

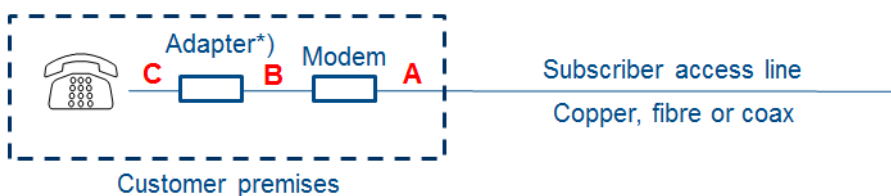
(1) Traditional POTS service



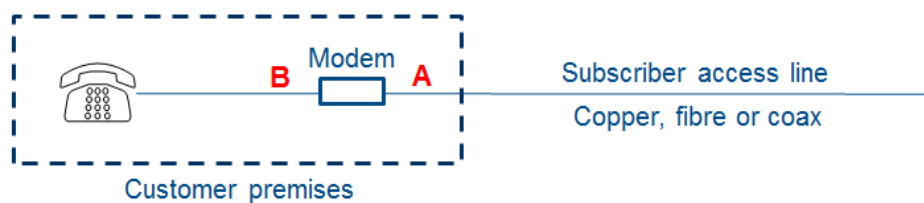
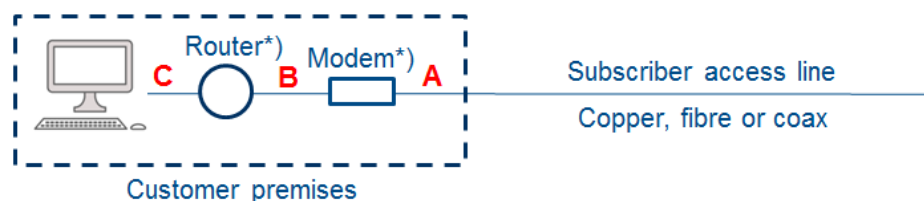
(2) Traditional ISDN service



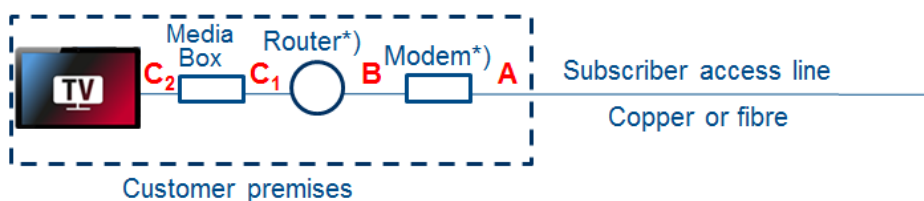
(3) POTS/ISDN with VoIP on the subscriber access line



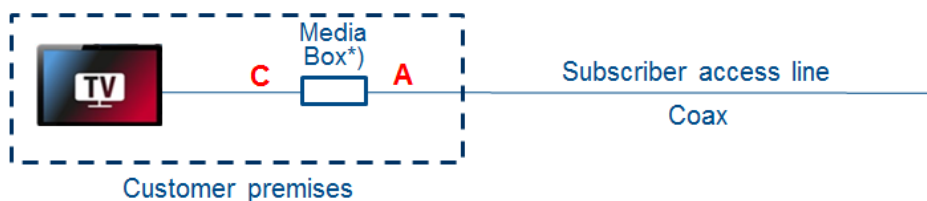
*) Conversion between POTS/ISDN and VoIP. Adapter and modem may be integrated in one device.

(4) VoIP service**(5) Internet access service**

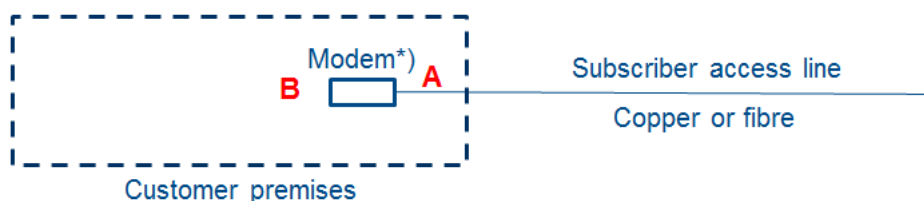
*) In case the NTP is at point A or C, router and modem may be integrated in one device.

(6) TV service (copper, fibre)

*) In case the NTP is not at point B, router and modem may be integrated in one device.

(7) TV service (coax)

*) Location B is not accessible from outside since the media box provides not only network termination functionality.

(8) Leased line

*) E.g. SHDSL modem, SDH terminal multiplexer, Ethernet network termination unit