COMMUNICATIONS ALLIANCE LTD

NATIONAL BROADBAND NETWORK

WHOLESALE SERVICE DEFINITION FRAMEWORK - ETHERNET

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National Broadband Network Wholesale Service Definition Framework – Ethernet

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1 INTRODUCTION

1.1 General

1.1.1 This document has been developed by the Wholesale Services working group of the Communications Alliance National Broadband Network (NBN) Project and has been subject to a public consultation process. It provides a framework and template for the definition of wholesale services that may be available on the NBN and potentially by other Broadband Infrastructure Providers (BIP) including Broadband Access Providers (BAP) and Broadband Backhaul Providers (BBP). Refer to section 2 for definitions of these different provider roles, and to section 3 (including Figures 4, 5 and 6) for more information on the different providers.

1.1.2 Some areas of this service definition template will need to be populated by the BAP / BBP / BIP with values for the service attributes in accordance with the network design and service characteristics.

1.2 Relationship with other Communications Alliance NBN Working Groups

1.2.1 The work of the Wholesale Services working group is related to activities within other NBN Project working groups in Communications Alliance. The general relationships can be seen in Figure 1.

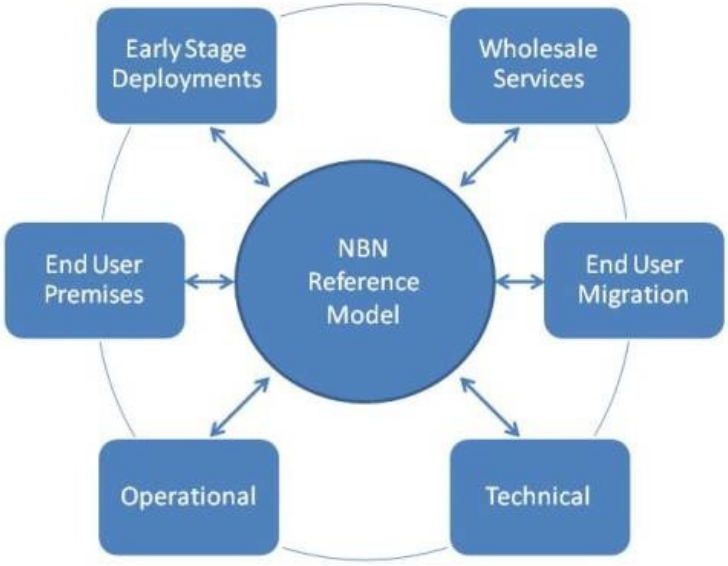

FIGURE 1
Communications Alliance NBN Project Working Group Structure

1.2.2 More specifically, the following activities underway in the other working groups relate to Ethernet Wholesale Services definition.

1.2.3 Reference Model

(a) Reference Architecture: the overarching architecture, service types and boundaries at the end-user premise and to other communications providers at a Point Of Interconnect (POI).

(b) Terminology: definitions and recommended use of terms.

(c) Use Cases: descriptions of application services, such as voice and video, that will be used to test the wholesale service definition to ensure all necessary aspects are defined to support the delivery of the application by a retail service provider.

1.2.4 End-User Premises

(a) Reference Architecture in the premises: description of how single and multiple instances of the Ethernet wholesale service can be delivered in different types of end-user premises.

1.2.5 Operational

(a) Wholesale Service Acquirer (WSA) facing processes: Catalogue of all of the potential interactions between the end user and the NBN that enable delivery of a satisfactory end user experience (supporting ordering, provisioning, service assurance etc). Drawing upon established best practices including those identified by international experience and relevant standards development organisations.

1.2.6 Technical

(a) Identify appropriate international standards (or domestic standards and codes if available) and their features which meet the characteristics required by the wholesale services, to demonstrate that the wholesale services can be implemented, and to facilitate the sourcing and configuration of network elements.

1.3 Scope

1.3.1 The document provides a description of the key capabilities to be specified in the Ethernet wholesale service definitions for the following service types:

(a) Ethernet Line Access Service (ELAS);

(b) Ethernet Line Backhaul Service (ELBS); and

(c) Ethernet Multicast Service (EMCS).

1.3.2 This document does not address all potential service types that could be delivered through the Reference Architecture and which may potentially be defined in future versions of this work. The Service Description Framework will form the foundation block for further work around the provision of voice, data and video services.

NOTE: This document presents a range of scenarios and options that Communications Alliance working groups have identified with the purpose of facilitating broader NBN discussion and decision making for NBNs. It does not represent the preferred position of Communications Alliance, its individual members, or the communications industry.

2 ABBREVIATIONS, DEFINITIONS AND INTERPRETATIONS

2.1 List of terms

A current list of terms and their definitions is available at:
https://commswiki.dgit.biz/index.php/Agreed_Term_Definitions

NOTE: At the time of publication of this Release the relevant wiki page was being finalized for public availability.

2.2 Definitions and Abbreviations

Refer to Table 1 for a list of definitions and associated abbreviations used in the Guideline.

TABLE 1
Abbreviations and Definitions for Terms

Term	Abbreviation (where relevant)	Definition	Comments / References
Carriage Service Provider	CSP	a person who supplies a carriage service to the public using licenced network units.	Section 87 of the *Telecommunications Act 1997*.
Content Service Provider	CoSP	a person who uses a listed carriage service to supply a content service to the public.	Section 97 of the *Telecommunications Act 1997*.
Service Provider	SP	as a stand alone term "Service Provider" is defined in section 86 of the Telecommunications Act 1997 as: "(a) a carriage service provider; or (b) a content service provider."	There are legislative consequences for "service providers." As far as possible the term should be avoided as a stand-alone term.
Ethernet Line Access Service	ELAS	A Layer 2 Ethernet access service provided by a Broadband Access Provider.	It is modelled on the Broadband Forum's NSP model (defined in TR-059) generally and L2 Ethernet NSP wholesale service in TR-101 and TR-144 specifically. The ELAS definition leverages the Metro Ethernet Forum's E-NNI work. The service characteristics are based on MEF 10.1 and MEF 23.

Ethernet Line Backhaul Service	ELBS	A service used to backhaul one or more ELASs from a 3a POI, in the CA NBN Reference Architecture, to a 3b POI.	An ELBS may or may not be provided by the same entity as the backhauled ELASs. Where the providing entity does not provide the ELAS, it is referred to as a Broadband Backhaul Provider. Where the entity providing the ELBS also provides the ELAS it is referred to as a Broadband Infrastructure Provider (BIP).
Ethernet Multicast Service	EMCS	An Ethernet based multicast service that can be used to deliver multicast from a POI to a set of End-User Premises.	
Broadband Access Provider	BAP	An entity that provides ELASs and potentially other access services, but not ELBSs.	
Broadband Backhaul Provider	BBP	An entity that provides ELBSs and potentially other types of services, but not ELASs.	
Broadband Infrastructure Provider	BIP	An entity that provides ELASs and ELBSs, as well as potentially other types of services.	
Wholesale Service Acquirer	WSA	An entity that consumes a wholesale service from a BAP, BBP or BIP.	

2.3 Other Abbreviations

Other abbreviations used in the Guideline and their meaning are:

AAA	Authentication, Authorisation and Accounting
ATA	Analogue Terminal Adaptor
BBF	Broadband Forum
bps	bits per second
CBS	Committed Burst Size
CIR	Committed Information Rate
CoS	Class of Service
C-TAG	Customer VLAN Tag
DEI	Discard Eligible Indicator
DHCP	Dynamic Host Configuration Protocol
EAS	Ethernet Access Service
EBS	Excess Burst Size
E-NNI	External Network to Network Interface
EVC	Ethernet Virtual Connection
FD	Frame Delay
FDV	Frame Delay Variation
FLR	Frame Loss Ratio
FTTP	Fibre To The Premises
IEEE	Institute of Electrical and Electronic Engineers
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
Kbps	Kilobits per second
L2	Layer 2
MEF	Metro Ethernet Forum
MPLS	Multi Protocol Label Switching
MTU	Maximum Transmission Unit
NBN	National Broadband Network

NNI	Network to Network Interface
NICC	National Interconnect Consultative Committee (in the UK)
NSP	Network Service Provider
NTU	Network Termination Unit
OAM	Operations Administration and Maintenance
ONT	Optical Network Termination
PCP	Priority Code Point
PPP	Point to Point Protocol
PPPoE	Point to Point Protocol over Ethernet
POI	Point of Interconnect
RADIUS	Remote Authentication Dial In User Service
SBP	Service Boundary Point
S-Tag	Service VLAN Tag
SLA	Service Level Agreement
SLAAC	Stateless Address Autoconfiguration
SLS	Service Level Specification
S-TAG	Service VLAN tag
UNI	User Network Interface
VLAN	Virtual Local Area Network

3 WHOLESALE SERVICES OVERVIEW

3.1 Communications Alliance NBN Reference Architecture

3.1.1 The Reference Model working group of the Communications Alliance NBN Project has defined Release 1 of a reference model in the National Broadband Network Reference Architecture – High Level Architecture Options for the NBN. This reference model shall be used to put into context the wholesale services definitions within this document.

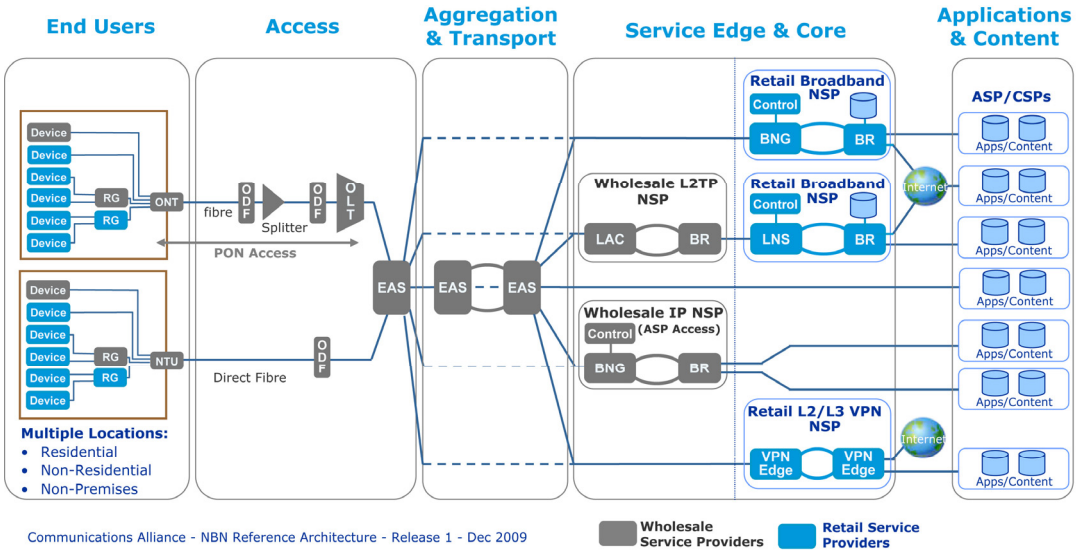

FIGURE 2

Broadband Network Reference Architecture - FTTP Access

3.1.2 It is intended that, as much as is possible, the reference architecture in Figure 2 will be applicable to the delivery of the Ethernet wholesale services, defined in this document, across all access technologies.

3.2 Service Boundary Points

3.2.1 The reference architecture describes a number of types of services. The services defined in this template relate to the Layer 2 Ethernet wholesale services. The Ethernet wholesale services are defined to operate between reference point 3 at the end-user location and a POI, reference point 3a or 3b as shown in Figure 3. The description of points 3, 3a and 3b is provided in Table 2, which is an excerpt from Table 1 in the Reference Architecture.

3.2.2 It should be recognized that the service boundary point, reference point 3, at the end-user premise is located such that a NTU device exists that is considered a component of the BAP network.

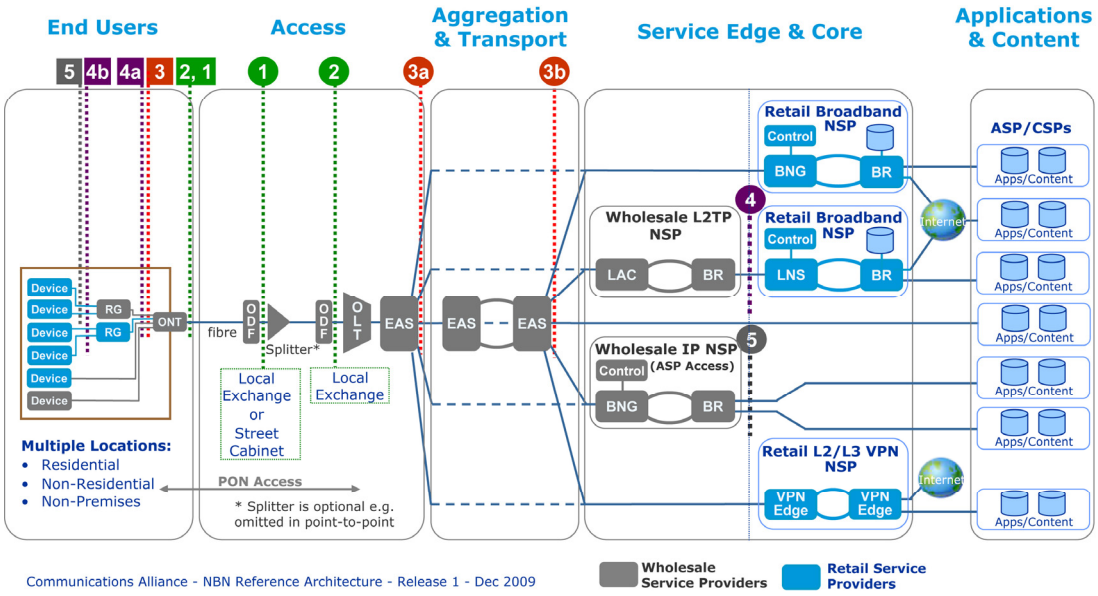

FIGURE 3

Reference Model Wholesale Point of Interconnect and Service Boundary Point Scenarios – FTTP Access

POI Scenario	POI Type	Service Functionality	POI Physical Location(s)	SBP Physical Location(s)
3	Layer2 – Ethernet	Layer 2 Ethernet service to the end user premises. Service could be untagged Ethernet or support IEEE 802.1Q VLAN tagged interfaces. Equivalent to Broadband Forum TR-156 "A10 – NSP L2 (Eth)" interface	3a) Local Exchange 3b) Regional, State and/or National Aggregation PoI Note: There may be circumstances where there are multiple instances of the 3b POI (i.e. Regional, State and National) involving multiple service providers. As a result a readers should not infer that POI Scenario 3 implies a strictly two layer hierarchy.	Ethernet port on the end user facing side of the NTU (internal, external or basement)

TABLE 2

Reference Model Wholesale POI and SBP Scenario for Layer 2 Ethernet (for FTTP access)

3.3 Application of the Reference Architecture

3.3.1 There are additional factors relating to the Ethernet wholesale services which need to be considered along side the current information from the Reference Architecture. These factors are listed below and are described in further detail in the following sections.

(a) The existence of a distinct Ethernet Line Backhaul Service (ELBS), that is decoupled from Ethernet Line Access Service (ELAS). An ELBS:

(i) can be used to provide connectivity from the 3a POI, which is considered the default POI for an ELAS, to a more aggregated POI.

(ii) may be provided by the same entity providing ELASs or a different entity.

(b) The 3b POI merely represents a POI that provides a greater level of aggregation than a 3a POI for ELASs. By aggregation this means the ELAS services are grouped and this grouping should be independent of contention of service attributes.

(i) It is possible and likely that there will be more than one degree of aggregation available at different POIs.

(ii) This is reflected in Table 2 in the POI Physical Location column.

(iii) Notation for more specific articulation of the degree of aggregation at the POI, may be introduced in the future as a result of the Reference Model terminology definition work.

NOTES:

1. The terminology in Table 1 relates to location(s) and site(s) relevant to the existing copper access network. They can be considered indicative in relating to a broadband network providing ELAS. ELBS and EMCS based on multiple access technologies including FTTP.

2. Updated terminology is being defined by the NBN Reference Model working group.

3.4 Ethernet Line Access Service (ELAS)

3.4.1 The ELAS is based upon the MEF E-Line service type, operating across a MEF E-NNI, which is intended to support the extension of Ethernet services across multiple operator Metro Ethernet Networks (MENs). An ELAS operates between the Service Boundary Point 3 (UNI) at the End-User Premise and (by default) a 3a POI (NNI). An entity that provides ELASs can be referred to as a Broadband Access Provider (BAP). This is depicted in Figure 4.

3.4.2 The ELAS service framework template is defined in 4.2.

3.4.3 ELASs can be delivered to a 3b POI with an ELBS, which is described in 3.5 and 4.3.

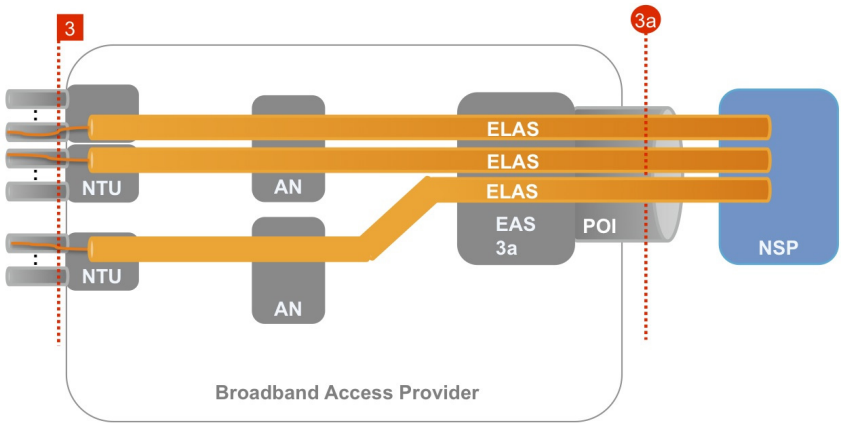

FIGURE 4
ELAS Overview

3.5 Ethernet Line Backhaul Service (ELBS)

3.5.1 ELBS is a service distinct from ELAS, which aggregates one or more ELASs from a particular 3a POI and backhauls them to a 3b POI. An ELBS will have a separate Service Level Agreement (SLA) and service attributes, distinct from individual ELAS SLAs. This will provide flexibility to allow a Wholesale Service Acquirer (WSA) to choose what, if any, aggregation and contention is applied at the ELAS to ELBS mapping point at the 3a POI.

3.5.2 The ELBS service framework template is defined in 4.3.

3.5.3 There are two options available in how ELBS may be implemented. The first is where the same entity that provides the ELAS provides the ELBS, here the entity can be referred to as a Broadband Infrastructure Provider (BIP). This option is depicted in Figure 5.

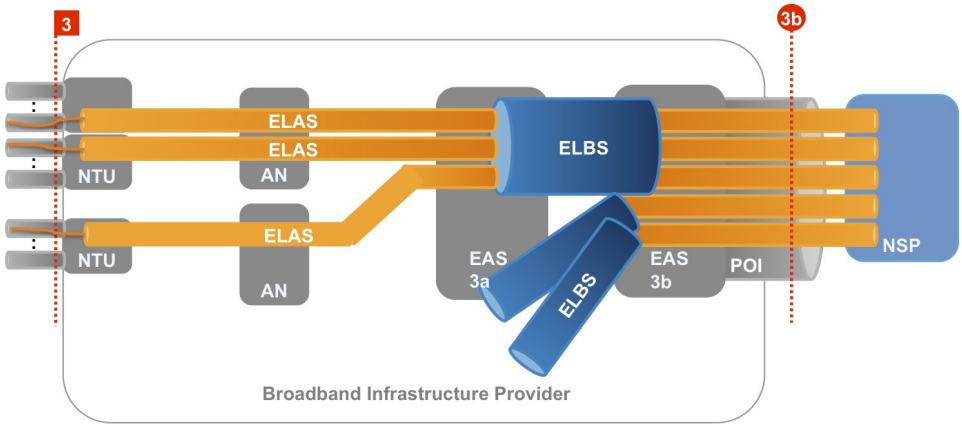

FIGURE 5
ELBS Overview – Broadband Infrastructure Provider

3.5.4 Secondly, the ELBS can be provided by an entity, referred to as a Broadband Backhaul Provider (BBP) that is different from the

entity that provides the ELAS, the BAP. This option is depicted in Figure 6.

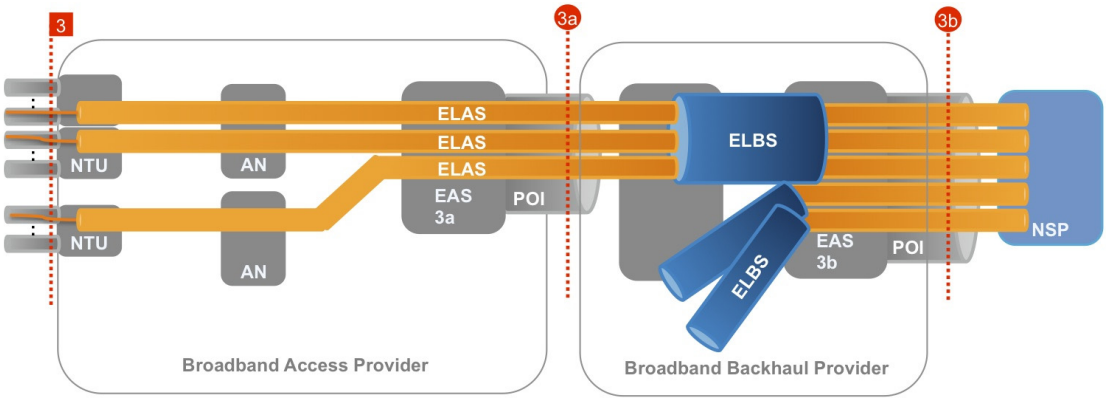

FIGURE 6
ELBS Overview – Broadband Backhaul Provider

3.6 Ethernet Multicast Service (EMCS)

3.6.1 The EMCS service definition template is provided in 4.4, which provides for the efficient delivery of multicast from a POI to an end-user premises. An overview of the EMCS can be seen in Figure 7.

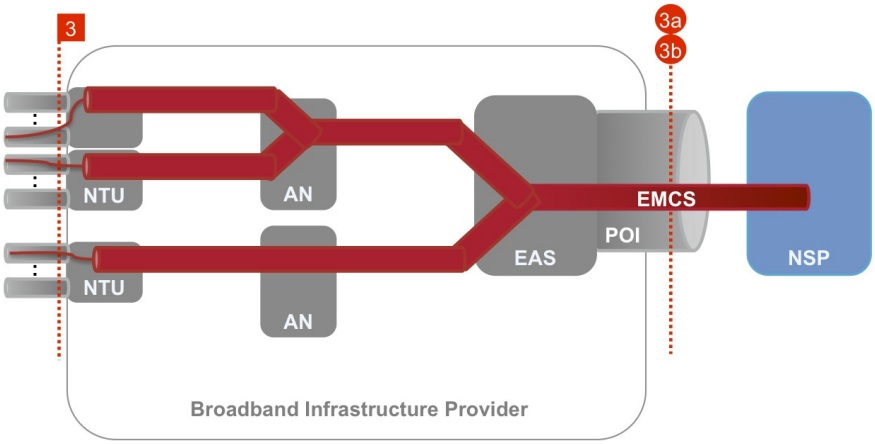

FIGURE 7
EMCS Overview

3.6.2 The significance of the level of aggregation at a POI in relation to the EMCS, i.e. whether 3a or 3b, can be considered independent of the service definition. There may be commercial considerations with respect to the EMCS being offered to cover smaller or larger geographic coverage areas.

4 ETHERNET WHOLESALE SERVICE DEFINITION TEMPLATES

4.1 Introduction

4.1.1 Service definition templates for the ELAS, ELBS and EMCS are described in the following sections.

4.2 Ethernet Line Access Service (ELAS)

4.2.1 The ELAS provides bidirectional point-to-point connectivity from a POI (reference point 3a), to a SBP at the end-user premise (reference point 3), as per Figure 8. ELAS supports appropriate attributes to allow the carriage of single or multiple application services with various bandwidth and QoS requirements.

4.2.2 Figure 8 shows the relationships between the various components of the ELAS. The key components that make up ELAS are the:

(a) ELAS virtual connection;

(b) Service Boundary Point (SBP) at the End User Premises; and

(c) ELAS PoI at reference point 3a.

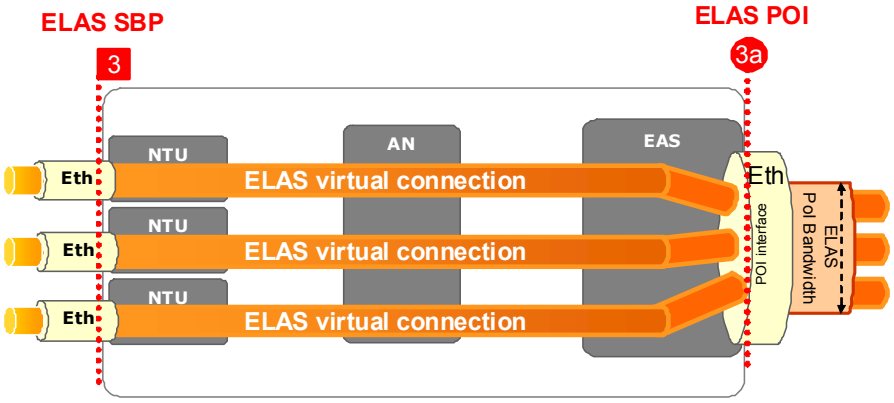

FIGURE 8
Components of ELAS

Background

4.2.3 The definition of ELAS is based on

(a) MEF specifications 10.1 and 23; and

(b) Broadband Forum's (BBF) Network Service Provider (NSP) Layer 2 Ethernet model and TR-101 1:1 VLAN model.

4.2.4 The definition of the role and responsibilities of a NSP and the related BIP (or separated BAP and BBP) can be found is 3.2 of TR-59. These definitions continue to remain valid in later BBF TRs and in the current work in progress.

4.2.5 This approach has been chosen due to the model emulating a circuit across the wholesale network. In addition, the 1:1 VLAN model provides a means for the connectivity from end-user to POI to be managed independent of the Ethernet MAC addresses received at the POI and SBP. This provides a level of transparency for the wholesale BAP / BBP / BIP and eliminates security and operational issues associated with duplicate MAC addresses and spoofed MAC addresses.

4.2.6 This approach has also been adopted in New Zealand with the Enhanced Unbundled Bitsream Access (EUBA) wholesale service and is the initial model being addressed in the UK by NICC, following on from the Ofcom Ethernet Active Line Access (ALA) requirements.

4.2.7 The ELAS construct is based on the following objectives:

(a) Sufficiently detailed characteristics to enable WSAs to deliver a range of application services with suitable quality of experience.

(b) Characteristics each with a sufficient set of options to enable WSAs to choose those that best suit application service requirements.

(c) Characteristics each with a sufficient set of options to enable WSAs to differentiate in their target markets.

ELAS Service Attributes

4.2.8 An ELAS is defined with a set of characteristics, each of which will have options for an WSA to chose. The characteristics and associated values will represent the SLA for the particular ELAS.

4.2.9 The relationship of the ELAS SLA is dependent on other necessary services a WSA must acquire, namely a POI connection and if chosen an ELBS. The ELBS and POI SLAs only represent aggregate values and selectable by the WSA. There is the possibility for a WSA to choose to contend ELAS SLAs in an ELBS and at the POI. These relationships are described further in Section 5.

4.2.10 The definition of ELAS characteristics is based on MEF 10.1, and includes either a bandwidth profile per ELAS, or a bandwidth profile per Class Of Service (CoS) instance associated with an ELAS.

4.2.11 The ELAS service attributes include admissible frame types (e.g. broadcast, multicast, flood) and L2 control protocol processing (e.g. block, tunnel).

4.2.12 The following ELAS characteristics apply to the bi-directional (up-stream and down-stream) traffic flows of an ELAS.

4.2.13 As noted by the MEF, for services to be adopted in the market, it is critical that they include strong service attributes that are based on meaningful and measurable parameters, which can be mapped into SLAs. The following sections discuss the relevant

standards bodies and the ELAS service attributes in terms of MEF bandwidth profiles and service performance parameters.

Relevant Standards

4.2.14 The approach taken in this definition aims to primarily adopt ratified international standards. For this purpose there are valuable models available from the Metro Ethernet Forum (MEF) in MEF10.1 and 23 and from the BBF in TR-101 and TR-156.

4.2.15 The MEF definition of bandwidth profiles and service performance parameters is directly relevant to ELASs. In addition the traffic management models where the application of bandwidth profiles to Ethernet Virtual Connections (EVCs) and the application of bandwidth profiles to Classes of Service (CoS) instances per EVC are relevant. These approaches are specified in MEF 10.1.

4.2.16 The BBF TR-101 and TR-156 elements, which are relevant to ELAS as it is modelled on the NSP L2 Ethernet service, are the access and aggregation network specifications. The BBF architecture caters for QoS to support ELAS, however, there needs to be consideration for the case where there are multiple ELAS in operation to an end-user premise.

4.2.17 This definition fully leverages the definition of MEF service attributes in an effort to adopt ratified international standards. In a broadband sense, the following considerations should be taken into account when implementing this model.

4.2.18 The management of excess traffic (EIR) needs to be considered in the scenario where a bandwidth profile per CoS per ELAS model is used. In this case the utilisation of EIR designated traffic may vary from the manner in which it is utilised in the context of current broadband networks. This relates to an ELAS being utilised by a WSA to deliver multiple services requiring differentiated traffic management via a single, multi-CoS ELAS, with each CoS bandwidth profile potentially containing a EIR specification. The management of EIR traffic in this instance is performed in the context of EIR traffic from the multiple per CoS ELAS in operation to an end-user premise.

4.2.19 There is work underway in these forums and they are collaborating, which may result in updates to their approaches which could be valuable for ELAS style services in the future.

ELAS Bandwidth Profiles

4.2.20 The ELAS bandwidth profile is based on the MEF 10.1 bandwidth profile.

4.2.21 The attributes of the bandwidth profile that can be populated with values, and a range of options for an WSA to select, are shown in Table 3.

4.2.22 The relationship between bandwidth profiles and ELAS, being either per ELAS or per ELAS CoS instance based, is discussed in 4.2.29 to 4.2.31 and associated Notes.

4.2.23 In general it would be expected that the traffic management of an ELAS is in accordance with the bandwidth profile across the BAP network. This bandwidth profile can be defined in terms of upstream (reference point 3, UNI ingress) and downstream (reference point 3a/b, NNI ingress) traffic.

4.2.24 The management of traffic in an ELBS and/or at a POI will be in accordance with the ELBS and/or POI SLAs. This mapping to the POI and/or ELBS service is discussed in more detail in 5.3 and 5.4.

Option	**Committed Information Rate (CIR)**	**Excess Information Rate (EIR)**	**Committed Burst Size (CBS)**	**Excess Burst Size (EBS)**
Metric	**Kbps**	**Kbps**	**Bytes**	**Bytes**
1				
…				
N				

TABLE 3

ELAS Bandwidth Profile Options

4.2.25 There are two options available to signify which traffic is in-profile (CIR) and which traffic is out-of-profile (EIR), and therefore eligible to be discarded as per the traffic management policies of the BAP. These mechanisms are specified in MEF 10.1 and BBF TR-101.

4.2.26 The first option is based on pre-determining certain IEEE 802.1p priority code points (PCP) to represent CIR and EIR traffic, per ELAS. This approach is limited to four CoS bandwidth profiles per ELAS per service.

4.2.27 The second option leverages the Discard Eligible Indicator (DEI) bit as specified by IEEE 802.1ad to indicate out-of-profile (EIR) traffic. This in conjunction with the IEEE 802.1p PCP bits, enables DEI significance for all eight IEEE 802.1p values and thus would allow up to eight bandwidth profiles per ELAS.

ELAS Service Performance Parameters

4.2.28 Traffic carried in an ELAS with respect to a bandwidth profile, described in 4.2.20 to 4.2.27, also can have Service Performance Parameters defined. The Service Performance Parameters only apply to CIR (in-profile) traffic. The parameters are represented in Table 4.

Class of Service Designation	Frame Delay (one-way, mean)	Frame Delay Variation (one-way)	Frame Loss Ratio
Metric	**Milliseconds**	**Milliseconds**	**%**
1 Bandwidth Profile A			

TABLE 4

ELAS Service Performance Parameters

Application of Bandwidth Profile to ELAS

4.2.29 The MEF defines three ways in which to apply a bandwidth profile to an E-Line service, two of which are relevant to ELAS. They are:

(a) bandwidth profile per ELAS; and

(b) bandwidth profile per CoS Instance associated with an ELAS.

4.2.30 In the bandwidth profile per ELAS case, all traffic is treated in respect to:

(a) an in-profile (i.e. CIR) data rate; and

(b) an out-of-profile (i.e. EIR) data rate.

4.2.31 In the bandwidth profile per CoS instance case, bandwidth profiles are applied according to IEEE 802.1p markings. The IEEE 802.1p markings are carried in the Ethernet frames at reference point 3 and 3a/3b and signify to which CoS instance the frames belong. There is some discussion in 4.2.14 to 4.2.19 of additional considerations that may be beneficial to take into account in a broadband scenario.

NOTES:

1. The working group that developed this document has not determined a recommended minimum and maximum number of CoS bandwidth profiles that should be supported per ELAS by a BAP.

2. MEF 23 specifies support for up to three CoS bandwidth profiles per EVC.

3. MEF 22 specifies a minimum of two CoS bandwidth profiles per EVC with four CoS bandwidth profiles being desired.

4. The Singapore IDA Nucleus Connect NBN plans to support four CoS bandwidth profiles per EVC.

5. A minimum of two to four CoS bandwidth profiles is considered acceptable for ELAS implementations in Australia.

6. There will be benefit for the Australian industry to establish a common standard for the minimum number of CoS bandwidth profiles, to allow WSAs to achieve consistency in leveraging ELAS across multiple different BAPs.

ELAS Identifier at the POI

4.2.32 An ELAS is identified from the BAP network to the WSA primarily based on the S-TAG and C-TAG VLAN combination as per IEEE 802.1ad and the usage of VLAN tags as defined in TR-101 in the 1:1 VLAN model. VLAN numbering is to be considered independently.

4.2.33 The ELAS identifier is based on the S-TAG and C-TAG VLAN combination as this provides the most flexibility and no impediment to the carriage of upper layer protocols.

4.2.34 Optionally a BAP may choose to implement certain alternative functions to communicate ELAS identification to a WSA. This maybe implemented to provide backwards compatibility with existing service provider networks.

4.2.35 Mechanisms such as PPPoE Intermediate Agent and DHCP L2 Relay Agent, as defined in TR-101 can be used to provide ELAS identification for PPPoE and IPv4 with DHCP addressed upper layer protocols. The ELAS identifier in these scenarios will be based on a text string, the format of which can be as defined in TR-101, otherwise will need the definition to be liaised between the BAP and WSA.

4.2.36 It should be noted that there are currently no methods available to provide a similar text string form of ELAS identification for IPv6 and IPv4 with static addressing.

AAA Interactions Between BAP and WSA

4.2.37 At the current time there are no use-cases that require an AAA interaction, e.g. using RADIUS between the BAP and a WSA for ELAS.

4.2.38 There maybe use-cases that warrant AAA interaction between the BAP and the WSA which come to light in the future. These can be considered at that time.

4.2.39 An option to provide authentication at the NTU for WSA equipment is listed in 6.1. The implementation of this option could result in the need for an AAA interaction between the BAP and the WSA.

Protocol Transparency

4.2.40 It is intended that all upper layer protocols be carried transparently over ELASs.

4.2.41 This transparency includes being agnostic to the Ethertype values encoded in the IEEE 802.3 Ethernet frames received at the end

user SBP and at the POI. Ethertype values and the upper layer protocols currently that are expected to be supported, but not limited to, include:

(a) 0x8100 (802.1Q VLAN tagged frame)

(b) 0x8863 / 0x8864 (PPPoE),

(c) 0x0800 (IPv4, both statically and DHCP addressed),

(d) 0x86DD (IPv6 both SLAAC and DHCPv6 addressed),

(e) 0x8847 / 0x8848 (MPLS).

4.2.42 This transparency includes being agnostic to the specific Ethernet frame encapsulation type. Ethernet fame types that should be supported include, but are not limited to:

(a) Ethernet II;

(b) 802.1Q single-tag and double-tagged (Q-in-Q)VLAN trunking;

(c) 802.2 LLC; and

(d) 802.2 LLC/SNAP

4.2.43 This transparency includes supporting Ethernet frame Maximum Transmission Units (MTUs) large enough not to inhibit upper layer protocols carried within the Ethernet payload. Ethernet payload fields of 1500 octets should be supported.

4.2.44 Layer 2 protocol transparency is also an important aspect of business orientated transparent LAN services. This case was identified in 4.2.46 as an item for further study and would result in an update to this definition.

Other Cases

4.2.45 Several cases have been identified where further study is required to build on the service definition in this document to support particular protocols, application services and/or use cases.

4.2.46 These cases for further study are:

(a) Voice interworking;

(b) Video interworking; and

(c) Business transparent LAN services

4.2.47 The Communications Alliance NBN project working groups will consider these areas for updates to this definition and potentially as additional items for release.

4.3 Ethernet Line Backhaul Service (ELBS)

4.3.1 The key components that make up the ELBS are:

(a) The ELBS POI at reference point 3a;

(b) The ELBS; and

(c) The ELBS Aggregation POI at reference point 3b

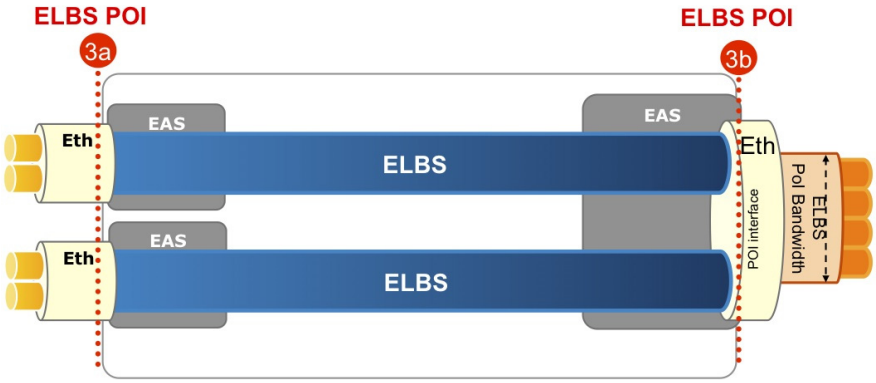

FIGURE 9
Components of ELBS

4.3.2 ELBS is described in 3.5. It is an optional service that may be utilised by an WSA to backhaul ELAS from a 3a POI to a more aggregated 3b POI.

ELBS Service Attributes

4.3.3 The ELBS service characteristics are based on BBF and MEF models in the same way as ELAS. The ELBS definition follows the same approach as the ELAS definition, however, the ELBS characteristics are considered in aggregate to all ELAS that are backhauled by the particular ELBS. The relationship of ELAS, ELBS and POI can be seen in Figure 9.

4.3.4 An ELBS SLA, which would be compiled from the chosen ELBS service attributes, will take precedence over the transported ELAS SLAs. Rules governing allowable ELBS service attributes may be put in place by BBPs e.g. ELBS CIR ≥ (SUM of ELAS CIR).

4.3.5 There should be the option for WSAs to choose to aggregate and contend, if desired, ELAS SLAs within an ELBS SLA. The corollary is also valid, in that a WSA should be able to choose not to contend ELAS SLAs in an ELBS SLA.

ELBS Bandwidth Profiles

4.3.6 The ELBS bandwidth profile is based on the MEF 10.1 Bandwidth Profile.

4.3.7 The attributes of the bandwidth profile that can be populated with values, and a range of options for an WSA to select, are shown in Table 5.

4.3.8 The relationship between Bandwidth Profiles and ELBS, is similar to the ELAS case. In the ELBS case, a bandwidth profile could be applied to either an ELBS in aggregate or per CoS group per ELBS.

4.3.9 In general it would be expected that the traffic management of an ELBS is in accordance with the Bandwidth Profile across the BBP network. This bandwidth profile can be defined in terms of upstream (reference point 3a ingress) and downstream (reference point 3b, NNI ingress) traffic.

4.3.10 The management of traffic at a POI will be in accordance with the POI SLAs. This mapping to the POI service is discussed in more detail in 5.4.

Option	**Committed Information Rate (CIR)**	**Excess Information Rate (EIR)**	**Committed Burst Size (CBS)**	**Excess Burst Size (EBS)**
Metric	**Kbps**	**Kbps**	**Bytes**	**Bytes**
1				
…				
N				

TABLE 5

ELBS Bandwidth Profile Options

ELBS Service Performance Parameters

4.3.11 Traffic carried in an ELBS with respect to a bandwidth profile, described in 4.3.6 to 4.3.10, also can have Service Performance Parameters defined. The Service Performance Parameters only apply to CIR (in-profile) traffic. The parameters are represented in Table 6.

Class of Service Designation	**Frame Delay (one-way, mean)**	**Frame Delay Variation (one-way)**	**Frame Loss Ratio**
Metric	**Milliseconds**	**Milliseconds**	**%**
1 Bandwidth Profile A			

TABLE 6

ELBS Service Performance Parameters

4.4 Ethernet Multicast Service (EMCS)

4.4.1 The EMCS definition is based on the Multicast VLAN model (MVLAN) of the BBF TR-101 and the MEF E-tree service. An overview of the EMCS is presented in 3.6.

4.4.2 This definition aims to provide the basis for a service that can be offered by a BAP or BIP to meet the following objectives.

Objectives

4.4.3 The EMCS should aim to meet the following objectives:

(a) Efficient multicast transport at the POI.
i.e. only a single copy of each multicast packet per multicast group (or group and source combination if desired).

(b) Efficient multicast transport in the access network.
i.e. IGMP snooping in the access network to determine whether a multicast stream should be sent to a given end-user premise.

(c) EMCS service that can be delivered along with ELAS and ELBS by an WSA, however, is not dependent and can be selected as a standalone service by an WSA.

(d) Independence, where an EMCS of one WSA is independent of EMCSs of another WSA.
i.e. no restriction on the use of IP Multicast group addresses.

(e) Support the delivery of IPv4 and IPv6 Multicast.
i.e. support for the necessary IGMP and MLD snooping functions to meet efficiency objectives (in (a) and (b) above).

(f) Support the communication of multicast control traffic from end-users to WSAs. This would require consideration of snooping options e.g. IGMP proxy snooping or transparent snooping.

(g) the EMCS does not provide direct communication between end users.

EMCS Service Attributes

4.4.4 The EMCS definition can, with the other Ethernet Wholesale Services, leverage the MEF service attributes definition. In the EMCS instance, a bandwidth profile, based on that specified in 4.2.8 to 4.2.13 would be applicable.

4.4.5 It is likely that only the model for bandwidth profile mapped to a VLAN will be required for the EMCS. However, this is something that may vary with WSA application requirements.

4.4.6 The difference with EMCS is that the desired values for the bandwidth profile will vary across the BAP / BIP network. The variance will be based on the efficiency mechanisms implemented by the BAP / BIP, as listed in the EMCS objectives in 4.4.3.

4.4.7 It is likely that based on this variance, at least two levels of bandwidth profile will need by a WSA to achieve an appropriate model for multicast delivery.

4.4.8 Where at least two bandwidth profiles should be provided, it is likely that only two will be sufficient as in Figure 10.

4.4.9 The first bandwidth profile would be based on the aggregate multicast traffic rate to be received ingress at the POI. There would be one bandwidth profile per EMCS, which would be applicable across the BIP network from the POI to the access network.

4.4.10 The second bandwidth profile would relate to each EMCS end-user of an WSA and would be applicable from a point, defined by the BAP / BIP, in the access network to the end-user premise. It could be possible to vary this second bandwidth profile on a per end-user basis. This bandwidth profile would relate to the amount of multicast traffic expected to be send to an end-user at any one time.

4.4.11 A depiction of these bandwidth profiles can be seen in Figure 10.

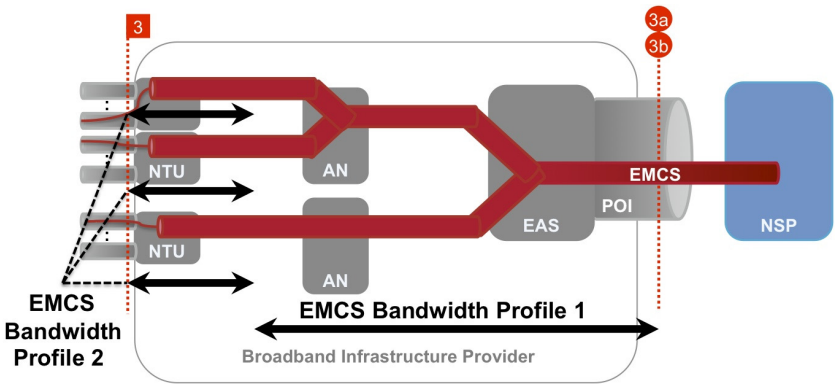

FIGURE 10
EMCS Bandwidth Profiles

5 DELIVERY PERMUTATIONS OF ETHERNET WHOLESALE SERVICES

5.1 Introduction

5.1.1 The following sections describe the rules and relationships associated with combining different components of services, different types of services and multiple instances of the same service. Examples of the possible permutations are also described where relevant.

5.2 ELAS to End-User Relationship

5.2.1 It is recommended to have the capability for more than one ELAS to be operational at any given time at each end-user premise.

5.2.2 There has been no determination as to maximum number of ELASs which could simultaneously operational at an end-user premise. Example implementation options considering the NTU at the end-user premise are provided in Appendix A.

5.2.3 The service definitions described in the preceding sections, need to be considered with the respect to the total available resources of the BAP over which the ELASs will be provided.

5.3 ELAS and ELBS Relationship

5.3.1 ELASs are by default terminated at :

(a) The End-User location at reference point 3; and

(b) The 3a POI.

5.3.2 Optionally, an WSA may choose to backhaul all of the ELASs they have in operation from a particular 3a POI to a more centralised and aggregated POI referred to as 3b. The ELBS can be utilised for this purpose.

5.3.3 In this instance, all of the ELAS of an WSA that are in operation at the 3a POI that an ELBS is provided to are backhauled to the more centralised 3b POI. However, it is possible that over a BBP / BIP network, ELBS may be utilised at some 3a POIs and not at others.

5.3.4 The geographic coverage areas and the resulting number of Access Services available from a 3a POI, and in turn the number of ELAS able to be multiplexed into a ELBS will be determined by the BAP / BIP.

5.3.5 Figure 11 depicts the multiplexing of ELAS into an ELBS.

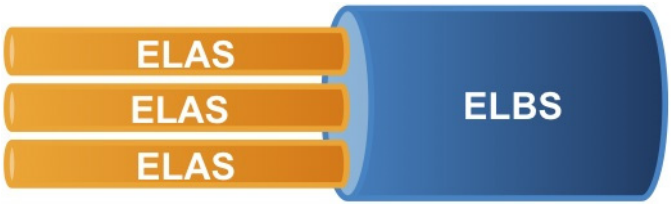

FIGURE 11
Access Service to Backhaul Service Relationship

5.4 POI, ELAS and ELBS Relationships

5.4.1 The following sections describe the possible options for ELAS to be handed off at a POI. Options for POI redundancy are also mentioned.

ELAS and POI 3a

5.4.2 Figure 12 depicts the relationship between ELAS of a particular WSA , which are delivered to POI 3a.

5.4.3 In this instance the bandwidth profile and associated SLA of the 3a POI that an WSA chooses for the ELAS to transit, takes precedence over the ELAS SLAs. That is, if an WSA chooses to contend the ELASs at the POI that is a choice and the responsibility of the WSA to manage the contention.

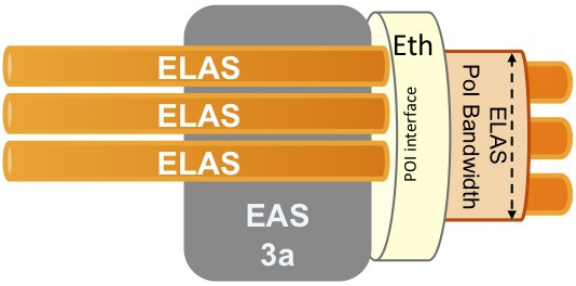

FIGURE 12
ELAS and POI 3a Relationship

ELAS, ELBS and POI 3b

5.4.4 Figure 13 depicts the relationship between ELAS of a particular WSA, multiplexed into a ELBS, of the WSA, and delivered to a POI 3b.

5.4.5 In this instance the bandwidth profile and associated SLA of the ELBS and the 3b POI that an WSA chooses for the ELAS to transit, takes precedence over the ELAS SLAs. That is, if an WSA chooses to contend the ELASs in the ELBS and/or at the POI, that is a choice and the responsibility of the WSA to manage the contention.

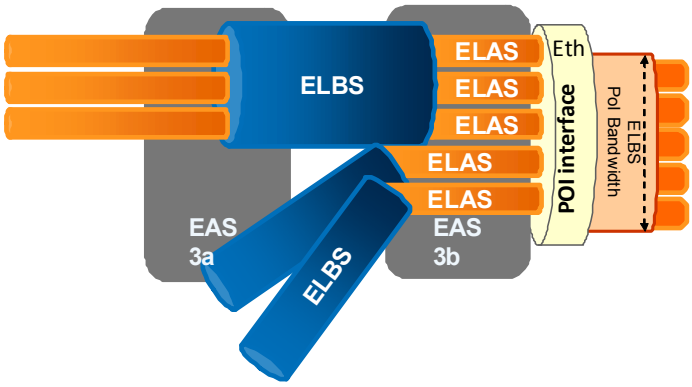

FIGURE 13
ELAS, ELBS and POI 3b Relationship

5.5 POI Redundancy

5.5.1 The following discussion of POI redundancy should fit within a larger discussion of network and service availability. Available modelling is impractical for this service definition. As such this section merely describes options that are deemed likely to be needed to meet desired availability targets.

5.5.2 The POI redundancy options described below, need to be considered within the context of the following general redundancy options:

(a) No redundancy (link or node).

(b) Link redundancy (described in 6.2).

(c) Node (EAS) redundancy at the POI (which may or may not map to site redundancy).

POI 3a Redundancy

5.5.3 ELAS are by default delivered to 3a POIs. In this instance, there may be an option for an WSA to choose a redundant 3a POI.

5.5.4 Figure 14 depicts the ELAS delivered to a 3a POI, some of which are provided redundantly to a backup 3a POI.

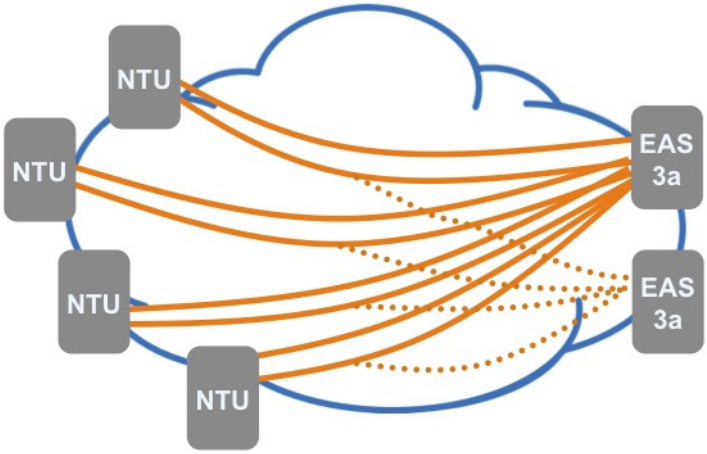

FIGURE 14
POI 3a Redundancy

POI 3b Redundancy

5.5.5 ELBS provides backhaul for ELASs for a given WSAs, from reference point 3a to a particular POI at 3b. Figure 15 depicts the ELBS being transported from an EAS located at 3a, across the Aggregation and Transport domain to the EAS at POI 3b.

5.5.6 Figure 15 shows the ability for some Backhaul Services delivered to an EAS at POI 3b, with redundancy for the EAS at POI 3b.

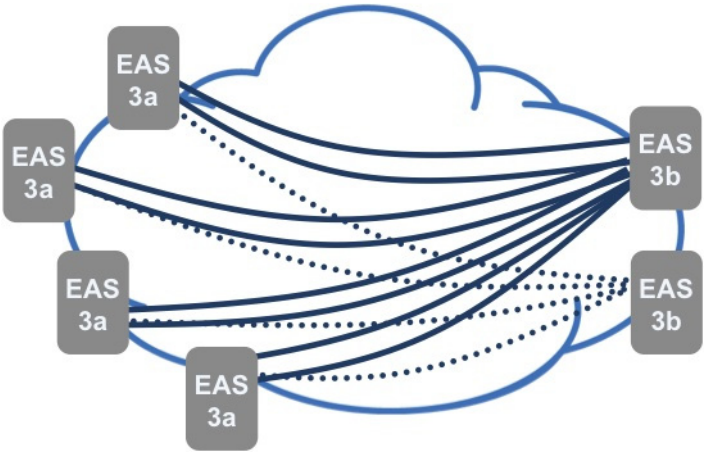

FIGURE 15
ELBS and POI 3b Redundancy

6 INTERFACE SPECIFICATIONS

6.1 End-User Premise

6.1.1 This interface maps to SBP 3 of the Reference Architecture.

Layer 1 Physical Interface Options

6.1.2 The options for physical interface specifications include:

(a) Fast Ethernet:

(i) IEEE 802.3u 100Base-FX optical fibre

(ii) IEEE 802.3u 100Base-TX twisted-pair Copper

(b) Gigabit Ethernet:

(i) IEEE 802.3z 1000BaseX optical fibre

(ii) IEEE 802.3ab 1000BaseT twisted-pair copper

Layer 2 Logical Interface Options

6.1.3 An ELAS will, by default, be terminated on un-tagged, with respect to IEEE 802.1Q, interfaces at the end-user premises. The presence or absence of an IEEE 802.1Q tag at the end-user premises need not match the corresponding virtual connection at the POI, which will always include an IEEE 802.1Q tag.

6.1.4 There will be options for the end-user premise to support IEEE 802.1p priority tagged frames, with respect to IEEE 802.1Q to support the ELAS Service Attributes defined in ELAS Service Attributes 4.2.8 to 4.2.13.

6.1.5 In addition, there maybe the possibility for the BAP to provide IEEE 802.1X authentication at the SBP at the end-user premise. This scenario would require further specification.

6.1.6 The SBP and POI will be capable of transmitting Ethernet frame types (i.e. Ethernet II, IEEE 802.2 LLC, and IEEE 802.3 LLC/SNAP) in to the ELAS.

NOTES:

1. The BAP will transport Ethernet frame(s) transparently i.e. it is unable to alter the frame type between the EUP and the POI.

2. It is the responsibility of the WSA to correctly support Ethernet frame(s) at the SBP or POI as per the Ethernet frame(s) injected at the corresponding POI or SBP for the ELAS.

End-User Premise Delimiter

6.1.7 The ELAS identifier at the end-user premise will vary the options of how the service is terminated. Some possible options are

described in Appendix A. Two primary options are as a result possible for the ELAS identifier, a physical port on an NTU or a VLAN on a port of an NTU.

6.2 POI Interface

6.2.1 This interface maps to reference point 3a or 3b of the Reference Architecture.

Layer 1 Physical Interface Options

6.2.2 The options for connectivity based on the following physical interface specifications include:

(a) Gigabit Ethernet.

(i) IEEE 802.3z 1000Base-FX optical fibre.

(ii) IEEE 802.3ab 1000BaseT twisted-pair copper.

(b) Gigabit Ethernet Link Aggregation – refer to IEEE 802.3ad.

(i) Load sharing.

(ii) Resilience.

(c) 10 Gigabit Ethernet.

(i) IEEE 802.3ae 10GBase optical fibre.

(d) 10 Gigabit Ethernet Link Aggregation – refer to IEEE 802.3ad.

(i) Load sharing.

(ii) Resilience.

Layer 2

6.2.3 The POI layer 2 encapsulation will be based on IEEE 802.1ad in general and specifically the VLAN models presented in section 4 for ELAS and EMCS.

6.2.4 The SBP and POI will be capable of transmitting Ethernet frame types (i.e. Ethernet II, IEEE 802.2 LLC, and IEEE 802.3 LLC/SNAP) in to the ELAS.

NOTES:

1. The BAP will transport Ethernet frame(s) transparently i.e. it is unable to alter the frame type between the EUP and the POI.

2. It is the responsibility of the WSA to correctly support Ethernet frame(s) at the SBP or POI as per the Ethernet frame(s) injected at the corresponding POI or SBP for the ELAS.

POI Bandwidth

6.2.5 The POI bandwidth determines the maximum peak throughput available at the POI. The POI bandwidth must be less than or equal to the POI physical interface bandwidth.

6.2.6 It should be noted that it is up to the WSA to dimension the POI bandwidth to meet their overall traffic requirements for the services they wish to offer. In particular, the WSA must decide whether to "overbook" the SLA attributes for the ELAS EVCs on that POI and by how much.

6.2.7 A single POI bandwidth profile may be applied to the POI or multiple bandwidth profiles, one per CoS instance may be applied.

POI Delimiter

6.2.8 The ELAS delimiter will be based on VLAN tags. A combination of S-TAG and C-TAG, as per IEEE 802.1ad, will uniquely identify an ELAS at a particular POI.

6.2.9 It should be noted that (S-TAG, C-TAG) combinations will not be unique across the entire NBN footprint.

6.2.10 An alternative solution for Transparent LAN Services (TLS) style services, where VLAN tagged interfaces at the End-User hand-off and transparent carriage of these tagged frames to the relevant POI is an area to be considered further. Business End-Users are possible examples. Approaches for these types of services should follow international standards.

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IEEE 802.3™-2008	IEEE Standard for Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements Part 3: Carrier sense multiple access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications http://standards.ieee.org/getieee802/802.3.html Refer to section three of IEEE 802.3™-2008 for information on Gigabit Ethernet: http://standards.ieee.org/getieee802/download/802.3-2008_section3.pdf Refer to section four of IEEE 802.3™-2008 for information on 10 Gigabit Ethernet: http://standards.ieee.org/getieee802/download/802.3-2008_section4.pdf
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MEF 22 (January, 2009)	Mobile Backhaul Implementation Agreement, Phase 1 Refer to: http://www.metroethernetforum.org/MSWord_Documents/MEF_22.doc
MEF 23 (June, 2009)	Carrier Ethernet Class of Service Implementation Agreement, Phase 1 Refer to: http://www.metroethernetforum.org/MSWord_Documents/MEF_23.doc
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Legislation	
Telecommunications Act 1997	
Broadcasting Services Act 1992	

APPENDIX

A END-USER PREMISE ELAS TERMINATION OPTIONS

A1 Introduction

A.1.1 Below are some examples of the options for termination of an ELAS at the End User Premises and some of the potential implications of these options.

A2 Traditional Wholesale Broadband

A.2.1 One access service per end-user premise. An access is mapped to a physical port on the NTU, where an NTU exists. Alternatively the access service could be a "wires only" service, as in xDSL wholesale today.

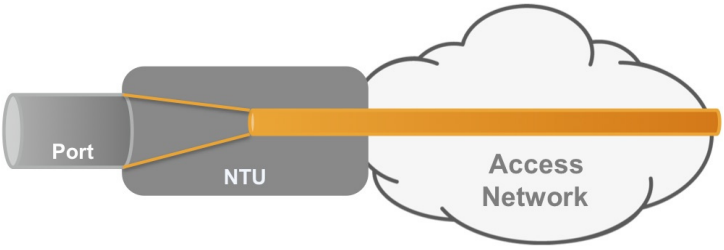

FIGURE 16
Traditional NSP Wholesale Broadband

A3 Multiple Access Services per End-User Premise – Port Terminated

A.3.1 Multiple access services can be operational simultaneously at an end-user premise. Each access service is mapped to a physical port on the NTU.

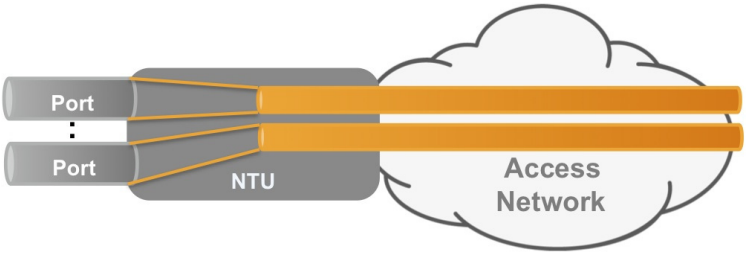

FIGURE 17
Multiple Access Services per End-User Premise – Port Terminated

A4 Multiple Access Services per End-User Premise – Virtual Port Terminated

A.4.1 Multiple access services can be operational simultaneously at an end-user premise. Each access service is mapped to a virtual port on the NTU, such as a VLAN.

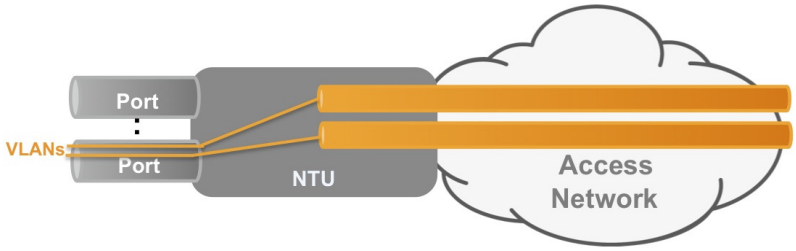

FIGURE 18

Multiple Access Services per End-User Premise – Virtual Port Terminated

A.4.2 The pros and cons associated with a single physical port on a NTU e.g. ONT, across multiple WSAs (i.e. a virtual Service Boundary Point) must be considered in terms of the extensibility provided with the technical and operational issues that result.

Management Complexity

A.4.3 The device connected to the shared NTU port is beyond the NBN SBP, therefore, it must be managed by another entity. This device could be managed by either the end-user, one of the WSAs sharing the NTU physical port, or under a shared management arrangement agreed by all WSAs sharing the NTU physical port.

(a) Management by the end-user would require the configuration of the device and management of any issues that could impact the integrity of services delivered over the shared NTU physical port. This could include VLAN IDs and associated upstream bandwidth and QoS profiles.

(b) Management by one of the WSAs raises the potential issue of equivalence. The WSA assuming the role of management, in effect provides a mediation function between the WSAs for access to the shared NTU physical port resources and co-ordination of service delivery. This approach would need to meet the requirements of the end-user and any regulatory or other policies that protect open and equivalent access.

(c) Shared management by all WSAs would require a strict set of rules about how resources such as NTU port bandwidth are shared among the WSAs. The device would require a degree of virtualisation or support of multiple management domains, which are some issues considered by the Broadband Forum's Broadband Home working group specifications. This capability would need to address

aspects such as configuration capabilities, QoS and bandwidth management.

A.4.4 Where the device connected to the shared NTU port is an layer 3 Residential Gateway (RG), additional IP-layer management issues must also be addressed, for example:

(a) Coordination of RG and device IP addressing across multiple WSAs;

(b) IP routing capabilities to support the access services including the limit of a single default route for the attached RG.

Operational Complexity

A.4.5 The delineation of responsibilities for OAM for shared devices needs to be considered.

A.4.6 In any scenario where shared physical infrastructure is involved, there is the potential for fault conditions to arise which affect one or more WSAs.

A.4.7 It is also possible that mis-configuration by one WSA can affect other WSAs.

A.4.8 From the end-user point of view it may not be clear which WSA is responsible for repairing any shared infrastructure.

A.4.9 The operational environment must consider the relationships and interactions to cater for cases such as where one access service impacts another.

Device Capability

A.4.10 The scenario of a virtual SBP directly connecting into a shared home network medium (e.g. powerline) needs to be considered.

A.4.11 This includes considering the capabilities of devices connected to the shared medium. Capabilities to allow a device to be associated with a particular access service need to be provided over the shared medium e.g. VLANs.

A.4.12 This is typically not the case with today's CPE (particularly in the consumer market) and would therefore require industry development.

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