COMMUNICATIONS ALLIANCE LTD

NATIONAL BROADBAND NETWORK
OVERVIEW OF TECHNICAL STANDARDS

RELEASE 1

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National Broadband Network – Overview of Technical Standards
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1 GENERAL

1.1 Introduction

The Communications Alliance NBN Technical working group developed the survey and analysis of NBN telecommunications standards in this document.

1.2 Relationship with other Communications Alliance NBN Working Groups

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

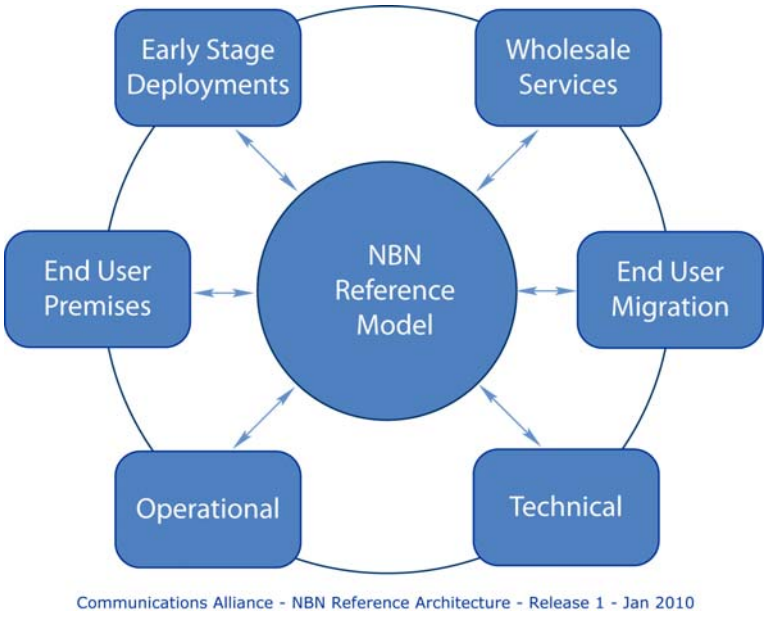

FIGURE 1
Communications Alliance NBN Project Working Group Structure

1.2.2 The NBN Reference Model working group is one of seven working groups established by Communications Alliance to address industry requirements for the National Broadband Network (NBN). The other six working groups address:

(a) **NBN Reference Model** - The NBN Reference Model Group is developing a reference model that seeks to identify within the NBN framework:

(i) the roles and responsibilities of Service Providers,

(ii) key principles related to End Users,

(iii) key principles related to Services, and

(iv) key principles related to Interconnection of Networks;

(b) **Wholesale Services** - The Wholesale Services working group is developing high level service definitions relevant to the National Broadband Network (NBN) that will be required in an NBN framework and supplied by NBN Co, FTTP greenfields carriers and other broadband access providers.

(c) **Early Stage Deployments** - The Early Stage Deployments working group is developing a definition of "Greenfields" for Fibre To The Premises (FTTP) developments, plus information to guide stakeholders such as planning authorities, approvals bodies, premises owners and constructors that draws upon industry best practices.

(d) **End User Premises** - The End User Premises working group is developing advice on NBN installation practices for end-user premises, guidelines on in-premises distribution and suggested procedures for testing and provisioning services. The types of end-user premises include business, residential (including multi-dwelling), government, educational, infrastructure and backhaul sites.

(e) **End User Migration** - The End User Migration working group is defining a 'migration' with respect to the NBN for the definition of processes for customer movement to, within and from the NBN.

(f) **Operational** – The Operational working group is proposing approaches to enable the best possible customer experience in provisioning, assurance and billing of NBN services.

1.3 The Technical Working Group

1.3.1 The Technical working group has identified a number of appropriate international and local standards and industry documents that can be used to realise the NBN Reference Model options. Where alternative standards have been considered or optional features are available, the Technical working group will describe the advantages and disadvantages of these alternatives and options.

1.3.2 The alignment with standards, especially international standards, is important to:

(a) Provide the telecommunications community with a common vocabulary when discussing or planning the use of the NBN;

(b) ensure that the NBN makes use of the experience available around the world and approximates world's best practice; and

(c) provide assurance that the elements required to build and use the NBN will be readily available from a range of global suppliers.

1.3.3 The Technical working group recognises there is no single set of technical recommendations which fully capture the deployment model and reference architecture envisaged by the Australian NBN.

1.3.4 It is recognised the international technical recommendations are still work-in-progress and the Technical working group will need to draw upon a range of technical recommendations. Therefore the proposed approach of the working group is to use those recommendations and standards most closely aligned with the expected requirements of the NBN.

1.3.5 In some cases, implementation models which draw upon industry best practices will be required, particularly where no suitable recommendations/standards exist.

1.4 Scope

1.4.1 This document identifies the relevant standards which underpin the ability of the global telecommunications industry to:

(a) implement the NBN Reference Model as documented by the NBN Reference Model working group; and

(b) Implement the NBN Wholesale Services (currently limited to active layer 2 wholesale services) as documented by the Wholesale Services working group.

1.4.2 This document also discusses the:

(a) relevance of the on-going work of key international standards bodies (e.g. Broadband Forum, Metro-Ethernet Forum and the ITU-T) to the NBN;

(b) characteristics of competing access technologies (viz. EPON and GPON; and)

(c) standards relevant to the need for the NBN to be Secure, Robust, Environmentally Sustainable, Future Proof, and to support IPv6.

1.5 Future Work

1.5.1 Areas identified for a future release include:

(a) the means to realize passive (dark fibre, dark PON) wholesale services, and RF overlay services; and

(b) the means to realize active IP services (e.g. for wireless or satellite access).

2 DEFINITIONS AND ACRONYMS

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 the relevant wiki page was being finalized for public availability.*

2.2 Acronyms

Acronyms used in this document and their meaning are:

ALA	Active Line Access
ASP	Application Service Provider
ATA	Analogue Terminal Adaptor
BBF	Broadband Forum
DSL	Digital Subscriber Line
ELAS	Ethernet Line Access Service
ELBS	Ethernet Backhaul Service
EMCS	Ethernet Multicast Service
EPON	Ethernet Passive Optical Network
FDH	Fibre Distribution Hub
FTTP	Fibre To The Premises
Gbps	Gigabits per second
GPON	Gigabit Passive Optical Network
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPv6	Internet Protocol version 6
ISO	International Organisation for Standardization
ITU-T	International Telecommunication Union - Telecommunications Sector
L2TP	Layer 2 Tunnelling Protocol
MEF	Metro Ethernet Forum

NBN	National Broadband Network
NICC	Network Interoperability Consultative Committee
NIST	National Institute of Standards and Technology
NSP	Network Service Provider
ODF	Optical Distribution Frame
ODN	Optical Data Network
OFCOM	Office of Communications, UK
OMCI	ONT Management and Control Interface
ONT	Optical Network Termination
ONU	Optical Network Unit
OLT	Optical Line Termination
OMCI	ONT Management and Control Interface
POI	Point of Interconnection
PON	Passive Optical Network
P2P	Point to Point
RF	Radio Frequency
RG	Routing Gateway
SBP	Service Boundary Point
TDM	Time Division Multiplexing
WDM	Wavelength Division Multiplexing
3GPP	3rd Generation Partnership Project
10GPON	10 Gbps Gigabit Passive Optical Network

3 OVERARCHING STANDARDS & ISSUES

3.1 Active Standards

See Appendix A for Active Standards.

3.2 The Reference Model and Broadband Forum Standards

3.2.1 There are several Broadband Forum Recommendations that approximate the Communications Alliance NBN Reference Model. They are:

(a) TR-101 - which is a DSL recommendation that introduces several essential topics, such as the introduction of Ethernet-based broadband access technologies, and wholesale access services,

(b) TR-059 - which provides the definitions for Broadband Service Providers which are assumed in subsequent recommendations,

(c) TR-156 - which is a GPON version of TR-101, and

(d) TR-144 - which is the most generic of the set and includes both layer 2 and layer 3 access services across a range of access technologies (DSL, PON, P2P, wireless and satellite).

3.2.2 While TR 144 is the closest match for the complete Communications Alliance NBN Reference Model, it draws on the other two documents for detail.

3.2.3 The key diagram in ***TR 144 "Broadband Multi-Service Architecture & Framework Requirements"*** is the "Broadband Multi-Service Reference Model" (labelled as Fig.2 in TR-144, refer to Figure 2 here).

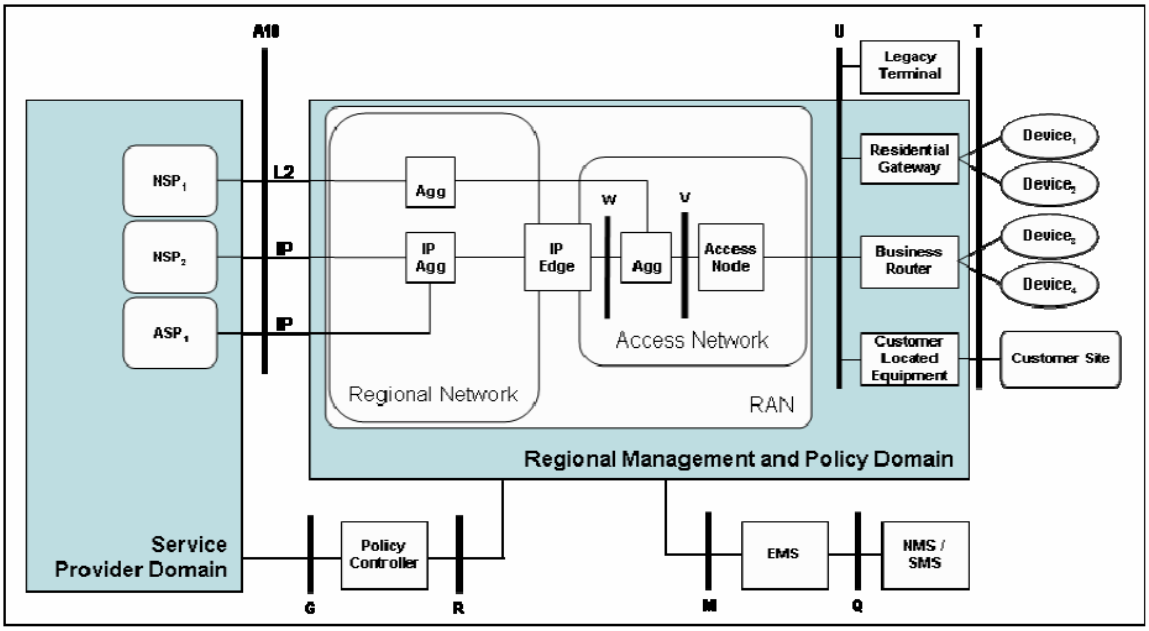

FIGURE 2

Figure 2 from TR-144

3.2.4 Note that a single element (the "Access Node") encompasses the entire GPON path, from switch (OLT) to user-premises equipment (ONT/ONU) including the passive optical data network (ODN). This is expanded in ***TR-156 "Using GPON Access in the context of TR 101"***. The key diagram is "Network architecture for Ethernet-based GPON aggregation" (labelled Fig.1 in TR 156, refer to Figure 3 here).

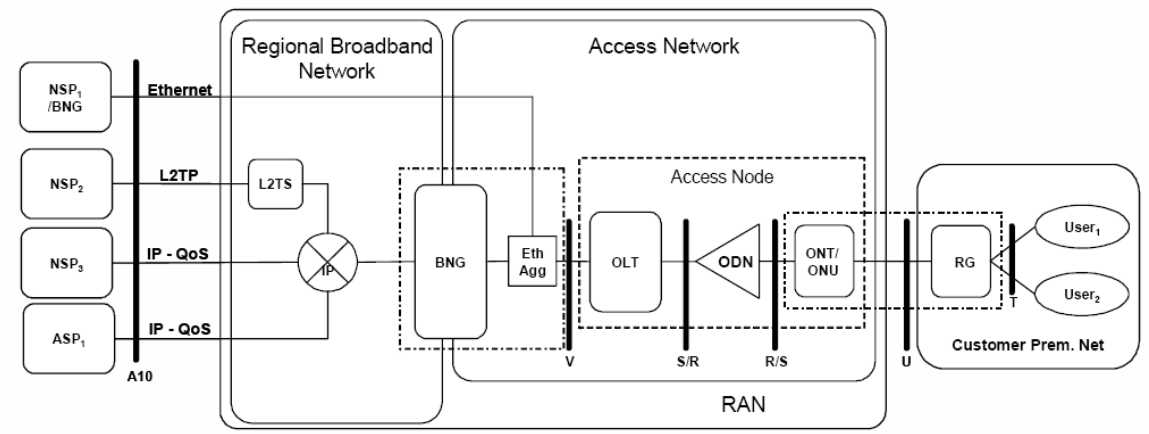

FIGURE 3

Figure 1 from TR-156

3.2.5 These two diagrams can be matched with the Points of Interconnection and Service Boundary Points as identified in the

Communications Alliance NBN Reference Model – FTTP Access (refer to Figure 4).

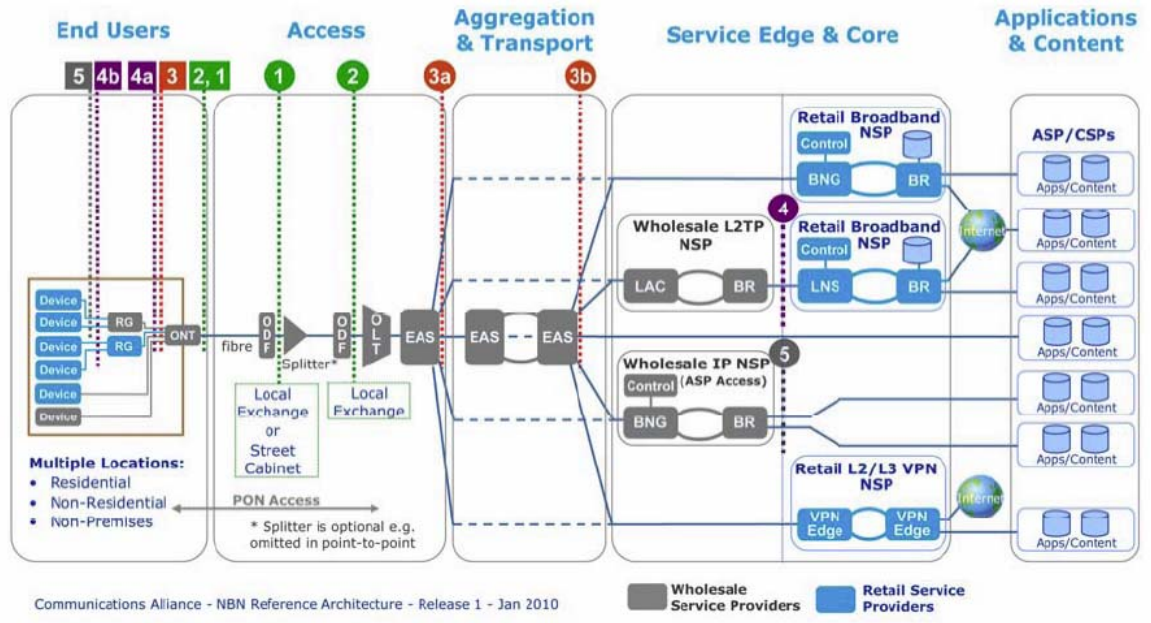

FIGURE 4

Wholesale Point of Interconnect and Service Boundary Point Scenarios - FTTP Access

TABLE 1

POI to SBP for Fibre Access

CA NBN Reference Model PoI to SBP	Broadband Forum PoI to SBP
Passive Direct Dark Fibre,1 to 1	TR-156 R/S to TR-156 R/S
Passive Dark PON, 2 to 2	TR-156 S/R to TR-156 R/S
Layer 2 Ethernet, 3a or 3b to 3	TR-156 A10 L2 to TR-156 U
Layer 2 Wholesale L2TP, 4 to 4a or 4b	TR-156 A10 L2TP to TR-156 U or T
Layer 3 Wholesale IP, 5 to 5	TR-144 A10 IP to TR-144 T

3.2.6 To a limited extent, it is possible to match the Points of Interconnection and Services Boundary Points as identified in the CA NBN Reference Model – Terrestrial Wireless/Satellite Layer 2 Ethernet Access.

TABLE 2

POI to SBP for Terrestrial Wireless/Satellite Layer 2 Access

CA NBN Reference Model PoI to SBP	Broadband Forum PoI to SBP
Wireless Layer 2 Ethernet, 1 to 1	TR-144 W to TR-144 U
Satellite Layer 2 Ethernet , 2a or 2b to 2	TR-144 W or V to TR-144 U
Wholesale L2TP, 3 to 3	TR-156 A10 L2TP to TR-156 T
Wholesale Layer 3 IP, 4 to 4	TR-144 A10 IP to TR-144 T

3.2.7 And similarly for CA NBN Reference Model – Terrestrial Wireless/Satellite IP Access.

TABLE 3

POI to SBP for Terrestrial Wireless/Satellite IP Access

CA NBN Reference Model PoI to SBP	Broadband Forum PoI to SBP
Wholesale Layer 3 IP, 1 to 1	TR-144 A10 IP to TR-144 T
Wholesale Layer 3 IP-VPN, 2 to 2	TR-144 A10 IP to TR-144 T

3.2.8 The choice of appropriate interface for wireless/satellite PoI should be resolved by future work on BBF WT-145.

3.2.9 The definition of the entities involved in a broadband network, especially considering wholesale environment are very useful. The terms NSP and ASP continue to be relevant in TR 144 and subsequently developed documents, however, for the definition TR-059 needs to be consulted. The relevant excerpt from TR-059 is provided below.

3.2 Broadband Provider Reference Definitions

...

The Network Service Provider (NSP):

- *Includes Internet Service Providers (ISPs) and Corporate Service Providers (CSPs)*
- *Is responsible for overall service assurance*
- *May provide CPE, or software to run on customer-owned CPE, to support a given service*
- *Provides the customer contact point for any and all customer related problems related to the provision of 'this service*
- *Authenticates access and provides and manages the IP address to the subscribers*

The Application Service Provider (ASP):

- *Provides application services to the application subscriber (gaming, video, content on demand, IP Telephony, etc.)*
- *Is responsible for the service assurance relating to this application service*
- *Responsible for providing to subscribers additional software or CPE which specific services may require.*
- *Provides the subscriber contact point for all subscriber problems related to the provision of specific service applications and any related subscriber software.*
- *Does not provide or manage the IP address to the subscribers.*

...

The Access Network Provider:

- *Provides digital connectivity to the customer via the metallic Loop*
- *Is responsible for the performance and repair of the access transmission equipment*

The Regional Network Provider:

Provides appropriate connectivity between the Access Network and the NSPs and ASPs

- *Is responsible for Regional Network performance and repair*
- *May perform aggregation services to NSPs or ASPs and/or may provide any to any connectivity within the 'RBN on behalf of the NSP/ASP*

3.2.10 While these Broadband Forum Recommendations do provide an effective match to many elements of the CA NBN Reference Model, there are some ways in which they are not helpful, viz.

(a) The Transport Elements are considered as "embedded" in the model, whereas for NBN they are expected to be more visible, not least because in some instances it is expected that will be provided by organisations other than NBN Co.

(b) The passive Optical Data Network (ODN) is even more embedded, such that there is no insight provided for the structure of the ODN, yet this infrastructure comprises by far the most expensive part of the NBN.

(c) Certain topics that may be important, such as the use of a RF Video overlay on the GPON access, are identified as out-of-scope.

(d) There is the expectation in the Recommendations that the new NBN will support all legacy telco services (such as business TDM services), when it may be more appropriate to exit some legacy services, or leave them on current (copper) infrastructure.

(e) BBF TR-144, TR-156 and other models are based on IP services and therefore do not adequately detail the underlying layers which are transparent to the IP layer. Future work on WT 145, the first detailed report following on from TR 144, is paving the way for a more detailed representation of the transport and passive layers.

(f) The BBF TR-144 and other report do not detail wireless technologies at the current time. That said there is motivation from member service provider organisations to address wireless in the overall architecture. Liaison and detail around WiMAX interworking is underway with the WiMAX Forum. Liaison and detail around 3GPP interworking is underway with 3GPP.

3.2.11 The Broadband Forum Recommendations thus represent a useful framework for the NBN, but in use will require careful interpretation.

3.3 PON Standards

Origins of EPON and GPON

3.3.1 EPON from the IEEE (often called Gigabit-EPON), championed by the IT market as a member of the Ethernet family of standards (IEEE 802.3ah).

3.3.2 GPON from the ITU, championed by the Telco market as a member of the FSAN family of standards (ITU-T G.984).

Global Market Share

3.3.3 EPON has the largest number of subscribers because of NTT in the Japanese market.

3.3.4 GPON is forecast by Infonetics to overtake EPON in 2010.

Technical Advantages/Disadvantages

3.3.5 EPON has 1Gbps shared downstream, with recent introduction of 10Gbps EPON standard. Limited OMCI (ONT Management and Control Interface used to remotely manage ONTs at user premises) definition has led to operators having to enforce their own definitions of OMCI to allow them to generate a competitive third-party ONT (optical modem) market. The EPON standard does not include clock-synchronisation across an EPON access network.

3.3.6 GPON has 2.5 Gbps shared downstream, with an agreed draft for 10Gbps GPON standard. Comprehensive OMCI definition

underpins regular OLT-ONT interworking tests across GPON vendors. The GPON standard includes clock-synchronisation across a GPON access network, facilitating the support of business TDM links and GbE mobile backhaul links.

Recommendation

3.3.7 Considering that:

(a) the comparison of capabilities above shows GPON as having richer features, and larger future market share, and

(b) NBN Co has identified GPON as the likely preferred PON technology,

the Technical working group will focus on GPON as the FTTP access protocol for active wholesale services (PoI 3,4,5). Other working groups have also focused on GPON.

3.3.8 It is noted that the wholesale dark fibre / dark PON services (PoIs 1, 2) allow a wide range of access protocols to be supported over the passive infrastructure, including EPON and GPON.

3.4 Wireless Standards

See Appendix C for Wireless Standards.

3.5 Other Standards

Home Networking

3.5.1 To complement the standardized arrangements in access networks requires standardised arrangements for networks in the premises.

3.5.2 ITU-T Study Group 15 (SG15) has been designated the lead Study Group for Optical Technology and for Optical Transport Networks within the ITU-T. SG15 responsibility includes "development of standards on optical transport networks and access network infrastructures, systems, equipment, optical fibres and cables, and their related installation, maintenance, test, instrumentation and measurement techniques, and control plane technologies to enable the evolution toward intelligent transport networks. This encompasses the development of related standards for the customer premises, access, metropolitan and long haul sections of communication networks". More information is available from: http://www.itu.int/ITU-T/studygroups/com15/index.asp.

3.5.3 SG15 has led the activity that resulted in the publication of the ITU-T Recommendations on home networking, including:

(a) G.9960 Next generation home networking transceivers; and

(b) G.9970 Generic home network transport architecture.

3.5.4 The Communications Cabling Manual by Standards Australia consists of two volumes:

(a) Volume 1 is a practical guide to cabling installation requirements; and

(b) Volume 2 contains all the related technical Standards referred to in Volume 1.

Other

3.5.5 See Appendix D for other relevant standards.

4 REALISING WHOLESALE SERVICES

4.1 Passive Services

While passive services (Dark Fibre, Dark PON) have been identified in the Communications Alliance NBN Reference Model, these services have not yet been elaborated on by the Wholesale Services working group. Consequently the area is one for future work by the Wholesale Services and Technical working groups.

4.2 Active Ethernet Services

4.2.1 There are three Active Ethernet Services currently defined by the Wholesale Services working group. These services match the services identified in the Reference Model between PoI 3a and 3b, and SBP 3. It is assumed that the delivery to SBP 3 is via GPON, and as yet there are no terrestrial wireless Active Ethernet Services.

4.2.2 These services are:

(a) **ELAS (Ethernet Line Access Service):** provides transparent carriage of Ethernet frames with defined bandwidth and class of service as provided by MEF and OFCOM/NICC Active Line Access(ALA) standards from aggregation switches in an NBN Access Node (Exchange/C.O.) to Ethernet interfaces on an ONT. Where multiple Network Service Providers are delivered on the same Ethernet interface Ethernet tags are used to differentiate individual streams.

(b) **ELBS (Ethernet Backhaul Service):** provides for the extension of ELAS services to another location allowing the aggregation of traffic from many NBN Access Nodes (Exchange/C.O.) and if desired achieving further economies through statistical multiplexing. The underlying transmission technology is not defined save that it must sustain the desired bandwidth and class of service demands.

(c) **EMCS (Ethernet Multicast Service):** provides a similar service to ELAS, however provision is made such that packets/frames with multicast addresses are detected and automatically replicated within the Access Node, making the carriage of broadcast video (and similar) services more efficient.

4.2.3 The Wholesale Services working group has produced a document that defines these services in more detail, and identifies the relevant standards.

4.2.4 The fundamental standard references for these services are provided by the MEF. However a subset of the MEF standards, called ALA, have been promoted by the UK Regulator (OFCOM) as being more appropriate for an open access/wholesale

service, and passed to the UK Network Interoperability Consultative Committee (NICC) to refine the definition.

Ofcom - Ethernet Active Line Access

4.2.5 Specifically:

(a) Ethernet Active Line Access: Updated Technical Requirements (Exec Summary in html or whole document as .pdf)

(b) Ethernet in Access Study (Background and Context as html or International Case Studies as .pdf)

Ofcom - Next Generation Competitive Broadband: from LLU to ALA?

4.2.6 The NICC has taken over the ALA work from Ofcom and combined the requirements with NGNUK, the requirements document is available from: NICC ND 1642 Requirements for Ethernet Interconnect and Ethernet ALA.

4.2.7 The ALA references the Metro Ethernet Forum Technical Specifications, and MEF 6.1 Ethernet Services Definitions may provide a useful framework.

4.2.8 Another MEF specification that may provide a useful framework is MEF 26 External Network Network Interface (ENNI) Phase 1. This was completed subsequent to the publication of the NICC requirements document and so was not referenced in the above Ofcom work.

4.3 Active IP Services

4.3.1 While active layer 3 IP services have been identified in the Communications Alliance NBN Reference Model, in particular for services carried over wireless or satellite access, these services have not yet been elaborated on by the Wholesale Services working group. Consequently the area is one for future work by the Wholesale Services and Technical working groups.

5 UNDERLYING REQUIREMENTS

5.1 Security

5.1.1 The NBN will carry a wide range of different applications/services, for a wide range of service providers and end-users. Consequently it will be expected to deliver a secure broadband access network where security can be considered as both surviving attack on the NBN active equipment, passive equipment and operations, and also keeping user sessions secure while they traverse the NBN.

5.1.2 However security for user sessions must be established between end user and application provider and is not the direct responsibility of the NBN.

5.1.3 Since the wholesale NBN services (e.g. ELAS and ELBS) are not end-to-end they must be transparent to high-level security. ELAS and ELBS are only required to be secure so that:

(a) A SP cannot read/intercept/disrupt/starve another SP's data while it traverses the NBN; and

(b) An end-user cannot read/intercept/disrupt/starve another user's data while it traverses the NBN.

5.1.4 A useful reference document might be ISO 31000:2009 Risk management - Principles and guidelines, available from: http://www.iso.org/iso/catalogue_detail.htm?csnumber=43170

5.1.5 Another model might be the:

Cyber Security Coordination Task Group. National Institute of Standards and Technology, DRAFT NISTIR 7628:

Smart Grid Cyber Security Strategy and Requirements

"... With the Smart Grid's transformation of the electric system to a two-way flow of electricity and information, the information technology (IT) and telecommunications infrastructures have become critical to the energy sector infrastructure. Therefore, the management and protection of systems and components of these infrastructures must also be addressed by an increasingly diverse energy sector. To achieve this requires that security be designed in at the architectural level. NIST has established a Smart Grid Cyber Security Coordination Task Group (CSCTG), which now has more than 200 volunteer members from the public and private sectors, academia, regulatory organizations, and federal agencies. Cyber security is being addressed in a complementary and integral process that will result in a comprehensive set of cyber security requirements..."

5.1.6 More information on the NIST activity on smart grids is at: http://www.nist.gov/smartgrid/

5.1.7 ITU-T Study Group 17 (SG17) has been designated the Lead Study Group for Telecommunication Security within ITU-T. Activities of SG17 include: developing and maintaining security outreach material; coordination of security-related work; and identification of needs and assignment and prioritization of work to encourage timely development of telecommunication security Recommendations. More information is available from http://www.itu.int/ITU-T/studygroups/com17/index.asp.

5.2 Robustness

5.2.1 The NBN is assumed to support a major portion of Australia's access traffic, and as such must be reliable on a day-to-day basis, able to provide service in the presence of natural disasters, to limit the impact of disaster or fault to as few services and users as possible, and when damaged to be promptly restored to service.

5.2.2 These capabilities will require the designing-in of features to automatically handle predictable faults (perhaps over diverse routes), to quickly identify faults (perhaps through specific test points), and to quickly restore services (perhaps through the use of modular cables and ducts).

5.3 Environmental Sustainability

5.3.1 Increasingly modern telecommunications will be held to high standards regarding environmental sustainability. As a new network, the NBN represents an opportunity to greatly reduce the energy consumed (i.e. equivalent carbon-dioxide emissions) in operating and building the network, as well as other forms of pollution.

5.3.2 Opportunities for reducing energy use include selecting more efficient optical switch (OLT) and optical modem (ONT) technologies, as well as more efficient build practices.

5.3.3 Reducing energy consumption by operators and end-users has been studied by the European Commission. Useful documents include **"**End Use Energy Efficiency: Code of Conduct on Energy Consumption of Broadband Equipment" and the related "Reporting form".

Energy Consumption / Emissions

5.3.4 Various studies have been conducted to investigate the lifecycle emissions of FTTP networks. (In particular the FTTH Councils in Europe and USA have commissioned lifecycle studies with PWC.) In order of importance the important contributions to emissions are:

(a) End-user equipment (for example a hybrid TV set top box with storage used to capture and store broadcast TV and thus powered and in use constantly can consume 0.5-1kWh/day). Combined with other devices such as Wi-Fi

access points, and home server/s, a household can consume as much as 2kWh/day on broadband-connected devices; the equivalent of having a second refrigerator in the house.

(b) The build of the passive infrastructure (civil works and cables) has been estimated as contributing from >80% of the life-cycle emissions (in Europe with underground build) to <10% (in the USA with predominantly aerial build).

(c) ONTs can consume .2-0.4kWh/day depending on their use of a "low-power state" (or "sleep mode").

(d) OLTs can consume .48kWh/day/PON which equates to 0.15kWh/day/subscriber (1:32 split) or 0.20kWh/day/subscriber (1:24 split).

(e) Exchange/C.O. equipment such as aggregation switches, and hosted equipment, along with air-conditioning add to the emissions to a small extent per subscriber. A facility handling approximately 50,000 premises can be expected to require 10-20MWh/day.

5.3.5 As a major consumer of electricity, the NBN operator will be obliged to report on its emissions, and plans to reduce these emissions over time. There are a range of approaches available:

(a) End-user equipment can often be replaced by network based services (e.g. streaming video on-demand rather than download and store), as well as more energy efficient end user devices (LCD TVs in place of plasma TVs) with more efficient power supplies (see Appendix D).

(b) Civil works techniques that require less energy (diesel fuel) use can be preferred, and the remaining emissions can be offset by contractors.

(c) ONTs and OLTs are becoming more efficient. In the European Union the European Commission is circulating a "Code of Conduct on Energy Consumption of Broadband Equipment" which identifies expected reductions in OLT and ONT energy consumption.

(d) Exchange/C.O. energy use can be reduced by careful design (e.g. encouraging natural ventilation) and by establishing contracts for the supply of zero-emissions energy from renewable sources such as wind or solar. (In the UK BT have committed to sourcing the bulk of their energy from renewables, and this includes the building of wind farms.)

5.3.6 Other carriers whose services complement NBN Co, such as Transport Operators and Retail Service Providers, are also expected to build their networks, and thus their emissions will also increase as an indirect consequence of the construction of the NBN.

“Lifeline Service”

5.3.7 There appears to often be confusion regarding the existence or not of legislation mandating a “lifeline service” (i.e. the maintenance of a telephone capability during a local power failure). This subject is also often confused with the requirement for operators to support “emergency calling” (i.e. the ability for telephone users to call a special number (e.g. “000” for fixed telephones) to request assistance from police/ambulance/fire brigade.

5.3.8 In brief there is no legislated requirement for an Australian operator to support residential telephony, either to emergency services or any other party, during a local power failure. The confusion may have arisen because originally all telephones were powered from the local exchange (indeed many houses at the time did not have domestic electricity), and this capability has been sustained over the years, though it is now largely irrelevant due to the growth in mains-powered telephones (e.g. cordless phones) and mobile telephones.

5.3.9 With FTTP networks the fibre network cannot power the optical modems (ONTs). However a small number of FTTP subscribers may wish to have a battery backup device so that the ONT can be kept working for a while during a local power failure to support critical end user services.

5.3.10 Of course for this to be of value it would also be necessary for the ONT and end-user equipment to both have battery backup. In the case of telephony this means that the telephone, ATA (telephony adapter) and ONT all need backup. While battery backup devices can be offered by operators as an option, the batteries themselves are relatively short-lived, and the actual lifespan will be determined by the environment and usage pattern of the batteries.

5.3.11 Consequently it is common practice for operators to require that end-users accept responsibility for monitoring the battery function, purchase of a replacement battery, installation of the new battery, and recycling of the spent battery.

5.3.12 In the case of telephony the availability and popularity of mobile phones makes them an alternative for emergency telephony to a fixed phone with battery backup.

5.3.13 There are other end-user devices which communicate over a "dialup telephone line", such as home security systems or medical alarm equipment, and these devices typically incorporate battery backup for which the end-user is also responsible. (AS4607-1999 requires medical alarm equipment to operate for 36 hours in the event of a mains power failure.) Users of such devices will need to be informed that they will also need to make provision for the supply and maintenance of battery backup facilities for their ATA and ONT.

5.3.14 An important consideration is that the use of battery backup on a large-scale (e.g. mandating battery backup on all ONTs) would create extra costs for end-users and operators, and very likely lead to environmental problems as end-users discard batteries into land-fill. The use of batteries also leads to increased energy emissions, as constant trickle-charging is necessary to compensate for their self-discharge. Thus for environmental reasons the use of batteries for backup should be minimised.

5.4 Future Proofing

5.4.1 The R&D programme for FTTP technologies are well underway, and include higher speed versions of existing standards (e.g. 10Gbps versions of GPON and EPON), new technologies (WDM-PON), and ways of extending the reach of existing standards using various types of amplifiers and repeaters.

5.4.2 Some of these innovations will be commercially available within the build phase of the NBN (in particular the 10Gbps versions of PON), and consequently the NBN must be designed to anticipate the requirements of these new standards and technologies, to minimise difficulties and costs in introducing them in the network.

Faster FTTP Standards

5.4.3 The speeds offered to end users can be increased on a GPON access by reducing the split ratio used on each PON, e.g. 1:8 rather than 1:32 would allow an effective average speed increase from 100Mbps to 400Mbps. However such an approach would also require four times the number of splitters in the FDH and four times the number of feeder cables and PON ports on the OLT.

5.4.4 A more promising approach is that used historically, viz. using higher speed active technologies. 10Gbps is four times faster than today's 2.5Gbps GPON, and can thus achieve a comparable speed increase with no changes to the passive optical data network. However it does require replacing the ONTs (optical modems) and OLT ports.

5.4.5 To achieve even higher speeds such as 1Gbps to all subscribers, even faster GPON technologies are anticipated.

10Gbps version of GPON

5.4.6 The next generation GPON standard uses a higher speed signal encoding such that signals are transmitted at 10Gbps (instead of today's 2.5Gbps). Different wavelengths are used for 10Gbps connections, however these wavelengths are selected such that they can co-exist on the same fibre PON as a 2.5Gbps service. This ability to co-exist on the same PON is intended to facilitate the transition from 2.5Gbps to 10Gbps services.

5.4.7 To allow both types to co-exist a special type of filter (known as a "combiner") is used to allow both the 2.5Gbps and 10Gbps OLT ports to be connected to the same feeder fibre. However this

combiner introduces a further loss (of approximately 1 dB) to the optical budget. Also if co-existence were to be required then the combiners would ideally be inserted when the original cable plant (using 2.5Gbps GPON equipment) is being built.

5.4.8 An alternative transition strategy is to keep 2.5Gbps PONs and 10Gbps PONs separate, with separate PON OLT ports, feeder cables, and splitters, and to move premises from one PON to the other when their 10Gbps PON ONT is installed. To facilitate this approach, the distribution cables should mate with the splitters via a connector. This approach also requires the early installation of extra feeder cables and splitters in FDHs; indeed in the worst case the number of splitters and feeder cables could be double the number required by the previous (co-existence) strategy.

WDM PON

5.4.9 WDM PON refers to a range of PON models in which every ONT uses a different transmit/receive pair of wavelengths to/from the OLT. Consequently while the NT's share a feeder cable, they do not time-share communications. This increases the speed of communications, but there remain a number of technical challenges which have not yet been resolved, such as:

(a) the development of "colourless" ONTs which can automatically discover a pair of wavelengths that they can use, and

(b) thermally stable Arrayed Waveguide Grating (AWG), the WDM equivalent of a GPON passive splitter.

5.4.10 Today WDM PONs have not yet been completely standardised, and existing pilot installations are limited.

5.5 IPv6

5.5.1 Within the build phase of the NBN, it is expected that network operators will be obliged to introduce IPv6 into their networks. Thus while NBN will emphasize layer 2 (Metro Ethernet) services, it will clearly be carrying IPv6 traffic, and in some cases it may have to be layer 3 (IP) "aware" in order to efficiently support some services (e.g. multicast).

5.5.2 Furthermore, the interaction between Service Providers and the NBN relating to charging, business systems support (BSS), and operations systems support (OSS), may use IPv6.

5.5.3 Consequently it will be essential for the working groups to specifically identify where IPv6 will be required, both initially, and longer-term.

APPENDIX

A ACTIVE STANDARDS

Broadband Forum (BBF)

Technical Reports, and in particular:

TR-144 "Broadband Multi-Service Architecture & Framework Requirements"

TR-101 "Migration to Ethernet-based DSL Aggregation"

TR-156 "Using GPON Access in the context of TR-101"

TR-059 "DSL Evolution - Architecture Requirements for the Support of QoS-Enabled IP Services, September 2003"

International Telecommunications Union – Standardisation sector (ITU-T)

ITU-T Recommendations - From the G-Series of recommendations.

PON

G.983.1 "Broadband optical access systems based on Passive Optical Networks (PON)"

GPON

G.984.1 "Gigabit capable Passive Optical Networks (GPON): General characteristics"

G.984.2 "Gigabit capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification"

G.984.3 "Gigabit capable Passive Optical Networks (GPON): Transmission Convergence Layer Specification"

G.Imp984.3 "Implementers' Guide for ITU-T Rec. G.984.3 (02/2004)"

G.984.4 "Gigabit-capable passive optical networks (G-PON): ONT management and control interface specification"

G.Imp.984.4 "Implementor's Guide for ITU-T Rec. G.984.4"

G.984.5 "Gigabit-capable optical access networks: Enhancement band"

G.984.6 "Gigabit-capable passive optical networks (GPON): Reach extension"

Security

ITUSG17 "Study Group 17"

Metro Ethernet Forum (MEF)

MEF List of Technical Specifications

MEF 6.1 "Metro Ethernet Services Definitions Phase 2"

MEF 10.1 "Ethernet Services Attributes Phase 2"

MEF 22 "Mobile Backhaul Implementation Agreement, Phase 1"

MEF 23 "Carrier Ethernet Class of Service Implementation Agreement, Phase 1"

MEF 26 "External Network Network Interface (ENNI) Phase 1"

Institute of Electronic and Electrical Engineers (IEEE)

LAN/MAN CSMA/CD (Ethernet) Access Method (IEEE 802.3™)

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"

Refer to section 3 of IEEE 802.3-2008 for information on Gigabit Ethernet.
Refer to section 4 of IEEE 802.3-2008 for information on 10 Gigabit Ethernet.
Refer to section 5 of IEEE 802.3-2008 for information related to EPON (i.e. IEEE 802.3ah "Ethernet in the First Mile").

IEEE 802a-2003 "IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture — Amendment 1: Ethertypes for prototype and vendor-specific protocol development."

IEEE 802.1ad-2005 "Amendment to IEEE 802.1Q-2005. IEEE Standard for Local and Metropolitan Area Networks — Virtual Bridged Local Area Networks — Revision — Amendment 4: Provider Bridges"

IEEE 802.1Q-2005 "IEEE Standard for Local and Metropolitan Area Networks—Virtual Bridged Local Area Networks— Corrigendum 1: Corrections to the Multiple Registration Protocol"

Internet Engineering Task Force (IETF)

Search appropriate RFCs at rfc-editor.org/rfcsearch.html

Standards appropriate to the 'Aggregation and Backhaul' and 'Service Edge and Core' domains fall into these areas,

MPLS, MPLS-TP, VPLS, L2VPN, L3VPN , PWE3

Particularly important topics are:

a) the requirement to support conventional IP packets (IPv4) and the newer larger IPv6 packets and associated protocols (e.g. multicast for IPv6).

   i) IETF RFC 2460 Internet Protocol, Version 6 (IPv6) Specification

b) Support for Layer Two Tunneling Protocol (L2TP) which is commonly used by ISPs to connect to wholesale DSL services, and thus represents a convenient means of transition to NBN fibre access services, until operators are able to implement wholesale Ethernet (e.g. ALA) services.

   i) RFC 2661 Layer Two Tunneling Protocol "L2TP"

   ii) RFC 3817 Layer 2 Tunneling Protocol (L2TP) Active Discovery Relay for PPP over Ethernet (PPPoE)

   iii) RFC 3931 Layer Two Tunneling Protocol - Version 3 (L2TPv3)

B PASSIVE STANDARDS

International Electrotechnical Commission (IEC)

IEC 61753-1 “Fibre optic interconnecting devices and passive components performance standard - Part 1: General and guidance for performance standards.”

IEC 61753-021-2 “Fibre optic interconnecting devices and passive components performance standard - Part 021-2: Grade C/3 single-mode fibre optic connectors for category C - Controlled environment.”

IEC 61753-022-2 “Fibre optic interconnecting devices and passive components performance standard - Part 022-2: Fibre optic connectors terminated on multimode fibre for category C - Controlled environment.”

International Telecommunications Union – Standardisation sector (ITU-T)

ITU-T Recommendations

From the G-Series recommendations

Optical Fibre - Test Methods

G.650 Definition and test methods for the relevant parameters of single-mode fibres - divided into G.650.1 and G.650.2

G.650.1 Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable

G.650.2 Definitions and test methods for statistical and non-linear related attributes of single-mode fibre and cable

G.650.3 Test methods for installed single-mode optical fibre cable links

Optical Fibre - Characteristics

G.651.1 Characteristics of a 50/125 µm multimode graded index optical fibre cable for the optical access network

G.652 Characteristics of a single-mode optical fibre and cable

G.653 Characteristics of a dispersion-shifted single-mode optical fibre and cable

G.654 Characteristics of a cut-off shifted single-mode optical fibre and cable

G.655 Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable

G.656 Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport

G.657 Characteristics of a Bending Loss Insensitive Single Mode Optical Fibre and Cable for the Access Network

G.671 Transmission characteristics of optical components and subsystems

C WIRELESS STANDARDS

Possible source documents include:

Institute of Electronic and Electrical Engineers (IEEE)

IEEE 802.16 Broadband Wireless Metropolitan Area Network (also known as WiMax)

IEEE 802.16 IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems

3rd Generation Partnership Project (3GPP)

3GPP Specifications

3GPP specification numbering

FTP index for 3GPP specifications

D OTHER STANDARDS

International Standards Organisation (ISO)

ISO 31000:2009 Risk management - Principles and guidelines

International Telecommunications Union – Standardisation sector (ITU-T)

ITU-T Recommendations

From the G-Series recommendations:

Home Networking

G.9960 Next generation home networking transceivers

G.9970 Generic home network transport architecture

Also anticipated for approval in 2010 is G.9961 on Data link layer (DLL) for unified high-speed wire-line home networking transceivers

From the Y-Series recommendations:

Operations Administration Maintenance

Y.1730 Requirements for OAM functions in Ethernet-based networks and Ethernet services

Y.1731 OAM functions and mechanisms for Ethernet based networks

Ethernet QoS

Y.2113 Ethernet QoS control for next generation networks

AS/NZ Standards

Australian power supply standards:

AS/NZS 4665.1:2005 Performance of external power supplies – Test method and energy performance mark

AS/NZS 4665.2:2005 Performance of external power supplies – Minimum energy performance standard (MEPS) requirements.

Communications Cabling Manual (CCM):

CCM Volume 1—2007 Handbooks, codes and regulations

HB 252—2007 Communications Cabling Manual— Module 3: Residential communications cabling handbook

HB 243—2007 Communications cabling manual—Module 1: Australian regulatory arrangements

HB 29—2007 Communications cabling manual—Module 2: Communications cabling handbook

AS/ACIF S008:2006 Requirements for customer cabling products

AS/ACIF S009:2006 Installation requirements for customer cabling (Wiring Rules)

CCM Volume 2—2007 Standards

AS/NZS ISO/IEC 14763.3:2007 Implementation and operation of customer premises cabling—Part 3: Testing of optical fibre cabling

AS/NZS ISO/IEC 15018:2005 Information technology—Generic cabling for homes

AS/NZS ISO/IEC 24702:2007 Telecommunications installations—Generic cabling—Industrial premises

AS/NZS 3080:2003 Telecommunications installations—Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)

AS/NZS 3084:2003 Telecommunications installations—Telecommunications pathways and spaces for commercial buildings (Incorporating Amendment 1:2007)

AS/NZS 3085.1:2004 Telecommunications installations—Administration of communications cabling systems—Basic requirements

AS/NZS IEC 61935.1:2006 Testing of balanced communication cabling in accordance with ISO/IEC 11801—Installed cabling

AS/NZS IEC 61935.2:2006 Testing of balanced communication cabling in accordance with ISO/IEC 11801—Patch cords and work area cords

Other Australian standards:

AS/NZS 2211.1:2004 Safety of laser products - Equipment classification, requirements and users guide (IEC 60825-1:2001, MOD)
Note: AS/NZS 2211.1:2004 is identical to IEC 60825-1 Ed. 2.0

AS/NZS 2211.2:2006 Safety of laser products - Safety of optical fibre communication systems (OFCS)
Note: AS/NZS 2211.2:2006 is identical to IEC 60825-2 Ed. 3.0 and Ed. 3.1

AS/NZS 2967:2010 Optical fibre communication cabling systems safety

AS 4607-1999 Personal response systems

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