

# **Layer 2 Wholesale Access Products excluding Ethernet-based Leased Lines on Market 4**

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## Executive Summary

In recent years, in some countries the NRA imposed a Layer 2 wholesale access product (L2 WAP) on the wholesale high-quality access market (Market 4) which is not an Ethernet-based leased line. This possibility is also foreseen in the EC's Recommendation on relevant product markets of 2014, according to which Market 4 may not only include leased lines (with traditional and/or alternative interfaces, namely Ethernet) but also other high-quality access products, if they fulfil certain criteria.

BEREC already analysed L2 WAPs imposed as a remedy on the wholesale local access market (Market 3a) and on the wholesale central access market (Market 3b) and published a report on common characteristics of L2 WAPs (BoR (15) 133) and a common position on L2 WAPs (BoR (16) 162).

This report now analyses L2 WAPs imposed on Market 4 with a focus on advanced bitstream products (not including Ethernet-based leased lines). In order to get a deeper insight into these products and to contribute to a consistent regulation of access products as well as to foster the knowledge transfer between NRAs, the objectives are: (i) to give an overview of L2 WAPs currently in place on Market 4 based on experiences of NRAs (ii) to analyse the reasons why such products have been imposed on Market 4 (iii) to analyse to what extent L2 WAPs in different countries have characteristics in common and to identify them and (iv) to analyse the main differences between L2 WAPs imposed on Market 4 and L2 WAPs imposed on Markets 3a and 3b. The analysis is descriptive and does not aim to be normative or to recommend best practices.

Six countries (ES, FI, FR, NL, PT, SI) imposed a L2 WAP on Market 4 and the main motivation was to enable alternative network operators (ANOs) to offer high-quality retail communication services to businesses and/or replicate such services of the SMP operator. Compared to (Ethernet) leased lines, a L2 WAP has the advantage to be less costly and still has a sufficiently high quality level to use it for high-end business services.

The imposition of a L2 WAP on Market 4 indicates that traditional remedies like leased lines with traditional interfaces or even Ethernet-based leased lines (and other remedies on Markets 3a and 3b) have not been sufficient to address the competition problems identified in course of the Market 4 analysis. It also shows that, in some cases, it was considered more appropriate to impose a L2 WAP on Market 4 than e.g. on Market 3a or 3b. This would usually be the case if the L2 WAP is a substitute for other Market 4 products (mainly leased lines). In five countries (FI, FR, NL, PT, SI), this is actually the case. In the other country (ES), the L2 WAP is also analysed together with Market 4 products since both are "high-quality access" wholesale products and the competitive conditions are considered to be sufficiently homogenous.

The common characteristics of the L2 WAPs on Market 4 in the countries analysed (not taking into account one country for which data were not available) are as follows:

#### Common characteristics of L2 WAPs on Market 4

1. **Technology:** The L2 WAP is based on Ethernet.
2. **Availability:** The L2 WAP is available at least in NGA rollout areas.
3. **Bandwidth:**
  - a. **Type:** The L2 WAP is available with both asymmetric and symmetric bandwidth profiles of the subscriber access lines.
  - b. **Speed:** In case regulation on Market 4 includes fibre-based access, the L2 WAP is available with symmetric bandwidth profiles of at least 600 Mbps.
4. **Quality of Service:**
  - a. **Type:** The L2 WAP is available with a defined QoS.
  - b. **Level:** The L2 WAP is available (in the best QoS class) with the following QoS performance targets:
    - (i) Frame Loss Ratio less than 0.1% (ranges in the countries between 0.001% and 0.1%);
    - (ii) Frame Delay less than 45 ms (ranges between 2 ms and 45 ms);
    - (iii) Frame Delay Variation less than 10 ms (ranges between 1 ms and 10 ms).
5. **Service Level Agreement:**
  - a. **Availability:** The L2 WAP is available with a SLA.
  - b. **Performance parameters:** The SLA defines the performance of provisioning time, service availability and repair time.
  - c. **Performance targets:** The performance targets (in the best service class) are as follows:
    - (i) Provisioning time maximum 10/40 (copper/fibre) working days (ranges in the countries between 6/8 (copper/fibre) working days and 10/40 working days);
    - (ii) Service availability at least 99.5% (ranges between 99.98% and 99.5%);
    - (iii) Repair time maximum 24 hours (ranges between 4 hours and 24 hours).
6. **Service Level Guarantee:** The L2 WAP is available with a SLG.
7. **Redundancy:** The L2 WAP is (optionally) available with redundancy.
8. **CPE/modem:** ANOs can use and configure their own CPE and in case of copper-based access (if available) their own CPE including the modem.
9. **Traffic Prioritisation:** The L2 WAP supports different traffic priorities.
10. **Customer Identification:** The L2 WAP enables ANOs to identify their end-users.
11. **Security:** The L2 WAP enables ANOs to apply security measures.

The common characteristics of the L2 WAPs on Market 4 identified differ from the common characteristics of the L2 WAPs on Market 3a and 3b analysed by BEREC in 2015 (BoR (15) 133) as follows. The L2 WAPs on Market 3a and 3b do also have the common characteristics 1, 2, 8 (partly), and 9 to 11, but not 3 and 4 which are rather similar to Ethernet-based leased lines (the characteristics 5 to 7 are rather specific to leased lines and therefore were not considered in BoR (15) 133).

## 1 Introduction and objective

In recent years, several NRAs imposed Layer 2 wholesale access products (L2 WAP) on SMP operators. BEREC already analysed L2 WAPs imposed as a remedy on the wholesale local access market (Market 3a) and on the wholesale central access market (Market 3b) and published a report on common characteristics of L2 WAPs (BoR (15) 133) and a common position on L2 WAPs (BoR (16) 162).

In addition to Markets 3a and 3b, L2 WAPs have also been imposed on the wholesale high-quality access market (Market 4) in some countries. According to the EC's Recommendation on relevant product markets of 2014, Market 4 may not only include leased lines (with traditional and/or alternative interfaces, namely Ethernet) but also other high-quality access products, if they fulfil certain criteria. Indeed, several NRAs included in Market 4 other high-quality access products than leased lines, in particular advanced bitstream products and imposed such products as a remedy on the SMP operator.

In order to get a deeper insight into these products and to contribute to a consistent regulation of access products as well as to foster the knowledge transfer between NRAs, the report analyses L2 WAPs imposed on Market 4 with a focus on advanced bitstream products (not including Ethernet-based leased lines<sup>1</sup>). The objectives are:

- to give an overview of L2 WAPs currently in place on Markets 3a, 3b and 4;
- to analyse the reasons why such products have been imposed on Market 4;
- to examine on Market 4 to what extent L2 WAPs in different countries have characteristics in common and to identify these common characteristics; and
- to analyse the main differences between L2 WAPs imposed on Market 4 and L2 WAPs imposed on Markets 3a and 3b.

The analysis is descriptive and does not aim to be normative or to recommend best practices.

The document begins with an overview of L2 WAPs imposed on Markets 3a, 3b and 4 in the EU (section 2). Then the regulatory context in which the L2 WAPs are imposed on Market 4 (section 3) and the prices of the L2 WAPs on Market 4 (section 4) are discussed. Following this, the technical characteristics of the L2 WAPs on Market 4 are analysed with a focus on which characteristics they have in common (section 5). Finally, common characteristics of the L2 WAPs imposed on Market 4 are identified and compared with the common characteristics of L2 WAPs on Markets 3a and 3b (section 6).

In order to increase the readability of the report, the wording in the entire document is simplified as follows:

- The document analyses L2 WAPs on Market 4 which are not Ethernet-based leased lines (i.e. typically a Layer 2 bitstream product) but the wording used for that is only

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<sup>1</sup> According to the definition in the explanatory note accompanying the 2014 Recommendation on relevant markets.

“L2 WAP on Market 4” without mentioning “which are not Ethernet-based leased lines”.

- The document analyses decisions on markets based on the current 2014 Recommendation on relevant markets. However, in case a NRA did not yet take a decision since this recommendation entered into force in October 2014, the decisions of the NRA on markets of the previous recommendation of 2007 are examined. However, the terms “Market 3a”, or “Market 3b” or “Market 4” (with a few exceptions where it is necessary to highlight this aspect) are used without mentioning that the previous recommendation of 2007 applies in case the NRA did not yet take a decision since the current recommendation entered into force.

## 2 Overview of L2 WAPs imposed on Markets 3a, 3b and 4 in the EU

This section provides an overview of the L2 WAPs imposed on Markets 3a, 3b and 4 in the EU (see Figure 1).

L2 WAP imposed on			Number of markets	Number of countries
only 3a: BG, CY, HU, MT, UK	only 3b: BE, DE, IT, LU, PL	only 4: FI, PT	Imposed only on 1 market	12
3a and 3b: AT, CZ, DK, GR, HR, IE, LV				
3b and 4: FR				
3a and 4: NL		3a and 4: NL	Imposed on 2 markets	9
3a, 3b and 4: ES, SI				
Imposed on all 3 markets				2
<b>Market 3a</b>	<b>Market 3b</b>	<b>Market 4</b>		
15	15	6		
<b>Number of countries per market</b>				

Source: BEREC

**Figure 1: L2 WAPs imposed on Markets 3a, 3b and 4 in the EU**

Two countries imposed a L2 WAP on all three markets (3a+3b+4; see red area), nine on two markets (3a+3b or 3a+4 or 3b+4; see blue area) and 12 countries on only one market (see

green area). Overall, 23 countries imposed a L2 WAP, 15 on Market 3a, also 15 on Market 3b and six on Market 4 (see bottom of Figure 1).

It can therefore be concluded that the imposition of L2 WAP has become very common in the EU over the past ten years. However, compared to Market 4, it is still more common on Markets 3a and 3b, where it was mainly imposed as an alternative to physical unbundling (see BoR (15) 133, pp. 5-7).

### 3 Regulatory context of L2 WAPs on Market 4

This section analyses reasons why or why not a L2 WAP was imposed on Market 4.

#### ***Reasons to impose a L2 WAP on Market 4***

The main motivation to impose a high-quality L2 WAP on Market 4 is to enable alternative network operators (ANOs) to offer high-quality retail communication services to businesses and/or replicate such services of the SMP operator. Since, in general, regulation has to be proportionate and not more intrusive than necessary, the imposition of a L2 WAP on Market 4 indicates that traditional Market 4 remedies like access to leased lines with traditional interfaces (e.g. PDH and SDH) or Ethernet-based leased lines (together with other remedies on Markets 3a and 3b) have not been sufficient to address the competition problems identified in course of the market analysis. Compared to leased lines, L2 WAPs on Market 4 have the advantage to be less costly but still have a sufficiently high quality level to use them for high-end business services.<sup>2</sup>

An imposition of a L2 WAP on Market 4 also shows that it was considered more appropriate to impose it (also) on Market 4 than e.g. (only) on Market 3a or 3b. This would usually be the case if the L2 WAP is considered to be a substitute for other Market 4 products (mainly leased lines). This is the case in five countries (FI, FR, NL, PT, SI), where the L2 WAP on Market 4 is available with high symmetrical bandwidths of up to 1 Gbit/s (FI, FR, PT, SI), similar to leased lines (see section 5.8), and also has service level agreements (SLAs) and service level guarantees (SLGs) (see section 5.6).<sup>3</sup>

It might also be the case that such products are not considered as substitutes, but they are still analysed together with Market 4 products, since (i) both are “high-quality access” wholesale products that allow alternative operators to configure high-quality tailor-made bundled offers (“personalized offers”) in order to meet the specific (and more complex) needs of business customers with multiple sites and different requirements for each site and (ii) the

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<sup>2</sup> There are two main types of use for Market 4 products: (i) Building up or extending a network (e.g. mobile operators connecting base stations or unbundling operators connecting MDFs) or (ii) providing services to businesses at the retail level. The focus of L2 WAP on Market 4 is usually the latter form of use.

<sup>3</sup> There is no information available whether the L2 WAPs imposed in Finland do also have these characteristics since there are several sub-national markets with 21 regional SMP operators and data of all 21 L2 WAPs are not available.



competitive conditions are considered to be sufficiently homogenous.<sup>4</sup> This is the case in Spain, where the product has lower symmetrical bandwidths than in the other four countries.

In some cases, a L2 WAP imposed on Market 3a and/or 3b provides also high-quality characteristics. Then the NRA has to decide whether to include a L2 WAP in Market 4 or not. This depends on the substitutability or the homogeneity of competitive conditions as outlined in the previous paragraph.

Geographic considerations may also play a certain role in the decision to impose a L2WAP on Market 4. If there are, for example, differences in competitive conditions in the residential segment, which lead to a geographic segmentation of Markets 3a or 3b, these do not necessarily apply to the high-end business segment.<sup>5</sup> In such circumstances, it might be appropriate to include and impose such a product on Market 4 since this might better reflect competitive conditions in the high-end business segment. In Spain, for example, Market 3b was subdivided geographically due to differences in competitive conditions in the mass-market (residential and small business) segment but Market 4 was defined as national market. In Portugal, both Market 3b and Market 4 are geographically differentiated, but the geographic areas differ.

#### ***Reasons not to impose a L2 WAP on Market 4***

There can also be reasons why a L2 WAP is not imposed on Market 4 (given that Market 4 is still regulated).<sup>6</sup> In a number of cases, it appears that the existing Market 4 regulation with access to leased lines (and in some cases dark fibre) together with remedies on Markets 3a and/or 3b were considered to be sufficient to remedy any competition problems identified by the respective NRAs. Several countries did not impose access to a L2 WAP on any market (EE, LT, RO, SE, SK). In these countries, a sufficient degree of competition in the high-quality business segment might be ensured e.g. by physical unbundling, duct access, access to leased lines and/or infrastructure based competition.

Some NRAs included and imposed a high-quality L2 WAP on Market 3a and/or 3b. In particular, if a L2 WAP for the use in the residential and mass-market business segment is imposed on these markets, it might be appropriate to include high-quality characteristics of this product in the same market (if no other differences apply, such as a different geographic segmentation). Such high-quality characteristics could be included e.g. based on supply-side substitution (BE) or the homogeneity of competitive conditions. Eight countries (AT, BE, HR, IE, IR, IT, LU<sup>7</sup>, PL) have imposed a L2 WAP on Market 3b which enable ANOs to provide business services with higher QoS requirements than mass-market services. Even in such

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<sup>4</sup> I.e., even if the markets were defined and analysed separately, the conclusions would not differ.

<sup>5</sup> E.g. because operators addressing this market segment do not enjoy the same economies of scale as the operators addressing the residential segment and therefore may not find it profitable to invest up to the level of the local exchange (MDF and/or ODF).

<sup>6</sup> At the time of writing this report, Market 4 was fully deregulated in five countries (BG, DK, EE, SE, SK).

<sup>7</sup> Only if technically feasible

cases, it should also be analysed whether the L2 WAP with high-quality characteristics should (also) be included in Market 4 (like e.g. in Spain). If the result of such an analysis is that it should not be included in Market 4, then the inclusion in Market 3a and/or 3b might be sufficient.

Six countries which took a decision on Market 4 since the 2014 Recommendation on relevant markets entered into force (CY, CZ, IT, MT, PL, UK) considered an existing L2 WAP on Market 3a or 3b not to be a substitute for Market 4 products. There are different reasons for this conclusion, mainly related to differences in product characteristics and demand. Still, some of these L2 WAP might also be appropriate (at least to some extent) for use in the business segment. In these six countries, a (additional) L2 WAP on Market 4 was not considered to be necessary or proportionate.

## **4 Prices of L2 WAPs on Market 4**

Information on the pricing methodology has been provided by five countries which imposed a L2 WAP on Market 4 (ES, FR, NL, PT, SI). The pricing obligation is in general cost oriented prices in combination with margin squeeze tests (see Table 12 in the annex). There are, however, some exceptions from cost orientation within certain countries. In Portugal and France, no cost orientation is applied in areas where there is a prospect of competition in the near future (PT) or there is at least one alternative wholesale provider at the MDF (FR). There are also differences with regard to the treatment of fibre in France and Spain. In Spain and France, no cost orientation applies to fibre based services of the L2 WAP on Market 4. In these countries, an economic replicability or margin squeeze test is applied instead. In France also a non-excessive pricing obligation is applied in areas with limited or no competition. In Portugal, the L2 WAP is only available based on fibre.

Information on prices of L2 WAP on Market 4 is available from four countries: Spain, France, the Netherlands, and Portugal. In Slovenia, the product has been imposed only recently and therefore the prices have not yet been set. In general, the prices depend on several parameters such as the bandwidth, the service level, the traffic class, the location of the endpoints, or the underlying infrastructure (copper or fibre). A direct price comparison is therefore not feasible. It can be observed, however, that prices of L2 WAPs more similar to Ethernet-based leased lines such as in Portugal and France are higher than those of the L2 WAP in Spain which is closer to an enhanced bitstream services.

## 5 Analysis of the technical characteristics of L2 WAPs on Market 4

This section analyses the technical characteristics of the L2 WAPs<sup>8</sup> of the countries which imposed such a product on Market 4 (see Table 1), based on the data provided in the annex, with one exception. Finland is not included in this analysis, since in Finland Market 4 is geographically differentiated and 21 regional SMP operators have to offer a L2 WAP and detailed data of these products is not available.

**Table 1: Overview of the L2 WAPs on Market 4 analysed**

Country	L2 WAP offered by	Name of the L2 WAP
France	Orange	<ul style="list-style-type: none"> <li>• CE-LAN (Core Ethernet LAN)</li> <li>• C2E (Core Ethernet Enterprises)<sup>9</sup></li> </ul>
Netherlands	KPN	VULA and WBA
Portugal	MEO	“Conetividade Ethernet”
Slovenia	Telekom Slovenije	Not known yet
Spain	Telefónica	NEBA empresarial (Business NEBA)

Source: BEREC

The analysis, on the one hand, constitutes the basis for the identification of common characteristics of L2 WAPs in section 6 and, on the other hand, also gives insight into where the technical characteristics of these L2 WAPs differ.

As discussed in section 2, several countries analysed in section 5 not only imposed a L2 WAP on Market 4 but also on Markets 3a and/or 3b. The technical characteristics of the L2 WAPs imposed on Market 4 are compared with the technical characteristics of the L2 WAPs imposed on Markets 3a and 3b at the end of this section.

### 5.1 Location of the PoH

The location of the PoH determines to what extent ANOs need own infrastructure (or an additional wholesale product) in order to be able to offer retail high-quality services to their customers based on a L2 WAP on Market 4. The definition of the PoH locations may be based on different criteria and therefore vary between countries. The total number of PoHs depends also on the size of the country.

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<sup>8</sup> The report analyses L2 WAP which are not an Ethernet-based leased line according to the explanatory note accompanying the 2014 Recommendation on relevant markets. For the purpose of this report, at least L2 WAPs imposed on Market 4 which provide access based on access nodes which are DSLAMs or OLTs are not considered to be an Ethernet-based leased line.

<sup>9</sup> In addition to the Ethernet-based L2 WAP, two legacy products based on ATM, DSLE (copper) and CE20 (fibre), are also available on Market 4 but are not included in the analysis in this section since they are no longer frequently used in current deployments.

In two countries (PT, SI), the PoH locations are based on the SMP operator's network topology and they are at the local level with 156 PoHs (PT<sup>10</sup>) and 936 PoHs (SI) and also at the regional level with 12 PoHs (PT) and 68 PoHs (SI) (see Table 4 and Table 5). In other two countries (FR, NL), the PoH locations are defined according to the geographic density of mass-market users, in one of them (NL) in addition also of business users, and they are at the regional level with 52 (FR) and 161 (NL) PoHs and in one country (FR) also at the national level with 2 PoHs. In the remaining country (ES), the L2 WAP is based on an existing L2 WAP (on Market 3b) with 50 PoHs at the regional level.

Overall, the L2 WAPs are available with PoHs at the local level in two countries (PT, SI), at the regional level in four countries (ES, FR, NL, PT) and at the national level in two countries (FR, NL).

## 5.2 Technology

Ethernet is the most commonly used interface in both packet based transport networks of service providers and local area networks (LAN) of end-users. Hence, the L2 WAP of all five countries analysed are based on the Ethernet protocol and provide an Ethernet service to the ANOs with an Ethernet interface at both the PoH and the customer premises (see Table 2 and Table 3).<sup>11</sup>

## 5.3 Availability

The availability of the L2 WAP determines where ANOs are able to provide retail services to their business customers based on the L2 WAP. In all five countries, the L2 WAP is available in the NGA rollout areas of the SMP operator where typically also business customers of the ANOs are located (see Table 6 and Table 7). However, in Portugal, since geographic Market 4 is defined as sub-national market, this is the case only in none-competitive areas. In addition in four countries (ES, FR, NL, SI), the L2 WAP is available on all copper access lines. In the other country (PT), the L2 WAP is only available based on fibre. In one country (ES), the L2 WAP is also available on all fibre access lines.

## 5.4 Type of access architecture

In access networks, different types of architectures (e.g. FTTE<sub>x</sub>, FTTC, FTTB, FTTH) are used depending on the extent to which fibre is rolled out. The closer the fibre to the end-user the higher the bandwidth that can be offered based on this access. The access architecture therefore determines the (maximum) bandwidth of the products ANOs can offer to their retail business customers.

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<sup>10</sup> In Portugal, the location of the "local" PoH of the L2 WAP on Market 4 (156 PoHs) is to some extent at a higher level of the network hierarchy than the local PoH of leased lines (> 1,600 PoHs).

<sup>11</sup> The interface at the customer premises is on Layer 2 based on Ethernet and on Layer 1 based on either also Ethernet or on DSL/PON depending whether the DSL modem/ONT is provided by the SMP operator or by the ANO.

In four countries (ES, FR, PT, SI), the L2 WAP is available on fibre-based subscriber access lines. In one country (ES), the L2 WAP is based on FTTH PON and in the other three countries (FR, PT, SI) based on FTTO or FTTH P2P.<sup>12</sup> In the other country (NL), Market 4 is only regulated for copper-based access and therefore the L2 WAP imposed on Market 4 is only available on copper-based access lines.

Other available access architectures are FTTB in two countries (ES, SI), FTTdp<sup>13</sup> (G.fast) in one country (SI) and FTTC in three countries (NL, SI, ES). In all four countries (ES, FR, NL, SI) in which the L2 WAP is available on copper, it is also available on legacy access FTTE<sup>14</sup>.

## 5.5 Redundancy

Redundancy maintains availability of the L2 WAP even in case of a failure. This is important for ANOs since their business customers to which they provide high-quality retail services based on the L2 WAP demand a highly resilient and reliable service. Redundancy can be provided in many different ways, and the type of redundancy used determines the level of protection against failures.

In all five countries, the L2 WAP is (optionally) available with redundancy (see Table 6 and Table 7). In all four countries (FR, NL, PT, SI) in which the L2 WAP is considered to be a substitute for leased lines, the L2 WAP is optionally available with redundant access. In three of them (FR, NL, PT), the L2 WAP is available with redundant access links (i.e. redundant links between node at the customer premises and access node in the network). Therefore, in case of a failure on one access link the L2 WAP remains available based on the other access link. In two (FR, PT) of these three countries, the L2 WAP is also available with redundant nodes at the customer premises and in one country (FR) in addition also with redundant access nodes in the network. Therefore, in these cases the L2 WAP remains available also in case of a failure of the node at the customer premises and in the latter case even when the access node in the network no longer works properly. In the fourth country (SI), redundant access is available depending on the redundancy available in the network of the SMP operator.

In the remaining country (ES) in which the L2 WAP was not considered to be a substitute for leased lines, the L2 WAP does not provide redundant access but redundant handover links at

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<sup>12</sup> According to footnote 8, L2 WAPs based on DSLAMs are included in the analysis and the L2 WAP FTTO of France and the L2 WAP FTTH P2P of Slovenia are based on DSLAMs (in France in addition, it may also be implemented based on Ethernet switches, but it is one product which cannot be divided into two pieces). In Portugal, for several reasons, the NRA does not consider the L2 WAP it imposed on Market 4 and which is based on FTTO as an Ethernet-based leased line. For example, ANOs can choose the overbooking in the network of the SMP operator between the access node and the PoH and it also provides asymmetric bandwidth profiles.

<sup>13</sup> FTTdp stands for “fibre to the distribution point” located very near the customer premises.

<sup>14</sup> FTTE<sup>14</sup> stands for “fibre to the exchange” i.e. fibre is rolled out to the exchange (MDF/CO) but not closer to the customer premises.

the PoH (i.e. two or more redundant links between the handover node of the ANO and the SMP operator).

## 5.6 Service level agreements (SLAs) and service level guarantees (SLGs)

SLAs contractually define the L2 WAP performance and SLGs ensure that the SMP operator has to pay penalties in case the performance targets are not met. SLAs and SLGs are important for ANOs since business customers with higher QoS requirements often demand retail business services with a defined performance. SLAs and SLGs also increase the acceptance of retail business services of ANOs based on a cost-effective L2 WAP instead of leased lines which are typically provided with SLAs and SLGs.

In all five countries, the L2 WAP is available with a SLA and SLG, in four of them (ES, FR, SI, NL) with more than one service class (up to 3 classes) (see Table 8 to Table 11). In all five countries, the SLA defines the performance of provisioning time, service availability and repair time.<sup>15</sup> The performance targets for these performance parameters are for the best service class as follows:

- Provisioning time: on copper-based access lines between 6 and 10 working days and on fibre-based access lines between 8 and approximately 40 working days.
- Average service availability: in four countries (ES, FR, NL, PT) between 99.85% and 99.98%, except for some high bandwidth lines in Portugal (99.5%).<sup>16</sup>
- Repair time: in four countries (ES, FR, NL, SI) between 4 and up to 24 hours, in three of them (ES; FR, NL) between 4 and 8 hours.<sup>17</sup>

In case the performance targets are not met, the SMP operator has to pay the penalty proactively and automatically in three countries (FR, NL, PT) and on request of the ANO in two countries (ES, SI). The penalties are defined in four countries (FR, NL, PT, SI) as a percentage of the monthly fee and in one country (ES) as a percentage of the one-off fee for the access.

In the four countries which considered the L2 WAP to be a substitute for leased lines (FR, NL, PT, SI), the L2 WAP is available with 24/7 support services, a 24/7 rapid repair and a 24/7 service desk.

## 5.7 Customer premises equipment (CPE)/Modem

ANOs provide the retail business services to their business customers based on the CPE/modem. If ANOs have the possibility to use their own CPE/modem, then they are able to

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<sup>15</sup> In Spain, the SLA defines several further performance parameters (see Table 9). In all five countries, the L2 WAP is provided with a defined QoS (see section 5.9).

<sup>16</sup> In the other country (SI), the average service availability is not yet defined but needs to be based on non-discrimination.

<sup>17</sup> In the other country (PT), the target is defined as key performance indicator (KPI), 90% of the repairs need to be finished within 4 hours, 100% within 48 hours.

further differentiate their services and tailor them to the individual needs of their business customers and to innovate. However, this obligation must be proportionate and technically feasible. The CPEs/modems of the ANOs need to be interoperable with the network of the SMP operator.

In all five countries, the ANOs can use their own CPE (e.g. router) and whether they can use their own CPE including the modem depends on the type of access architecture (see Table 13 and Table 14). In all four countries (ES, FR, NL, SI) in which the L2 WAP is available based on copper (FTTEx, FTTC, FTTB)<sup>18</sup>, ANOs have the possibility to use their own CPE including DSL modem. In order to ensure interoperability between CPEs/modems of the ANOs and the SMP operators' network, in three countries (ES, FR, NL), they can use CPEs/modems which fulfil certain requirements defined by the SMP operator and in two countries (NL, SI) ANOs can use CPEs/modems which are listed in a white list.<sup>19</sup>

In one (ES) of the two countries in which the L2 WAP is available based on PON, ANOs can use their own CPE including the fibre modem (ONT) and they can choose the ONT from a white list. In the other country (SI), ANOs can use their own CPE but the fibre modem (ONT) is provided by the SMP operator. ANOs can use all CPEs with the standard Ethernet interface of the fibre modem (ONT).

In the three countries (FR, PT, SI) in which the L2 WAP is available on a dedicated fibre access (FTTH P2P or FTTO), ANOs can also use their own CPE and they are allowed to use all CPEs with the standard Ethernet interface provided by the SMP operator.

## 5.8 Bandwidth

The bandwidth profiles of the subscriber access line of the L2 WAP determine the bandwidths of the retail business services ANOs are able to offer to their business customers based on the L2 WAP. Business customers with higher QoS requirements often demand also rather high bandwidths and in particular symmetric bandwidths or at least sufficiently high upload bandwidths.

In all five countries, the L2 WAP is available with symmetric bandwidth profiles (see Table 15 and Table 16). In four countries (ES, FR, PT, SI), the L2 WAP is available with symmetric bandwidth profiles up to 600 Mbps, in the other country (NL) only up to 20 Mbps, since in this country Market 4 is only regulated for copper access and therefore the L2 WAP imposed is also only available on copper-based access lines. The number of symmetric bandwidth profiles varies between 5 (ES) and up to 33 (PT) and the minimum symmetric bandwidth between 256 kbps (NL) and 30 Mbps (ES).<sup>20</sup>

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<sup>18</sup> For the types of access architecture available in these countries see section 5.4.

<sup>19</sup> In Slovenia, for example, the CPE/modem has to enable the SMP operator to measure the QoS of the L2 WAP.

<sup>20</sup> In Slovenia, the SMP operator has to provide the bandwidth profiles based on non-discrimination, however, the bandwidth profiles are not yet defined.



In four countries (ES, NL, PT, SI), the L2 WAP is also available with asymmetric bandwidth profiles. The highest asymmetric bandwidth profiles vary between 1000/200 Mbps (PT), 300/30 Mbps (ES) and 20/15 (NL) Mbps. The lowest asymmetric bandwidth profiles range between 10/1 Mbps (PT), 1/0.32 Mbps (ES) and 0.512/0.256 Mbps (NL). The L2 WAPs are available with at least 11 asymmetric bandwidth profiles (ES) and up to 45 asymmetric bandwidth profiles (NL).<sup>20</sup>

## 5.9 Quality of service

Quality of service (QoS) is an important characteristic of L2 WAPs (as it is with any other service), in particular on Market 4, since ANOs use them to provide retail business services to business customers with higher QoS requirements. Business customers rely on the QoS of the business services they use and therefore often also demand a defined QoS.

In all five countries, the L2 WAP is available with a defined QoS and in two of them (FR<sup>21</sup>, PT) with three QoS classes, in one country (ES) with two QoS classes and in another country (NL) with one QoS class (see Table 17 and Table 18).<sup>22</sup>

The QoS varies between the countries and the performance targets range in the best QoS class for the frame loss ratio between 0.001% and 0.1%, for the frame delay between 2 ms and 45 ms and for the frame delay variation between 1 ms and 10 ms. In the four countries (FR, NL, PT, SI) which considered the L2 WAP to be a substitute for leased lines, the QoS is higher and the performance targets vary for frame delay only between 2 ms and 10 ms and for the frame delay variation only between 1 ms and 5 ms.<sup>22</sup>

The bandwidth of the L2 WAP is, on the one hand, not completely uncontended, since frame loss, frame delay and frame delay variation occur, and, on the other hand, not uncontrolled contended because the L2 WAP provides a defined QoS.

## 5.10 Traffic prioritisation

Traffic prioritisation increases the flexibility of ANOs to design their products according to the specific needs of their business customers and enables them to use the bandwidth of L2 WAP more efficiently. ANOs can mark traffic with different priorities and, in case of congestion, traffic with lower priority is dropped first. For example, ANOs can give voice traffic a higher priority than internet traffic. In case of congestion, the voice traffic may not be affected because the internet traffic is dropped first. Traffic priorities may also be linked with QoS classes and then traffic with different priorities is provided with different QoS.

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<sup>21</sup> In France, three QoS classes are available with regard to frame loss ratio, not with regard to frame delay and frame delay variation.

<sup>22</sup> In Slovenia, the L2 WAP provides a defined QoS based on non-discrimination, however, the number of class of services and the performance targets are not yet defined.



In all five countries, the L2 WAPs support different traffic priorities, in two of them (FR, PT) three priorities and in two of them (ES, NL) two traffic priorities (see Table 17 and Table 18).<sup>23</sup>

## 5.11 Use of VLANs

VLANs enable operators to create bandwidth “pipes” in their networks at the level of the Ethernet protocol. The possibility to use several VLANs increases the flexibility of ANOs in the design of their products. For example, if ANOs can use several VLANs per end user, e.g. for each service (voice, internet etc.) a different VLAN, then this may make the provision of their services and traffic forwarding easier. Or, if a whole layer of VLANs is available completely for an ANO (VLAN stacking), then it can also offer L2 services to their business customers which enable them to connect their different sites easier (at the level of VLANs instead of LANs).

In three (FR, NL, SI) of the four countries which considered the L2 WAP to be a substitute for leased lines (see section 3), one (or several) layer(s) of VLANs are available for ANOs and therefore also several VLANs per end-user (see Table 19 and Table 20).<sup>24</sup> In the country (ES), which did not consider the L2 WAP to be a substitute for leased lines, this is not the case and one VLAN is available per end-user (during the definition of the service, operators requested an architecture based on a single VLAN).

In all four countries (FR, NL, PT, SI) which considered the L2 WAP to be a substitute for leased lines, the L2 WAP is available based on a dedicated VLAN, i.e. this VLAN is not shared between different customers which may help the provider of the L2 WAP to provide high bandwidths and a high QoS, in the other country (ES) this is not the case.

## 5.12 Multicast

A L2 WAP with multicast frame replication functionality enables ANOs to provide of services generating multicast traffic with an efficient use of the bandwidth of the L2 WAP.<sup>25</sup> On the other hand, the multicast frame replication functionality increases the complexity and costs of a L2 WAP.

In none of the countries examined, the NRA imposed a L2 WAP with a multicast frame replication functionality on Market 4. This is different to market 3a or 3b, where some NRAs imposed a L2 WAP with a multicast frame replication functionality mainly to enable ANOs to efficiently offer IPTV services at the retail level. On Market 4, however, IPTV is not an issue.

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<sup>23</sup> In Slovenia, the L2 WAP provides different traffic priorities based on non-discrimination, however, the number of priorities is not yet defined.

<sup>24</sup> In the other country (PT), this information is not available.

<sup>25</sup> For example, the multicast frame replication functionality ensures that an IPTV channel is only transported once on a link of the L2 WAP even if several customers watch the same IPTV channel.

### 5.13 Customer identification

ANOs need to be able to identify their customers in order to be able to provide individual services to them. The customer identification enables ANOs to set up the connection (including assignment of an IP address), to authorise for each customer individually which network resources (services) the customer can use (e.g. limiting the internet access speed based on what the customer has signed up for) and to monitor each connection to ensure that it is still connected to the network.

In all five countries, the L2 WAP enables ANOs to identify their customers (see Table 19 and Table 20). The following two different methods are used:

- VLAN identifier: The customer is identified based on the VLAN identifier.
- Port identifier and DSLAM/access node identifier: The customer is identified based on the identifier of the physical port of the DSLAM/access node to which the subscriber access line is connected to and the DSLAM/access node identifier. This information is provided with two different protocols, the Dynamic Host Configuration Protocol (DHCP option 82) and the Point-to-Point Protocol over Ethernet (PPPoE) and ANOs can choose the protocol they prefer.

In four countries (FR<sup>26</sup>, NL, PT, ES), ANOs can identify their customers based on the VLAN identifier and in two countries (FR<sup>27</sup>, NL), also based on the port identifier and the DSLAM/access node identifier provided with both protocols (DHCP option 82, PPPoE) between ANOs can choose.<sup>28</sup>

### 5.14 Security

With security measures network operators can preserve the integrity and availability of their networks and services. The L2 WAPs are Layer 2 services and therefore ANOs have the possibility to apply any security measure they would like to use at layers above Layer 2.

The L2 WAPs themselves can also apply security measures at the level of the Ethernet protocol and/or at higher layers. However, security measures at least potentially reduce the transparency of the L2 WAPs.<sup>29</sup> Therefore, operators may have a different view on whether L2 WAPs themselves should apply security measures or not.

In two countries (FR, NL), the L2 WAP applies security measures, in both countries up to the layer of the Ethernet protocol, and in the other three countries (ES, PT, SI) this is not specified (see Table 21 and Table 22).

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<sup>26</sup> Core Ethernet LAN (CE-LAN)

<sup>27</sup> Core Ethernet Enterprises (C2E)

<sup>28</sup> In Slovenia, the method for the identification of the customers is not yet defined.

<sup>29</sup> Transparent transmission means e.g. in downstream direction that the Ethernet frames that are handed over to ANOs at the customer premises are the same as the Ethernet frames ANOs handover to the L2 WAP provider at the PoH.

## 5.15 Fault management

ANOs can use and configure their own CPE including modem on copper-based subscriber access lines in all four countries (ES, FR, NL, SI) in which the L2 WAP is available based on copper and on fibre-based subscriber access lines in one country (ES) (see section 5.7). Therefore, in case of a failure, ANOs have to locate the fault and to determine whether the fault is in their own domain or in the domain of the L2 WAP provider. ANOs may need support for their fault management in order to be able to offer their business customers with higher QoS requirements also a short repair time.

In all four countries (ES, FR, NL, SI) in which ANOs can use their own CPE including modem, the L2 WAP supports the fault management of ANOs at the DSLAM/OLT level. In three of them (ES, NL, SI), ANOs receive actual values of parameters of the subscriber access line on request in the other country (FR) ANOs have the possibility to activate a test<sup>30</sup> and reset DSLAM ports (see Table 21 and Table 22). In these four countries, ANOs do have also the possibility to use the data from their own CPE including modem (if available in case of failure) for fault handling.

In the other country (PT), ANOs have the possibility to use their own CPE<sup>31</sup> and ANOs do also have the possibility to use the data from their own CPE (if available in case of failure) for fault handling.

## 5.16 Configuration of DSLAM/OLT

In principle, L2 WAPs may provide ANOs with the possibility to configure the DSLAM/OLT (e.g. bandwidth profiles, interleaving, noise margin, rate adaptation) based on direct access to the DSLAM/OLT management system. However, the provider of the L2 WAP is responsible for the provision of the L2 WAP and, if ANOs have the possibility to configure a network component like the DSLAM/OLT then it might be difficult for the L2 WAP provider to take the responsibility for that provision.

In no country analysed, the L2 WAP enables ANOs to configure the DSLAM/OLT based on direct access to the DSLAM/OLT management system (see Table 21 and Table 22).

## 5.17 Comparison with L2 WAP on Market 3b

Three countries (ES, FR, SI) which imposed a L2 WAP on Market 4 also imposed a L2 WAP on Market 3b (see section 2). In these countries, the quality characteristics of the L2 WAP on Market 3b are lower compared to the L2 WAP on Market 4 (see Table 23 and Table 24).

In Slovenia, the L2 WAP on Market 3b does have lower availability, lower SLAs and higher contention ratio. In France, the L2 WAP on Market 3b is not available with symmetric

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<sup>30</sup> DSLAM port synchronisation test

<sup>31</sup> Excluding modem since in this country (PT) the L2 WAP is based on P2P fibre only and therefore modems are not used (neither DSL modems nor fibre modems/ONTs).

bandwidth profiles on the subscriber access line, access redundancy, short repair time<sup>32</sup> and on fibre-based subscriber access lines (only available on copper). In Spain, the L2 WAP on Market 3b is not nation-wide (it is available in non-competitive areas of Market 3b) and has additional optional lower-end features (it allows lower QoS traffic and also allows for standard maintenance SLAs).

### **5.18 Comparison with L2 WAP on Market 3a**

Three countries (ES, NL, SI) which imposed a L2 WAP on Market 4 also imposed a L2 WAP on Market 3a and their characteristics differ as follows (see Table 25 and Table 26).

In Slovenia, the L2 WAP on Market 3a differs from the L2 WAP on Market 4 since its availability and SLAs are lower and it is available with a defined prioritisation and with a multicast frame replication functionality. In Spain, the L2 WAP on Market 3a offers bandwidth profiles with the current maximum speed (and ANOs build lower speed retail offers from it) and an ostensibly uncontended bandwidth. In the Netherlands, the L2 WAP on Market 3a is the same as on Market 4. The reason is that it was first, in 2012, imposed on Market 4. Later, in 2016, the NRA imposed the same L2 WAP also on Market 3a because Market 4 may be deregulated in the future.

## **6 Common characteristics of L2 WAPs on Market 4**

This section identifies common characteristics of the L2 WAPs imposed on Market 4 of the five countries analysed in this report (see section 5) and compare them at the end with the common characteristics of L2 WAPs imposed on Markets 3a and 3b.

As explained in section 3, L2 WAPs with high-quality are imposed on Market 4 in order to enable ANOs to offer high-quality retail communication services to businesses and/or replicate such services of the SMP operators. L2 WAPs on Market 4 have the advantage to be less costly than leased lines but still have a sufficiently high-quality level to use them for high-end business services.

The technical characteristics of the L2 WAPs on Market 4 depend on the demand of the retail business customers of the ANOs and also on the technical capabilities of the network of the SMP operator and maybe also on the market definition (e.g. bandwidths included). These aspects may vary between countries and therefore one might expect that also the technical characteristics of L2 WAPs on Market 4 differ between countries.

However, from the analysis in section 5 results that L2 WAPs on Market 4 of different countries, despite differences in national circumstances, do have the following characteristics in common.

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<sup>32</sup> No four hour repair time guarantee

**1) Technology:** The L2 WAP is based on Ethernet.

Ethernet is the most commonly used interface in both packet based transport networks of service providers and local area networks (LAN) of business customers. The L2 WAP analysed are based on the Ethernet protocol and provide an Ethernet service to ANOs.

**2) Availability:** The L2 WAP is available at least in NGA rollout areas.

The L2 WAP analysed are available at least in the NGA rollout areas of the SMP operator where typically also business customers of the ANOs are located.

**3) Bandwidth:**

**a) Type:** The L2 WAP is available with both asymmetric and symmetric bandwidth profiles of the subscriber access lines.

**b) Speed:** In case regulation on Market 4 includes fibre-based access, the L2 WAP is available with symmetric bandwidth profiles of at least 600 Mbps.

Business customers with higher QoS requirements often demand symmetric and rather high bandwidths and L2 WAPs with high symmetric bandwidth profiles of the subscriber access line enables ANOs to meet this bandwidth demand.

**4) Quality of Service:**

**a) Type:** The L2 WAP is available with a defined QoS.

**b) Level:** The L2 WAP is available (in the best QoS class) with the following QoS performance targets:

(i) Frame Loss Ratio less than 0.1% (ranges in the countries between 0.001% and 0.1%);

(ii) Frame Delay less than 45 ms (ranges between 2 ms and 45 ms);

(iii) Frame Delay Variation less than 10 ms (ranges between 1 ms and 10 ms).

Business customers with higher QoS requirements often demand a defined and rather high QoS and therefore a L2 WAP with defined QoS and the mentioned QoS performance targets enables ANOs to meet this demand.<sup>33</sup>

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<sup>33</sup> In one country (SI), the QoS performance targets are based on non-discrimination, however, not yet defined in detail. In case only the L2 WAPs are taken into account which are considered to be a substitute for leased lines (see section 3), the common QoS is higher and the QoS performance targets are as follows: Frame Delay maximum 10 ms and Frame Delay Variation maximum 5 ms.

**5) Service Level Agreement:**

- a) Availability:** The L2 WAP is available with a SLA.
- b) Performance parameters:** The SLA defines the performance of provisioning time, service availability and repair time.
- c) Performance targets:** The performance targets (in the best service class) are as follows:
  - (i) Provisioning time maximum 10/40 (copper/fibre) working days (ranges in the countries between 6/8 (copper/fibre) working days and 10/40 working days);<sup>34</sup>
  - (ii) Service availability at least 99.5%<sup>35</sup> (ranges between 99.98% and 99.5%);
  - (iii) Repair time maximum 24 hours<sup>36</sup> (ranges between 4 hours and 24 hours).

Business customers with higher QoS requirements often demand services which are rapid, reliable and highly available and have a defined performance and SLAs with the mentioned performance parameters and performance targets enables ANOs to meet this demand.

**6) Service Level Guarantee:** The L2 WAP is available with a SLG.

Business customers which demand SLAs expect that they are met and therefore often demand also penalties if the SLAs are not met and SLGs enable ANOs to meet this demand.

**7) Redundancy:** The L2 WAP is (optionally) available with redundancy.

Business customers with higher QoS requirements often demand highly resilient and reliable services and redundancy, which maintains the availability of a service even in case of a failure, enables ANOs to meet this demand.

**8) CPE/modem:** ANOs can use and configure their own CPE and in case of copper-based access (if available) their own CPE including the modem.

The use of their own CPE/modem enables ANOs to further differentiate their services and tailor them to the individual needs of their business customers and to innovate. The CPEs/modems of the ANOs need to be interoperable with the network of the SMP operator.

**9) Traffic Prioritisation:** The L2 WAP supports different traffic priorities.

Traffic prioritisation increases the flexibility of ANOs to design their products according to the specific needs of their business customers and enables them to use the bandwidth of the L2 WAP more efficiently (e.g. by prioritising voice traffic over internet traffic).

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<sup>34</sup> Of existing lines, no digging or repair.

<sup>35</sup> In one country (SI), the service availability is based on non-discrimination, however, not yet defined in detail. The service availability of the L2 WAP analysed is at least 99.85% except for some high bandwidth lines in Portugal.

<sup>36</sup> One country (PT) could not be taken into account since the repair time is defined differently, however, the mentioned repair time target have to be met by most repairs.

**10) Customer Identification:** The L2 WAP enables ANOs to identify their end-users.

Customer identification enables ANOs to provide individual services to their subscribers and to authorise for each customer individually which network resources (services) the customer can use (e.g. limiting the internet access speed based on what the subscriber has signed up for).

**11) Security:** The L2 WAP enables ANOs to apply security measures.

With security measures network operators can preserve the integrity and availability of their networks and services. ANOs have the possibility to apply any security measure they would like to use at Layer 3 and higher layers.

The common characteristics of the L2 WAPs on Market 4 identified differ from the common characteristics of the L2 WAPs on Market 3a and 3b analysed by BEREC in 2015 (BoR (15) 133) as follows. The L2 WAPs on Market 3a and 3b do also have the common characteristics 1, 2, 8 (partly), and 9 to 11, but not 3 and 4 which are rather similar to Ethernet-based leased lines. Information whether they do also have the common characteristics 5 to 7 is not available, since these characteristics are rather specific to leased lines and were therefore not included in the mentioned analysis of BEREC in 2015.

## 7 Abbreviations for countries

Abbreviation	Country
AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain

Abbreviation	Country
FI	Finland
FR	France
GR	Greece
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia

Abbreviation	Country
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom

## 8 Further abbreviations

ANO	Alternative Network Operator
BEREC	Body of European Regulators for Electronic Communications
BoR	Board of Regulators
CE-LAN	Core Ethernet LAN
CO	Central Office
CoS	Class of Service
CPE	Customer Premises Equipment
C2E	Core Ethernet Enterprises
DHCP	Dynamic Host Configuration Protocol
DSLAM	Digital Subscriber Line Access Multiplexer
EU	European Union
FD	Frame Delay
FDV	Frame Delay Variation
FLR	Frame Loss Ratio
FTTB	Fibre To The Building
FTTC	Fibre To The Curb
FTTdp	Fibre To The distribution point
FTTEx	Fibre To The Exchange



FTTH	Fibre To The Home
FTTO	Fibre To The Office
L2 WAP	Layer 2 Wholesale Access Product
MDF	Main Distribution Frame
NGA	Next Generation Access
NGN	Next Generation Network
NRA	National Regulatory Authority
ODF	Optical Distribution Frame
ONT	Optical Network Termination
OLT	Optical Line Termination
PDH	Plesiochronous Digital Hierarchy
PoH	Point of Handover
PON	Passive Optical Network
PPPoE	Point-to-Point Protocol over Ethernet
P2P	Point-to-Point
QoS	Quality of Service
SDH	Synchronous Digital Hierarchy
SLA	Service Level Agreement
SLG	Service Level Guarantee
SMP	Significant Market Power
SRA	Seamless Rate Adaption
VLAN	Virtual Local Area Network
VULA	Virtual Unbundled Local Access

## Annex

**Table 2: General information on the decision of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
When did the NRA take the last decision on Market 4?	December 2017	2012	September 2016.
Was the geographic Market 4 defined as:			
• National market?	Yes	Yes	No
• Sub-national market? If this is the case, how?	No	No	Yes. 3 sets of geographical areas. <sup>37</sup>
Name of the network operator which has to offer the L2 WAP on Market 4	Orange	KPN	MEO (formerly PT, acquired by Altice).
Name of the L2 WAP offered by this operator on Market 4	<ul style="list-style-type: none"> <li>• CE-LAN (Core Ethernet LAN, Ethernet delivery on a "Dedicated" or "1:1" VLAN architecture).</li> <li>• C2E (Core Ethernet Enterprises, Ethernet delivery on a "1:n" VLAN architecture)<sup>38</sup></li> </ul>	VULA and WBA	"Conetividade Ethernet".
Link to the reference offer	See footnote <sup>39</sup>	See footnote <sup>40</sup>	See footnote <sup>41</sup>

Source: BEREC

<sup>37</sup> Three sets of geographical areas (parishes, smallest administrative areas) were defined, according to the competitive level at the retail (and wholesale) market of high-quality access.

<sup>38</sup> Two legacy products, DSLE (copper, ATM delivery) and CE2O (fiber, ATM delivery) are also delivered, although they are not frequently used in current deployments they are still present in the installed base. Information on the characteristics of these products is not provided in the tables, except the number of access lines for those two products is included in the market figures in Table 4

<sup>39</sup> <https://www.orange.com/fr/Groupe/Activites/Les-reseaux/Documentation/Documentation-reseaux>, *Offre de Référence de Service de Capacité*, C2E : chapter 4.1, CE-LAN : chapter 4.2

<sup>40</sup> <https://www.kpn-wholesale.com/producten-diensten/breedband-toegang/wba.htm?itemId=18721> , <https://www.kpn-wholesale.com/producten-diensten/breedband-toegang/wba.htm>

<sup>41</sup> <http://ptwholesale.pt/en/servicos-nacionais/capacidade/Pages/orce.aspx>

**Table 3: General information on the decision of the L2 WAP imposed on Market 4 (ES, SI)**

<b>Country</b>	<b>Slovenia</b>	<b>Spain</b>
When did the NRA take the last decision on Market 4?	The decision will be imposed in the beginning of 2018.	24 <sup>th</sup> February 2016
Was the geographic Market 4 defined as:		
• National market (Yes/No)?	Yes.	Yes
• Sub-national market (Yes/No)? If this is the case, how?	No	No
Name of the network operator which has to offer the L2 WAP on Market 4	Telekom Slovenije	Telefónica
Name of the L2 WAP offered by this operator on Market 4	Not known yet.	NEBA empresarial (Business NEBA)
Link to the reference offer (please insert footnote and provide this link in the footnote)	Reference offer still in process.	See footnote <sup>42</sup>

Source: BEREC

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<sup>42</sup> [https://www.cnmc.es/sites/default/files/editor\\_contenidos/Telecomunicaciones/Ofertas/NEBA/2017\\_Texto%20NEBA%20Junio%202017.pdf](https://www.cnmc.es/sites/default/files/editor_contenidos/Telecomunicaciones/Ofertas/NEBA/2017_Texto%20NEBA%20Junio%202017.pdf)

**Table 4: Technology and PoHs of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
Interface of the L2 WAP at the PoH	Ethernet	Ethernet	Ethernet
The level of the network hierarchy of the PoHs is:			
• Local (CO/MDF) (Yes/No)?	No	No	Yes (although beyond the leased lines' local PoH, with a total of >1,6k Local CO).
• Regional (Yes/No)?	Yes	Yes	Yes
• National (Yes/No)?	Yes	No	No
Total number of PoHs of the L2 WAP per PoH level	<ul style="list-style-type: none"> <li>Regional: 24 regions, 2 POH per region (6 for Paris area)</li> <li>National: 2 PoHs (ANO's choice among the 52 regional PoHs)</li> </ul>	Regional: 161	156 "Local" (aggregation) and 12 Regional.
The PoHs are defined according to the geographic density of:			
• Mass-market users	Yes	Yes (VULA Market 3a and WBA) <sup>43</sup>	No
• Business users	No	Yes <sup>43</sup>	No
• The PoHs are defined according to other criteria	No	No	Yes, SMP operator's network topology (local/regional aggregation levels).
Number of subscriber access lines actively used for L2 WAP on Market 4	<ul style="list-style-type: none"> <li>DSL : ~ 210 000 end 2016<sup>44</sup></li> <li>Fiber ptp : ~ 45 000 end 2016<sup>45</sup></li> </ul>	80 700 (Q2 2017)	No information available.

Source: BEREC

<sup>43</sup> Metro core locations in the network of the SMP operator.<sup>44</sup> Figure includes also number of subscriber access lines actively used for legacy product DSLE (copper, ATM delivery) (see footnote 38).<sup>45</sup> Figure includes also number of subscriber access lines actively used for legacy product CE2O (fiber, ATM delivery) (see footnote 38).

**Table 5: Technology and PoHs of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
Interface of the L2 WAP at the PoH	Ethernet	Ethernet
The level of the network hierarchy of the PoHs is:		
• Local (CO/MDF)	Yes	No
• Regional	Yes (edge router level)	Yes
• National	No	No
Total number of PoHs of the L2 WAP per PoH level	907 copper MDFs 272 optical ODFs (936 different locations) 68 edge router locations	50
The PoHs are defined according to the geographic density of:		
• Mass-market users	No	No
• Business users	No	No
• The PoHs are defined according to other criteria	Yes, SMP's network topology	Yes, L2 WAP (Business NEBA) was defined based on the existing NEBA product, and maintains the number and locations of PoH (which can be used for both services).
Number of subscriber access lines actively used for L2 WAP on Market 4	None (decision in process)	January 2018: 13,835 lines

Source: BEREC

**Table 6: Availability and redundancy of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
The L2 WAP is available in the following areas:			
• In the NGA areas	Yes	Yes	Yes (in none competitive areas)
• For all broadband access lines	No	Yes	No (for > 24 Mbps and fiber based)
• For all copper access lines	Yes	Yes	No (not available for copper access, only fiber)
• Other areas	No	No	No
The L2 WAP is available based on the following NGA architectures			
• FTTEx	Yes	Yes	No
• FTTC	No	Yes	No
• FTTB	No	No	No
• FTTH (PON and/or P2P fibre)	No (see below)	No	No
• Others	Yes, FTTO <sup>46</sup>	No	Yes, FTTO
The L2 WAP is (optionally) available with redundancy	Yes	Yes	Yes (optional)
The redundancy options available are:			
• Redundant access	Yes. i) , ii), and iii) <sup>47</sup>	Yes, copper/fiber (FTTO, FTTH)	Yes. (i) and (ii) <sup>47</sup>
• Other redundancy option	No	Yes, mobile and FTTH	No

Source: BEREC

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<sup>46</sup> Fiber To The Office i.e. an 'ad hoc' dedicated fibre to the retail business customer

<sup>47</sup> (i) redundant access based on redundant access links (2 links between node at the customer premises and access node in the network), (ii) redundant access based on redundant nodes at the customer premises (both are connected to the same access node in the network) (iii) redundant access based on redundant nodes at the customer premises and redundant access nodes in the network (each node at the customer premises is connected to a different access node in the network).

**Table 7: Availability and redundancy of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
The L2 WAP is available in the following areas:		
• In the NGA areas	Yes	Yes
• For all broadband access lines	No (not for FTTO)	Yes
• For all copper access lines	Yes	Yes <sup>48</sup>
• Other areas	No	Yes, all fiber
The L2 WAP is available based on the following NGA architectures		
• FTTEx	Yes	Yes
• FTTC	Yes	Yes
• FTTB	Yes	Yes
• FTTH (PON and/or P2P fibre)	Yes, based on PON and P2P fibre	Yes, based on PON
• Others	Yes, for FTTdp (g.fast)	No
The L2 WAP is (optionally) available with redundancy	Yes	Yes
The redundancy options available are:		
• Redundant access	Yes, depends on availability	No
• Other redundancy option	Yes, redundant connections between customer premises and PoH in case ANO provides redundant connection	A PoH can be set up as a LAG (Link Aggregation Group, acc. IEEE 802.3ad)

Source: BEREC

<sup>48</sup> Subject to general availability of NEBA on copper lines

**Table 8: SLAs of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
The L2 WAP is (optionally) available with SLAs	Yes	Yes, all SLAs are available	Yes (mandatory).
The SLA defines the following performance parameters:			
• Provisioning time	Yes	Yes	Yes
• Average service availability	Yes	Yes	Yes
• Repair time	Yes	Yes	Yes
• Other performance parameters	No	Yes, CoS, QoS SLAs (jitter, delay, packet loss etc.)	No
Number of service classes (options) the SLA defines for each of the performance parameters	<ul style="list-style-type: none"> <li>Provisioning time : 1 (+ express optionally)</li> <li>Average service availability : 2</li> <li>Repair time : 2</li> </ul>	Provisioning time : 2 (plus 2 additional) Average service availability: 1 Repair time : 3	1 class only (different objectives/KPI for each parameter)
Performance targets for each performance parameter and service class:			
• Provisioning time	<ul style="list-style-type: none"> <li>DSL: 14 calendar days<sup>49</sup></li> <li>Fiber: 56 calendar days, in case fiber is already deployed on the site. The delay does not apply in case of exceptional difficulties</li> </ul>	NLS 1, NLS 2 and NLS 3: <sup>50</sup> <ul style="list-style-type: none"> <li>NLS 1 = 6 /10 working days (without / with testing and labelling)</li> <li>NLS 2 = 23 working days</li> <li>NLS 3 = 50 working days</li> </ul>	Type 1 (CO with Ethernet eq.) <ul style="list-style-type: none"> <li>20 days for 95%</li> <li>40 days 100%</li> </ul> Type 2 (CO without Ethernet eq.) <ul style="list-style-type: none"> <li>40 days for 95%</li> <li>60 days 100%</li> </ul>
• Average service availability	<ul style="list-style-type: none"> <li>Class 1: 99.85 of calendar year. (max. 13 hours of unavailability per year, 24/7)</li> <li>Class 2: 99.58 of calendar year (max. 13 hours of unavailability per year, on busy hours)</li> </ul>	99,98%	10 Mbps, 100 Mbps - 99,95% 1 Gbps - 99,50%
• Repair time	<ul style="list-style-type: none"> <li>Class 1: 4 hours 24/7</li> <li>Class 2 : 4 hours on business hours (Monday to Saturday, 8 am to 6 pm)</li> </ul>	8 hours / Business hours (working days 8h-18h) / Standard SLA (3 working days)	4 hours for 90% 48 hours for 100%

Source: BEREC

<sup>49</sup> In case of a copper local loop saturation (no resource available), production lead time standard is longer: a period of 77 days would become the new contractual reference.

<sup>50</sup> NLS 1 is the standard provisioning time (copper is already deployment and no problems are known). Only in case of problems/errors (NLS 2) or a new line request (NLS 3) another provisioning time is chosen. The performance targets are as follows: NLS 1 = 6 working days (without testing and labelling), NLS 1 = 10 working days (with testing and labelling), NLS 2 = 23 working days (repairs need to be done on the line) and NLS 3 = 50 working days (new line digging <50 meter).



**Table 9: SLAs of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
The L2 WAP is (optionally) available with SLAs	Yes	Yes
The SLA defines the following performance parameters:		
• Provisioning time	Yes	Yes
• Average service availability	Yes, based on non-discrimination	Yes
• Repair time	Yes, based on non-discrimination	Yes
• Other performance parameters	No	Several further performance parameters <sup>51</sup>
Number of service classes (options) the SLA defines for each of the performance parameters	3, based on non-discrimination.	2 classes for traffic QoS, 1 for the rest
Performance targets for each performance parameter and service class:		
• Provisioning time	8/15/30 working days	Copper: 6 working days FTTH: 10 working days (new access to be deployed) or 5 working days (access already existing)
• Average service availability	Yes, based on non-discrimination.	99.90%
• Repair time	Up to 24 hours (defined with SLA, based on non-discrimination.) 5 working days for heavy damages out of SLA	<ul style="list-style-type: none"> <li>PoH: 6 hours</li> <li>Access premium maintenance: 6/8/12 hours for copper, 1 working day for fibre</li> </ul>

Source: BEREC

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<sup>51</sup> Parameter change time, service deactivation time, PoH provisioning/deactivation/modification time, traffic QoS, backhaul link provision/availability

**Table 10: SLGs and 24/7 services of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
The L2 WAP is available with SLGs	Yes	Yes	Yes
<ul style="list-style-type: none"> <li>The payment of penalties is pro-active /automatic</li> </ul>	Yes, pro-active/automatic	Yes, pro-active/automatic	Yes, pro-active/automatic (quarterly list sent, checked by ANO).
<ul style="list-style-type: none"> <li>The penalties which have to be paid are defined as a percentage of the monthly fee</li> </ul>	Yes	Yes	Yes
The L2 WAP is (optionally) available with			
<ul style="list-style-type: none"> <li>Rapid 24/7 repair</li> </ul>	Yes	Yes	Yes
<ul style="list-style-type: none"> <li>24/7 service desk</li> </ul>	Yes	Yes	Yes
<ul style="list-style-type: none"> <li>Other 24/7 support</li> </ul>	No	Yes, standard (3 working days or 72 hours between Monday - Friday), business hours (between 8.00 -18.00)	No

Source: BEREC

**Table 11: SLGs and 24/7 services of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
The L2 WAP is available with SLGs	Yes	Yes
<ul style="list-style-type: none"> <li>The payment of penalties is pro-active /automatic</li> </ul>	No, ANO has to ask for it	No, ANO has to ask for it
<ul style="list-style-type: none"> <li>The penalties which have to be paid are defined as a percentage of the monthly fee</li> </ul>	Yes	No, penalties are a percentage (defined in the RO) of the one-off price for an access
The L2 WAP is (optionally) available with		
<ul style="list-style-type: none"> <li>Rapid 24/7 repair</li> </ul>	Yes	No
<ul style="list-style-type: none"> <li>24/7 service desk</li> </ul>	Yes	No
<ul style="list-style-type: none"> <li>Other 24/7 support</li> </ul>	No	No

Source: BEREC

Table 12: Price of the L2 WAP imposed on Market 4 (ES, FR, NL, PT; SI)

Country	France	Netherlands	Portugal	Slovenia	Spain
What is the pricing methodology?					
• Cost oriented prices	- DSL : Yes, areas with no competition (Orange only) = ZC3 (Zone Cuivre 3) - Fibre : No	Yes, only on copper	Yes (with the exception below).	Yes. LRIC+	Yes, for copper accesses.
• Margin squeeze test	- DSL : Yes, areas with limited competition (at least one alternative wholesale provider at the MDF) = ZC2 (Zone Cuivre 2) - Fibre : Yes, areas with limited or no competition = ZF2 (Zone Fibre 2)	Yes, only on copper	Yes. For a geographic market (set of geographical areas/parishes, where there is a prospect of competition in the near future). No cost-orientation for this market.	Yes, for monthly rentals.	No
• Other (please specify)	- DSL : no price obligations on most competitive areas (at least one alternative wholesale provider at the MDF for 7 years) = ZC1 (Zone Cuivre 1) - Fibre : no price obligations on most competitive areas = ZF1 (Zone Fibre 1) ; non excessive pricing on areas with limited or no competition = ZF2 (Zone Fibre 2)	N/A	No.	No.	Economic replicability test for fibre accesses.

Source: BEREC

**Table 13: CPE/modem of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
ANOs have the possibility to deploy their own CPE/modem in case of			
• copper-based subscriber access lines (FTTEx, FTTC, FTTB, FTTdp)	Yes, two options <sup>52</sup>	Yes	N/A (no copper access).
• fibre-based subscriber access lines (FTTH)	Yes, two options <sup>53</sup>	Yes	NT is provided by MEO (Ethernet interface) and CPE is deployed by the ANO
ANOs are allowed to deploy the following CPEs/modems on <u>copper-based</u> subscriber access lines:			
• A CPE/modem which is listed in a white list	No	Yes, ALU 1521 CLIP P CP (Copper Access)	N/A
• CPEs/modems which fulfil certain defined requirements	Yes <sup>54</sup>	Yes <sup>55</sup>	N/A
• Other CPEs/modems	No	No	N/A
ANOs are allowed to deploy the following CPEs/ONTs on <u>fibre-based</u> subscriber access lines:			
• A CPE/ONT which is listed in a white list	No	N/A	No
• CPEs/ONTs which fulfil certain defined requirements	Yes <sup>56</sup>	N/A	Yes (specified Ethernet interfaces – Annex 1 of the offer).
• Other CPEs/ONTs	No	N/A	No.

Source: BEREC

<sup>52</sup> Option 1: DSL modem provided and managed by SMP and Ethernet CPE provided by ANO. Option 2: DSL CPE provided by ANO directly connected on copper.

<sup>53</sup> Option 1: Fibre modem provided and managed by SMP and Ethernet CPE provided by ANO. Option 2: Fibre CPE provided by ANO directly connected on fibre.

<sup>54</sup> In case of option 1: CPE with 100 base-TX or 1000 base-T interfaces. In case of option 2: SMP (Orange) publishes a set of SHDSL specifications ANO's CPE must comply with.

<sup>55</sup> ADSL2+ over POTS: ITU G.992.5., ADSL2+ modem: (i) ITU T G.993.2 + ITU-T G.993.5 + G.INP (ITU-T- G.998.4 ) + SRA (ii) ITU-T G.998.2 / IEEE 802.3ah tbv VDSL Bonding/Vectored VDSL Bonding (iii) ETSI TR 101 830-1 V1.5.2; VDSL2 modem 3: ITU-T G997.1 rev. 3 handshake protocol defined in ITU-T G994.1

<sup>56</sup> In case of option 1: CPE with 100 base-TX or 1000 base-T interfaces. In case of option 2 (rarely used): CPE with standard optical Ethernet interface. SMP (Orange) provides the ANO with the optical characteristics of the access line.

**Table 14: CPE/modem of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
ANOs have the possibility to deploy their own CPE/modem in case of		
<ul style="list-style-type: none"> <li>copper-based subscriber access lines (FTTEx, FTTC, FTTB, FTTdp)</li> </ul>	Yes	Yes
<ul style="list-style-type: none"> <li>fibre-based subscriber access lines (FTTH)</li> </ul>	<ul style="list-style-type: none"> <li>FTTH P2P: Yes</li> <li>FTTH GPON: only CPE (not ONT)</li> </ul>	Yes
ANOs are allowed to deploy the following CPEs/modems on <u>copper-based</u> subscriber access lines:		
<ul style="list-style-type: none"> <li>A CPE/modem which is listed in a white list</li> </ul>	Yes. The number is not known yet.	No
<ul style="list-style-type: none"> <li>CPEs/modems which fulfil certain defined requirements</li> </ul>	No	Yes. General requirements are defined in the RO.
<ul style="list-style-type: none"> <li>Other CPEs/modems</li> </ul>	Yes, CPEs/modems which are tested by the provider of the L2 WAP	No
ANOs are allowed to deploy the following CPEs/ONTs on <u>fibre-based</u> subscriber access lines:		
<ul style="list-style-type: none"> <li>A CPE/ONT which is listed in a white list</li> </ul>	Yes, in case of FTTH P2P	Yes.
<ul style="list-style-type: none"> <li>CPEs/ONTs which fulfil certain defined requirements</li> </ul>	Yes, all CPEs with the standard Ethernet interface (PPPoE and VLAN capability) of the ONT (FTTH PON) or the NT/interface of SMP operator in case of FTTH P2P.	No
<ul style="list-style-type: none"> <li>Other CPEs/ONTs</li> </ul>	Yes, CPEs/modems which are tested by the provider of the L2 WAP	No

Source: BEREC

**Table 15: Bandwidth profiles of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
Asymmetric bandwidth profiles of the subscriber access line of the L2 WAP imposed on Market 4 in case of:			
FTTEx <sup>57</sup>	None (only SHDSL profiles)	N/A	N/A
FTTC	N/A	Approximately 45 profiles: <sup>58</sup> <ul style="list-style-type: none"> <li>• Maximum down/up 20/15 Mbps</li> <li>• Minimum down/up 0,512/0,256 Mbps</li> </ul>	N/A
FTTB	N/A	N/A	N/A
FTTH	N/A	N/A	38 profiles: 10/1, 10/2, 20/2, 20/4, 30/3, 30/6, 40/4, 40/8, ... 100/10, 100/20, 200/20, 200/40, 300/30, 300/60 ... 900/90, 900/180, 1000/100, 1000/200 Mbps
Other access architecture (e.g. FTTdp, FTTO)	FTTO: None (only symmetric profiles)	N/A	N/A
Symmetric bandwidth profiles of the subscriber access line of the L2 WAP imposed on Market 4 in case of:			
FTTEx <sup>57</sup>	SHDSL: 0,5 / 1 / 2 / 4 / 8 / 12 / 16 Mbps	N/A	N/A
FTTC	N/A	20 / 15 / 10 / 5 / 3 / 2 / 1 / 0,512 / 0,256 Mbps	N/A
FTTB	N/A	N/A	N/A
FTTH	N/A	N/A	33 profiles: 2 / 4 / 6 / 8 / 10 / 12 / 14 / 16 / 18 / 20 / 22 / 24 / ...80 / 90 / 100 / 200 / 300 / 400 / 500 / 600 / 700 / 800 / 900 / 1000 Mbps
Other access architecture (e.g. FTTdp, FTTO)	FTTO (PtP fiber): 12 profiles: 2 / 4 / 10 / 20 / 30 / 40 / 50 / 100 / 200 / 300 / 500 / 1,000 Mbps	N/A	N/A

Source: BEREC

<sup>57</sup> FTTEEx stands for Fibre To The EXchange (MDF/CO)<sup>58</sup> 20/15, 20/10, 15/10, 20/8, 15/8, 10/8, 20/6, 15/6, 10/6 .... 2/1, 2/0,512, 2/0,256, 1/0,512, 1/0,256, 0,512/0,256 Mbps

**Table 16: Bandwidth profiles of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
Asymmetric bandwidth profiles of the subscriber access line of the L2 WAP imposed on Market 4 in case of:		
FTTEx <sup>59</sup>	Based on non-discrimination.	<ul style="list-style-type: none"> <li>ADSL2+: 1/0,32, 4/0,64, 8/0,64, 10/0,8, 20/0,8 Mbps</li> <li>VDSL2: 10/1, 30/3 Mbps</li> </ul>
FTTC	Based on non-discrimination.	As in FTTEEx
FTTB	Based on non-discrimination.	As in FTTEEx
FTTH	Based on non-discrimination.	30/10, 50/5, 100/10, 300/30 Mbps
Other access architecture (e.g. FTTdp, FTTO)	Based on non-discrimination.	N/A
Symmetric bandwidth profiles of the subscriber access line of the L2 WAP imposed on Market 4 in case of:		
FTTEx <sup>59</sup>	Based on non-discrimination.	None
FTTC	Based on non-discrimination.	None
FTTB	Based on non-discrimination.	None
FTTH	<ul style="list-style-type: none"> <li>Based on non-discrimination.</li> <li>Up to 1 Gbps</li> </ul>	5 profiles: 30 / 50 / 100 / 300 / 600 Mbps
Other access architecture (e.g. FTTdp, FTTO)	Based on non-discrimination.	N/A

Source: BEREC

<sup>59</sup> FTTEEx stands for Fibre To The EXchange (MDF/CO)

**Table 17: Quality of service (QoS) and traffic prioritisation of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
The L2 WAP imposed on Market 4 is available with a bandwidth between customer premises and PoH which has a defined QoS with regard to: - Frame Loss Ratio (FLR) - Frame Delay (FD) - Frame Delay Variation (FDV)	<ul style="list-style-type: none"> <li>Frame Loss Ratio: 3 QoS classes<sup>60</sup>, target values : <math>10^{-5}/10^{-5}/10^{-4}</math></li> <li>One way Frame Delay : 3ms/10ms for regional/national PoH</li> <li>Frame Delay Variation : 1ms/3ms for regional/national PoH</li> </ul>	<ul style="list-style-type: none"> <li>Throughput= 99,98%</li> <li>Frame loss &lt;0.1%</li> <li>Delay 2ms</li> <li>Jitter &lt;5ms</li> </ul>	3 CoS (P1/P2/P3) <ul style="list-style-type: none"> <li>Frame Loss Ratio: 0.01% / 0.01% / 0.1%</li> <li>Frame Delay: &lt; 10 / 15 / 20 ms</li> <li>Frame Delay Variation: &lt; 2 / 5 / N/A ms</li> </ul>
The L2 WAP supports different traffic priorities	Yes	Yes	Yes
Number of traffic priorities	3	2	3
Based on p-bits	Yes, based on 802.1p marking (user priority bits)	Yes	No. Based on MEF 23.1.
Based on other parameters	No	No	See above (QoS parameters).

Source: BEREC

**Table 18: Quality of service (QoS) and traffic prioritisation of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
The L2 WAP imposed on Market 4 is available with a bandwidth between customer premises and PoH which has a defined QoS with regard to: - Frame Loss Ratio (FLR) - Frame Delay (FD) - Frame Delay Variation (FDV)	Yes, based on non-discrimination.	Yes <ul style="list-style-type: none"> <li>Gold traffic: FLR: 0.4%; FD: 66ms</li> <li>Real Time traffic: FLR: 0.02%; FD: 45ms; FDV: 10 ms</li> </ul>
The L2 WAP supports different traffic priorities	Yes, based on non-discrimination.	Yes
Number of traffic priorities	Based on non-discrimination.	2 (Gold, Real Time)
Based on p-bits	Based on non-discrimination.	Yes
Based on other parameters	Based on non-discrimination.	No

Source: BEREC

<sup>60</sup> Voice / Data Business / Data Guaranteed



**Table 19: VLAN characteristics and customer identification method of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
The number of C-VLANs the L2 WAP provides is	1	EVCs are transparent for the customer's CE-VLANs	EVCs are transparent for VLANs within the EVC <sup>61</sup> .
The maximum Ethernet frame size of the L2 WAP is	<ul style="list-style-type: none"> <li>• DSL: 1590 bytes for lines delivered from 2014 (until 2013 1576 bytes)</li> <li>• Fibre: 1793 bytes for lines delivered from 2014 (until 2013 1706 bytes)</li> </ul>	1592 bytes (untagged) /1600 bytes (with Q-in-Q tagging)	1526 bytes (including overhead). The availability of a MTU greater than 1526 bytes will be analysed on a case-by-case basis
The L2 WAP supports VLAN stacking	<ul style="list-style-type: none"> <li>• CE-LAN product: Yes, 4 VLAN levels allowed on the access line</li> <li>• C2E product: No</li> </ul>	Yes	No information available.
The L2 WAP provides a "Dedicated" or "1:1" VLAN <sup>62</sup>	<ul style="list-style-type: none"> <li>• CE-LAN product: Yes</li> <li>• C2E product: No</li> </ul>	Yes	Yes
The L2 WAP provides further advanced characteristics with regard to VLANs relevant for business customers	No	Yes (WBA Ethernet Point-to-Point)	No
The L2 WAP enables ANOs to identify their customers	Yes	Yes	Yes
If this is the case, ANOs have the possibility to identify their customers based on: <sup>63</sup>			
• VLAN identifiers	<ul style="list-style-type: none"> <li>• CE-LAN product: Yes</li> <li>• C2E product: No</li> </ul>	Yes	Yes <sup>64</sup>
• Port and DSLAM/access node identifier provided by the L2 WAP based on DHCP option 82	<ul style="list-style-type: none"> <li>• CE-LAN product: No</li> <li>• C2E product: Yes</li> </ul>	Yes	No
• Port and DSLAM/Access node identifier provided by the L2 WAP based on PPPoE Intermediate Agent	<ul style="list-style-type: none"> <li>• CE-LAN product: No</li> <li>• C2E product: Yes</li> </ul>	Yes	No
• Other method	No	No	No

Source: BEREC

<sup>61</sup> 1 EVC between PoH and customer premises and within each EVC ANOs can configure the VLANs that they want, as they pass transparently through the EVCs of this service.

<sup>62</sup> See BoR(15)133, p. 12

<sup>63</sup> The methods listed below are described in more detail in BoR (15)133, p. 16-17

<sup>64</sup> The ANO can assign VLAN IDs in the AA. If this assignment is not made by the ANO, MEO will sequentially assign the VLAN IDs in the AA.

**Table 20: VLAN characteristics and customer identification method of the L2 WAP imposed on Market 4 (ES, SI)**

Country	Slovenia	Spain
The number of C-VLANs the L2 WAP provides is	Based on non-discrimination.	1
The maximum Ethernet frame size of the L2 WAP is	Based on non-discrimination.	<ul style="list-style-type: none"> <li>• ADSL2+ and FTTH: 1600 bytes</li> <li>• VDSL2: 1518 bytes</li> </ul>
The L2 WAP supports VLAN stacking	Yes, based on non-discrimination.	No
The L2 WAP provides a "Dedicated" or "1:1" VLAN <sup>65</sup>	Yes, based on non-discrimination.	No
The L2 WAP provides further advanced characteristics with regard to VLANs relevant for business customers	Yes, based on non-discrimination.	No
The L2 WAP enables ANOs to identify their customers	Yes	Yes
If this is the case, ANOs have the possibility to identify their customers based on: <sup>66</sup>		
VLAN identifiers	Not defined.	Yes
Port and DSLAM/access node identifier provided by the L2 WAP based on DHCP option 82	Not defined.	No
Port and DSLAM/Access node identifier provided by the L2 WAP based on PPPoE Intermediate Agent	Not defined.	No
Other method	Not defined.	No

Source: BEREC

<sup>65</sup> See BoR(15)133, p. 12<sup>66</sup> The methods listed below are described in more detail in BoR (15)133, p. 16-17

**Table 21: Further characteristics of the L2 WAP imposed on Market 4 (FR, NL, PT)**

Country	France	Netherlands	Portugal
The L2 WAP is (optionally) available with a multicast frame replication functionality	<ul style="list-style-type: none"> <li>• CE-LAN product : N/A</li> <li>• CE2 product: Yes (not an option), C2E transparent to L2 multicast Ethernet Frames, with a limitation of 10 Mbps download traffic at each PoH (ANO POP =&gt; WSP POP).</li> </ul>	Yes	No
ANOs have the possibility to configure the DSLAM/OLT	No	No, however, ANOs are allowed to set their own configuration and the incumbent has to implement it in its network <sup>67</sup>	No. The L2WAP is not (yet) based on GPON.
The L2 WAP applies security measures	Yes	Yes	No information available.
If this is the case, at which layer:			
<ul style="list-style-type: none"> <li>• Up to Layer 2 (level of the Ethernet protocol)</li> </ul>	Yes	Layer 2	N/A
<ul style="list-style-type: none"> <li>• At higher layers than Layer 2</li> </ul>	No	No	N/A
The L2 WAP supports the fault management of ANOs as follows:			
<ul style="list-style-type: none"> <li>• ANOs have the possibility to use the data from their CPE/ONT/Modem (if available in case of failure) for fault handling</li> </ul>	Yes	Yes	Yes, but CPE only (without ONT/DSL modem since no copper and not (yet) PON)
<ul style="list-style-type: none"> <li>• ANOs have the possibility to receive actual values of parameters of the subscriber access line</li> </ul>	No, but ANOs can activate DSLAM port synchronization test and DSLAM port reset	Yes	No

Source: BEREC

<sup>67</sup> ANOs can request the incumbent to configure the DSLAM/ODF for them. For example, ANOs can request their own bandwidth speeds and the incumbent is obliged to configure the new configuration in its network.

**Table 22: Further characteristics of the L2 WAP imposed on Market 4 (ES, SI)**

<b>Country</b>	<b>Slovenia</b>	<b>Spain</b>
The L2 WAP is (optionally) available with a multicast frame replication functionality	No	No
ANOs have the possibility to configure the DSLAM/OLT	No	No
The L2 WAP applies security measures	Not defined	Not defined
If this is the case, at which layer:		
<ul style="list-style-type: none"> <li>Up to Layer 2 (level of the Ethernet protocol)</li> <li>At higher layers than Layer 2</li> </ul>		
The L2 WAP supports the fault management of ANOs as follows:		
<ul style="list-style-type: none"> <li>ANOs have the possibility to use the data from their CPE/ONT/Modem (if available in case of failure) for fault handling</li> </ul>	Yes for CPE	Yes, for CPE
<ul style="list-style-type: none"> <li>ANOs have the possibility to receive actual values of parameters of the subscriber access line</li> </ul>	Yes on request	Yes

Source: BEREC

**Table 23: Comparison of L2 WAPs imposed on Market 4 with L2 WAPs imposed on Market 3b – part 1**

Country	France	Slovenia	Spain
The characteristics of the L2 WAP imposed on Market 3b differ from the characteristics of the L2 WAP imposed on Market 4 mainly with regard to:			
<ul style="list-style-type: none"> <li>PoHs as described in Table 4 and Table 5</li> </ul>	Yes. On Market 3b, only the regional level is available	Yes. Regional and national PoH	No
<ul style="list-style-type: none"> <li>Availability and redundancy as described in Table 6 and Table 7</li> </ul>	<ul style="list-style-type: none"> <li>Availability: No</li> <li>Redundancy: Yes. Access redundancy is not available on Market 3b</li> </ul>	Yes. Lower availability on Market 3b.	No
<ul style="list-style-type: none"> <li>SLAs and SLGs as described in Table 8 and Table 9</li> </ul>	<ul style="list-style-type: none"> <li>Yes</li> <li>No 4h repair time guaranty on Market 3b</li> <li>Optional day+1 repair time guaranty<sup>68</sup></li> </ul>	Yes. Lower SLAs on Market 3b.	Yes. L2 WAP on Market 4 is not available with lower QoS (best-effort) and standard maintenance
<ul style="list-style-type: none"> <li>Pricing methodologies as described in Table 12</li> </ul>	Yes. No margin squeeze test pricing	Yes. ERT for NGA on Market 3b.	No
<ul style="list-style-type: none"> <li>CPEs/modems as described in Table 13 and Table 14</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Bandwidth profiles as described in Table 15 and Table 16</li> </ul>	Yes. Only asymmetric DSL access on Market 3b.	No	Yes. L2 WAP on Market 4 only includes high-quality traffic profiles.
<ul style="list-style-type: none"> <li>QoS as described in Table 17 and Table 18</li> </ul>	No	Yes. Higher contention ratio on Market 3b.	Yes. L2 WAP on Market 4 only includes high-quality traffic profiles.
<ul style="list-style-type: none"> <li>Traffic prioritisation as described in Table 17 and Table 18</li> </ul>	Yes. 4 traffic priorities.	No	Yes. L2 WAP on Market 4 only includes high-quality traffic profiles.
<ul style="list-style-type: none"> <li>VLAN characteristics as described in Table 19 and Table 20</li> </ul>	No. (Similar to C2E product)	No	No
<ul style="list-style-type: none"> <li>Customer identification as described Table 19 and Table 20</li> </ul>	No. (Similar to C2E product)	No	No

Source: BEREC

<sup>68</sup> Repair due before the end of the next business day.

**Table 24: Comparison of L2 WAPs imposed on Market 4 with L2 WAPs imposed on Market 3b – part 2**

Country	France	Slovenia	Spain
Contd.			
<ul style="list-style-type: none"> <li>Multicast as described in Table 21 and Table 22</li> </ul>	No	Yes	No
<ul style="list-style-type: none"> <li>Possibility to configure the DSLAM/OLT as described in Table 21 and Table 22</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Security measures as described in Table 21 and Table 22</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Support of the fault management of ANOs as described in Table 21 and Table 22</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Other characteristics</li> </ul>	No	No	L2 WAP on Market 4 is available in all exchanges. L2 WAP on Market 3b is available in non-competitive exchanges.
Are the L2 WAP on Market 4 and the L2 WAP on Market 3b:			
<ul style="list-style-type: none"> <li>Two different distinct products?</li> </ul>	Yes	Yes	No
<ul style="list-style-type: none"> <li>Are both the same product which has different options and some options are relevant for Market 4 and others for Market 3b?</li> </ul>	No	No	Yes

Source: BEREC

**Table 25: Comparison of L2 WAPs imposed on Market 4 with L2 WAPs imposed on Market 3a – part 1**

Country	Netherlands	Slovenia	Spain
The characteristics of the L2 WAP imposed on Market 3b differ from the characteristics of the L2 WAP imposed on Market 4 mainly with regard to:			
<ul style="list-style-type: none"> <li>PoHs as described in Table 4 and Table 5</li> </ul>	No	Yes, no PoH imposed on edge router for Market 3a.	Yes. The PoHs of L2 WAP of Market 3a (NEBA local) are located at the MPoP (local level, not regional level).
<ul style="list-style-type: none"> <li>Availability and redundancy as described in Table 6 and Table 7</li> </ul>	No	Yes. Lower availability on Market 3a.	The Market 3a product is not available for copper.
<ul style="list-style-type: none"> <li>SLAs and SLGs as described in Table 8 and Table 9</li> </ul>	No	Yes. Lower SLAs on Market 3a.	Yes. Market 4 product restricted to high quality SLAs.
<ul style="list-style-type: none"> <li>Pricing methodologies as described in Table 12</li> </ul>	No	Yes. ERT for NGA including VULA.	No
<ul style="list-style-type: none"> <li>CPEs/modems as described in Table 13 and Table 14</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Bandwidth profiles as described in Table 15 and Table 16</li> </ul>	No	No	Yes. The L2 WAP of Market 3a (NEBA local) offers a profile with the current maximum speed and the ANOs build lower speed retail offers from it. Additional profiles can be introduced in the future.
<ul style="list-style-type: none"> <li>QoS as described in Table 17 and Table 18</li> </ul>	No	No	Yes. The L2 WAP of Market 3a (NEBA local) offers ostensibly uncontended bandwidth.
<ul style="list-style-type: none"> <li>Traffic prioritisation as described in Table 17 and Table 18</li> </ul>	No	Yes, prioritisation defined on VULA.	Yes, the L2 WAP of Market 3a has 3 priorities.
<ul style="list-style-type: none"> <li>VLAN characteristics as described in Table 19 and Table 20</li> </ul>	No	Yes, exact number of VLANs imposed on VULA.	No
<ul style="list-style-type: none"> <li>Customer identification as described Table 19 and Table 20</li> </ul>	No	No	No

Source: BEREC

**Table 26: Comparison of L2 WAPs imposed on Market 4 with L2 WAPs imposed on Market 3a – part 2**

<b>Country</b>	<b>Netherlands</b>	<b>Slovenia</b>	<b>Spain</b>
Contd.			
<ul style="list-style-type: none"> <li>Multicast as described in Table 21 and Table 22</li> </ul>	No	Yes	No. However, multicast replication is under study for the L2 WAP on Market 3a (NEBA local).
<ul style="list-style-type: none"> <li>Possibility to configure the DSLAM/OLT as described in Table 21 and Table 22</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Security measures as described in Table 21 and Table 22</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Support of the fault management of ANOs as described in Table 21 and Table 22</li> </ul>	No	No	No
<ul style="list-style-type: none"> <li>Other characteristics</li> </ul>	No	No	No
Are the L2 WAP on Market 4 and the L2 WAP on Market 3b:			
<ul style="list-style-type: none"> <li>Two different distinct products?</li> </ul>	Yes	Yes	Yes
<ul style="list-style-type: none"> <li>Are both the same product which has different options and some options are relevant for Market 4 and others for Market 3b?</li> </ul>	No	No	No

Source: BEREC