COMMUNICATIONS ALLIANCE LTD

NATIONAL BROADBAND NETWORK

END USER PREMISES INSTALLATION, DISTRIBUTION, TESTING AND ASSOCIATED PRACTICE HANDBOOK

DRAFT FOR COMMENT

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DRAFT National Broadband Network End User Premises Installation, Distribution, Testing and Associated Practice Handbook

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1 INTRODUCTION

1.1 General

1.1.1 This document has been developed by the NBN End User Premises working group charged with developing a set of high level NBN End User Premises installation practices and guidelines. It aims to introduce a common language for the discussion of the NBN EUP and provide a consolidated point of reference for exploring the issues and solutions around the delivery of NBN services to End User Premises.

1.1.2 An End User Premise in the context of Australia's NBN includes any home, business or service site that may be connected to an NBN via FTTP or a fixed wireless service/satellite. Once connected to an NBN, an EUP will be able to access services provided by NSP/ASPs which are delivered over the NBN infrastructure. It is possible that each EUP will be able to access one or more service providers (for different or similar service types) simultaneously.

1.2 Target Audience

The target audience of this handbook is NBN infrastructure providers, retail and wholesale service providers, data, video and voice cabling professionals, building owners and managers (single and multi-dwelling), design and construction groups, regulatory and policy bodies and telecommunications equipment vendors.

Due to the focus on technical facts and terminology, this handbook is not suited for general end-users.

1.3 Scope

1.3.1 Currently this document focuses on fixed access network technologies, including point-to-multipoint Passive Optical Network (PON) technology and point-to-point Active Ethernet technology. It is planned for a later version of this document to address wireless/satellite access network technologies.

1.3.2 The following EUP types are covered by this document:

(a) Single Dwelling Units (SDUs)

(b) Multi-Dwelling Units (MDUs), including vertical and lateral MDUs

(c) Non-premises dwellings

(d) Existing premises (i.e. brownfields)

(e) New premises (i.e. redevelopment and Greenfield new estates)

1.3.3 It is recognised that there are a number of existing FTTP deployments in Australia which may contribute to the overall NBN

project. The EUP architecture and solutions described in this document are equally applicable to these networks in order to allow commonality of service throughout Australia.

NOTE:

1. 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. While the scenarios presented in this paper are technically feasible, any agreed final set of scenarios will require tradeoffs between technical and operational complexity versus requirements for maximum flexibility in support of functional and service requirements. These issues will need further analyses as part of more detailed Communications Alliance work stream activities.

2 DEFINTIONS 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 release of this draft for comment the relevant wiki page was being finalized for public availability.*

2.2 Acronyms

Abbreviations used in the Guideline and their meaning are:

AC	Alternating Current
ADSL	Asymmetric Digital Subscriber Line
ASP	Application Service Provider
ATA	Analogue Terminal Adaptor
BAP	Broadband Access Provider
BNG	Broadband Network Gateway
BR	Border Router
CFM	Connectivity Fault Management
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data Over Cable Service Interface Specification
DVB	Digital Video Broadcasting
EAS	Ethernet Access Service
ELAS	Ethernet Line Access Service
EMC	Electromagnetic Compatibility
EMCS	Ethernet Multicast Service
EPL	Ethernet over Power Line
EU	European Union
EUP	End User Premises
FTTP	Fibre To The Premises
GPON	Gigabit Passive Optical Network

HFC	Hybrid Fibre-Coaxial
HPNA	Home Phoneline Networking Alliance
HSPA	High Speed Packet Access
IGMP	Internet Group Management Protocol
IPoE	Internet Protocol Over Ethernet
IPv6	Internet Protocol version 6
ISDN	Integrated Services Digital Network
L2TP	Layer 2 Tunnelling Protocol
LAC	L2TP Access Concentrator
LED	Light Emitting Diode
LNS	L2TP Network Server
LTE	Long Term Evolution
LTR	Linktrace Reply
MDU	Multi-Dwelling Unit
mHUB	Multi-dwelling Connection Hub
mNTU	Multi-dwelling Network Termination Unit
MEP	Maintenance association End Point
MIP	Maintenance association Intermediate Point
MoCA	Multimedia over Coax Alliance
MTU	Multi-Tenant Unit
NAT	Network Address Translation
NBN	National Broadband Network
NSP	Network Service Provider
NTU	Network Termination Unit
OAM	Operations Administration and Maintenance
ODF	Optical Distribution Frame
OLT	Optical Line Termination
ONT	Optical Network Termination
POI	Point Of Interconnection
PON	Passive Optical Network

PPP	Point-to-Point Protocol
PPPoE	Point-to-Point Protocol over Ethernet
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RF	Radiofrequency
RG	Routing Gateway
RoHS	Restriction of Hazardous Substances
RSP	Retail Service Provider
SDP	Service Delivery Point
SBP	Service Boundary Point
SFU	Single Family Unit
SDU	Single Dwelling Unit
SMS	Short Message Service
sNTU	Sub Network Termination Unit
STB	Set Top Box
TLS	Transparent LAN Service
UV	Ultraviolet
VDSL	Very high speed Digital Subscriber Line
VF	Voiceband Frequency
VLAN	Virtual Local Area Network
VPN	Virtual Private Network
WEEE	Waste Electrical and Electronic Equipment
WSA	Wholesale Service Acquirer

3 END USER PREMISES ARCHITECTURE OVERVIEW

3.1 Communications Alliance NBN Reference Architecture

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

3.1.2 It is intended that, as much as is possible, the EUP architecture in Figures 2, 3 and 4 will be applicable to the delivery of NBN services and infrastructure as described in the NBN Reference Architecture into the End User Premises.

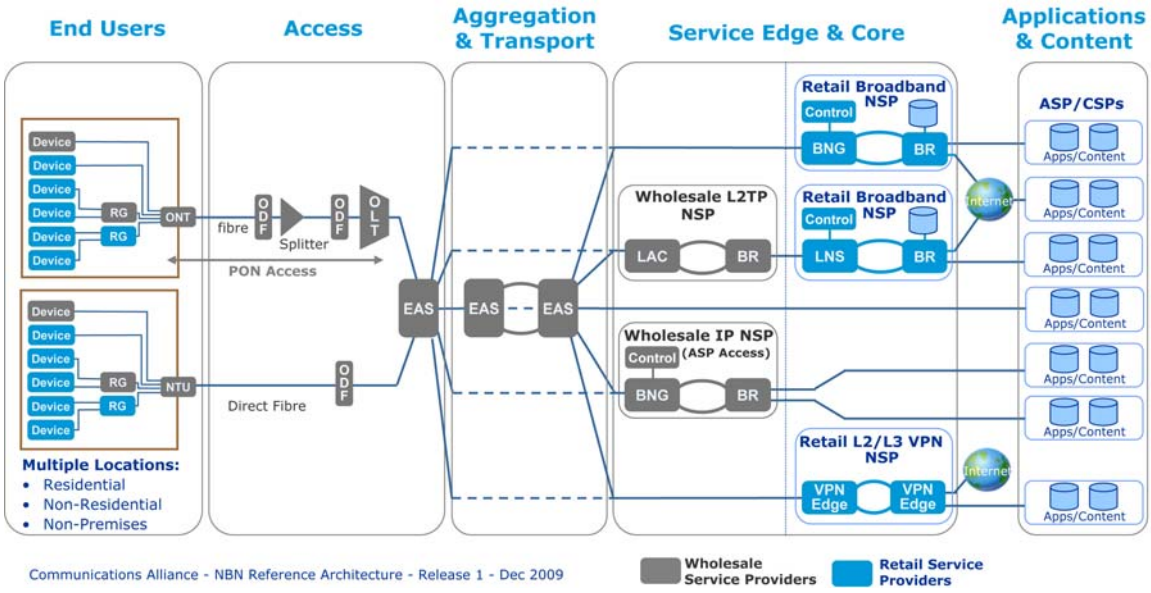

FIGURE 1

Broadband Network Reference Architecture - FTTP Access

3.1.3 In FTTP networks the NTU is often also referred to as an 'Optical Termination Unit'. The Communications Alliance NBN Reference Architecture uses the term ONT for PON connected EUP and the term NTU (Network Termination Unit) for point-to-point fibre connections. In this document the term 'NTU' will be used for generic items applying to both network architectures, and 'ONT' will be used for PON specific items.

3.2 NBN EUP Installation Architecture – Fixed Network Access

3.2.1 The EUP types covered by this document can be divided into three broad EUP installation categories:

(a) An EUP with a single NTU dedicated to the premise (e.g. stand-alone house or traffic monitoring station) as shown in Figure 2.

(b) A collection of EUP which share a single common NTU (e.g. residential apartment block or shopping centre) as shown in Figure 3.

(c) A collection of EUP in which each has its own NTU but are collected together by another shared network component (mHUB) (e.g. multi-tenant office block) as shown in Figure 4.

3.2.2 Although the categories in 3.2.1(b) and 3.2.1 (c) cover multi-EUP scenarios, there are key differences relating to the deployment and are therefore described as distinct scenarios in this document.

3.2.3 Section 4 describes the key aspects to be considered in the EUP installation architecture, corresponding to the components identified by the reference points, the numbered circles in Figures 2, 3 and 4.

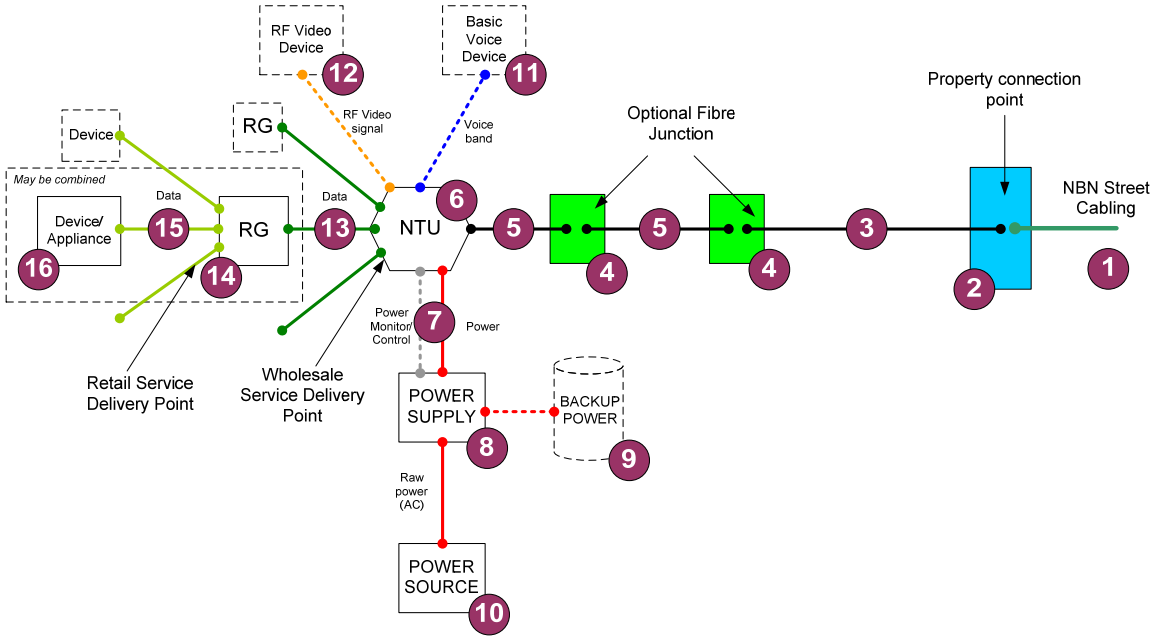

FIGURE 2

EUP Functional Diagram (Fixed Access) – Single NTU per premises

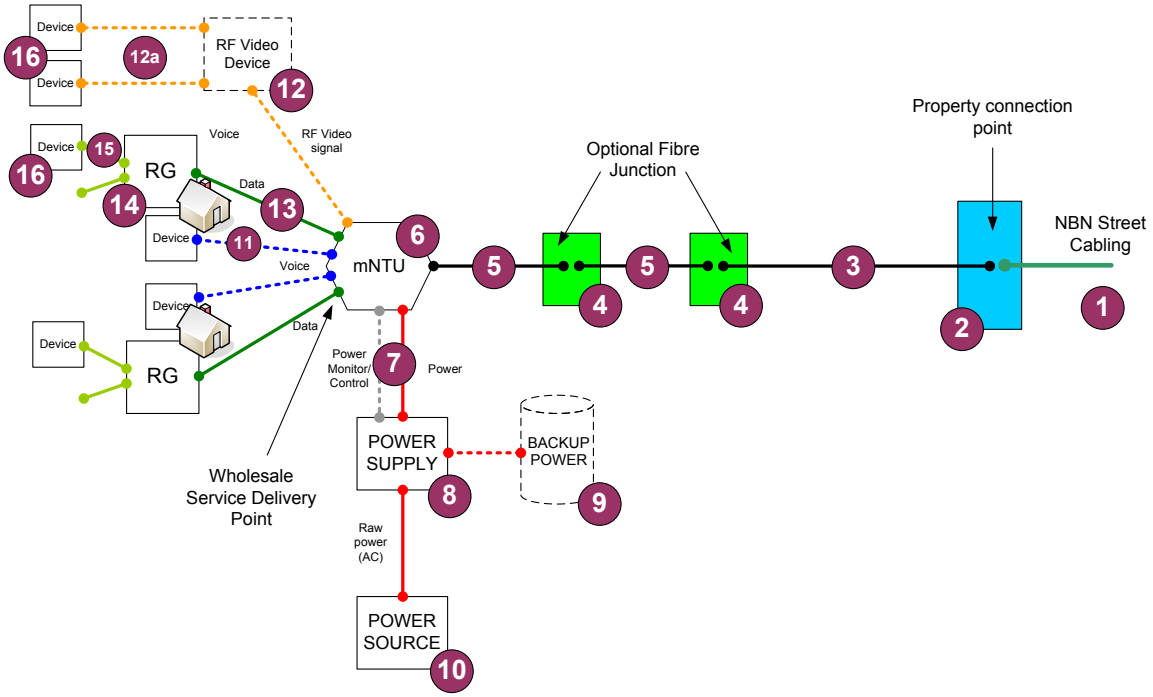

FIGURE 3

EUP Functional Diagram (Multiple User NTU shared for all premises)

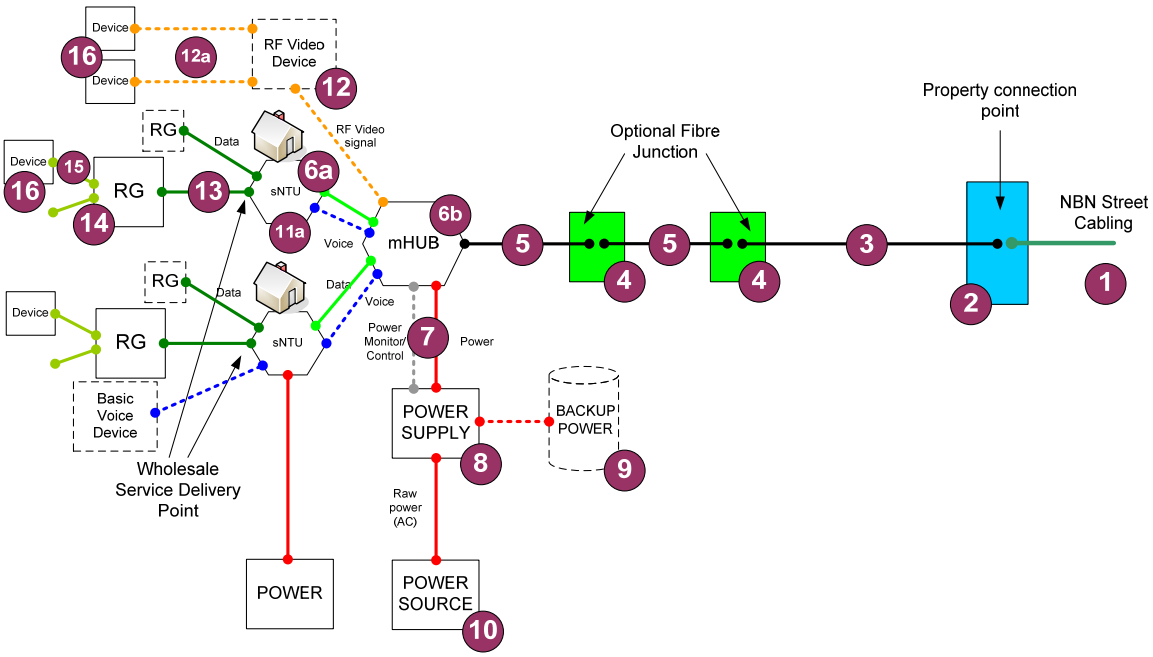

FIGURE 4

EUP Functional Diagram (Multiple User NTU, separate sNTU per premises)

4 EUP ARCHITECTURE COMPONENTS

4.1 NBN Infrastructure (Reference Point 1)

4.1.1 The NBN infrastructure is the high speed fibre and wireless access network to be deployed throughout Australia. This network will include Points-of-Interconnect to wholesale backhaul providers and/or retail service providers at various locations throughout the country.

4.1.2 In terms of fixed NBN infrastructure, this is expected to include the physical fibre distribution network and active electronics deployed in either a point-to-multipoint or point-to-point architecture up to the service delivery point.

4.2 Property Connection point (Reference Point 2)

4.2.1 Each EUP, or collection of EUPs, will connect to the NBN infrastructure at a point outside of the EUP property.

4.2.2 This property connection point will generally allow for connecting and disconnecting of premises or collections of premises to the broader fibre network and is owned, operated and maintained by the NBN Provider.

4.3 First stage lead-in (Reference Point 3)

4.3.1 The first stage lead-in is the optical fibre cable which provides the connection between the property connection (Reference Point 2) and the optical NTU (Reference Point 6) or an intermediate fibre junction.

4.3.2 In installations where the NTU is located on the outside of the premises building (and hence accessible by the network provider) the first stage lead-in (Reference Point 3) may terminate directly at the optical NTU (Reference Point 6).

4.3.3 In installations where the NTU is located inside the premise and not easily accessible by the network provider, or where additional fibre flexibility is desired, the first stage lead-in (Reference Point 3) may be terminated at one or more optional fibre junctions (Reference Point 4) before extending inside the premise. This is to allow some functions such as connection/disconnection and network testing to occur without requiring access to the inside of the EUP.

4.3.4 Lead-in cables can be pre-terminated and made to a fixed length or connectorised or spliced on site to a custom length by a trained installer.

4.4 Optional fibre junction (Reference Point 4)

4.4.1 The optional fibre junction (where used) is the facility in which connection is made between the first stage lead-in (Reference Point 3) and the second stage lead-in, in case of an indoor NTU

(Reference Point 5), or to join two second stage lead-ins (Reference Point 5) together.

4.4.2 Each of these two optical fibre cables may be of a different construction type and physical dimension (e.g. second stage lead-in fibre may have additional shielding and damage protection). Each cable will be terminated in a specific type of optical connector which is able to connect to each other.

4.4.3 The optical interfaces between first and second stage lead-ins should be appropriately matched to ensure optimal performance.

4.5 Second stage lead-in (Reference Point 5)

4.5.1 The second stage lead-in cable is generally in the interior of the EUP and connects from the optional fibre junction (Reference Point 4) to the NTU (Reference Point 6). In some installations, more than one optional fibre junction (Reference Point 4) and second stage lead-in (Reference Point 5) may be used between the first stage lead-in (Reference Point 3) and the NTU (6). For example, the use of wall plate connectors within an EUP may lead to this configuration.

4.5.2 The second stage lead-in will have an optical connector at each end which will screw or push into a corresponding connector on the optional fibre junction (Reference Point 4) or optical NTU (Reference Point 6).

4.5.3 Lead-in cables can be pre-terminated and made to a fixed length or connectorised or spliced on site by a trained installer to customise the length.

4.5.4 For second stage lead-in fibre, current FTTP installations recommend the use of ITU-T G.657.B.3 optical fibre, designed for minimum bend radius of 5.0 mm for use in end-user premises. This provides:

(a) greater flexibility and lower cost installation options (e.g. no conduit); and

(b) greater protection from macrobend losses at higher wavelengths (e.g. 1550 nm used for RF video overlay, 1577 nm for ITU-T 10G PON).

4.6 Network Termination Unit (NTU) (Reference Point 6)

4.6.1 The NTU is an active (powered) device that terminates the signal from the NBN and then offers one or more Service Delivery Points (SDPs) as physical interfaces on the NTU.

4.6.2 These SDPs will be the points to which a wholesale service provider will deliver services into an EUP. The SDP interfaces will then directly connect to the Routing Gateways (Reference Point 14) or the end user devices (Reference Point 16) for

distribution of retail services throughout the EUP using a defined interface (Reference Point 13).

4.6.3 The NTU will provide a number of functions to support the delivery of one or more services into an EUP by retail service providers. The NTU will also provide some test and diagnostic functions to aid in troubleshooting and ongoing NBN operational tasks, both towards the end user device interface (Reference Point 13) and towards the NBN interface (Reference Point 5).

NTU (ONT) Deployment Scenario Assumptions

4.6.4 As described in the Communications Alliance National Broadband Reference Architecture document [Release 1], there are a range of potential Service Boundary Points (SBP) (as per Figure 5).

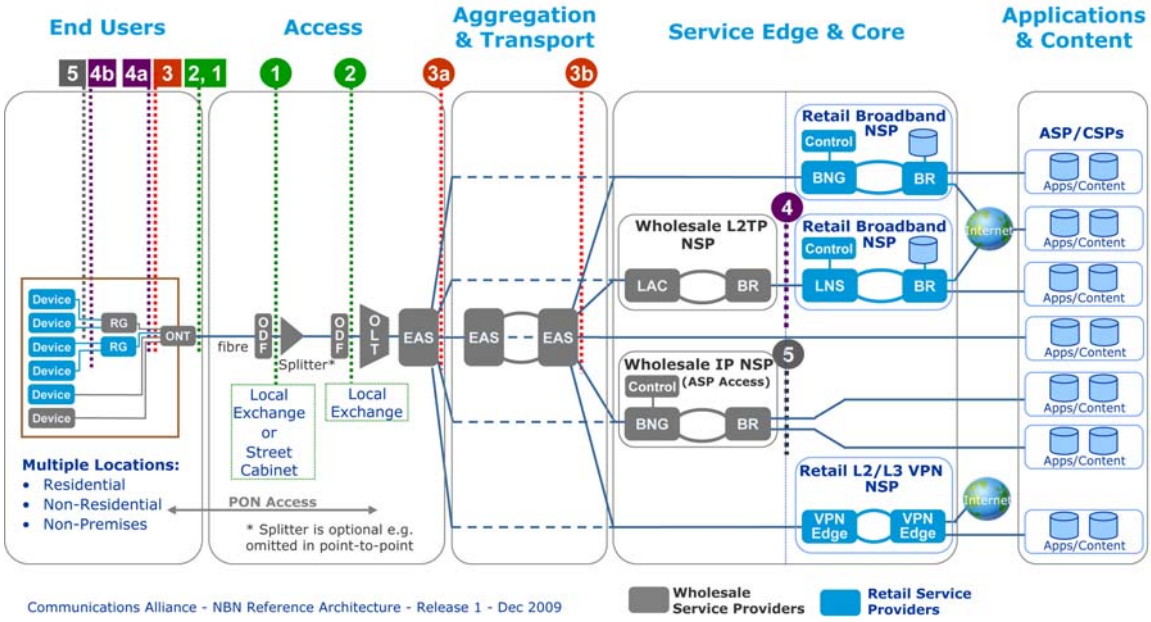

FIGURE 5

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

4.6.5 At the end-user premises, it is assumed that the physical SDP within the NBN end-user service interfaces of the NTU (i.e. corresponding to the potential logical scenarios 3 and 4 in Figure 5). The NTU is installed, owned and maintained by the NBN operator. It represents the demarcation point between the NBN operator's responsibilities and those of the end user including customer cabling and customer equipment with respect to provisioning of services and assurance.

4.6.6 There may be single or multiple fibres provisioned to an EUP, however it is only a single fibre termination per NTU. Multi-EUP (MDU/MTU) sites may require several fibres to serve multiple EUPs within the building.

4.6.7 The FTTP access may co-exist with other access networks (e.g. HFC and/or copper and/or wireless and/or satellite, or dedicated fibres from multiple providers). The end-user may receive services from retail service providers using different access networks simultaneously.

4.6.8 Note that the coexistence with existing services requires careful management of inter-network interference and cross talk, for example the use of xDSL from an NTU will need careful control and regulation to ensure interference with other copper services within the EUP or adjacent EUPs does not occur.

4.6.9 The NTU is not assumed to include Routing Gateway (RG) functions, but this is one of the technical options identified in the National Broadband Network Reference Architecture document.

4.6.10 NTUs will be locally powered (i.e. from the end-user's premises).

4.6.11 The NTU (Reference Point 6), power supply (i.e. AC to DC converter, (Reference Point 8)) and power backup source (Reference Point 9) are generally separate devices.

4.6.12 The power backup source (Reference Point 9) is optional.

NTU Types

4.6.13 NTUs can come in a number of sizes with various combinations of service interfaces. Generally, the following categories of NTUs are available:

(a) *SDU Single Dwelling Unit* (also referred to as Single Family Unit (SFU)) *NTU* – a single residence (or small business) NTU. These NTUs may also be used to provision services to non-building premises (e.g. traffic lights, payphones).

(b) *MDU Multi-Dwelling Unit* (also referred to as Multi-Tenant Unit (MTU)) *NTU* – this NTU is shared amongst multiple residences (and/or businesses) in a vertical and/or lateral MDU environment where SDU NTUs cannot be provisioned to each end-user premises for a variety of reasons. Normally, existing building wiring is utilised to provide services from the MDU NTU to each end-user premises. MDU NTUs may have modular plug-in units so that the NTU can be tailored for the number of end-user premises within the MDU. Figures 3 and 4 show two types of MDU NTU installations.

4.6.14 Variants of the above NTU types can be available for indoor and outdoor installation:

(a) *Indoor NTU* - The indoor NTU terminates services within the end-user's premises and is suitable for installation on a desktop, internal cabinet/enclosure or for attaching to an interior wall.

(b) *Outdoor NTU* - Outdoor NTUs are environmentally hardened to support the expected range of outdoor climatic conditions and have specially hardened enclosures that

can be installed outside end-user's premises. Outdoor NTUs should have appropriate physical security to limit unauthorised access. Tamper-resistant seals and bolts may be used to secure the network provider access cover to the NTU and to prevent easy access to the enclosure. Specialised security wrenches/tools may be required to open tamper-resistant screws.

4.6.15 Variants of the above NTU types can be available for residential and business installation:

(a) *Business NTU* – these NTUs may have additional and different interfaces to an SDU NTU so that it can meet the needs of small to medium size enterprises.

Location and Installation of NTU

4.6.16 The decision on what type of NTU to deploy and whether it be an internal or external location will depend on a range of factors as listed in 4.6.17 to 4.6.20.

4.6.17 Installation

(a) Cost (labour, equipment and materials)

(b) Complexity

(c) Access to premises cabling (if required)

(d) Access to and location of power source and power back-up source

(e) Access to optical lead-in

(f) Ability to install fibre to each end-user premises (i.e. in an MDU)

(g) Availability of skilled resources

(h) Aesthetics and heritage building considerations

(i) Earthing requirements (i.e. the NTU may require a hard-wired earth for safety or remote testing purposes)

(j) Building design

(i) Some buildings will not have suitable wall space for an external NTU (e.g. extensive glazing)

(ii) Many new buildings use light building materials that may not support the weight of the NTU (e.g. polystyrene wall cladding)

4.6.18 Operational

(a) Remote diagnostics and alarm capability

(b) Access to NTU, power source and backup power source

(c) Number and type of service interfaces provided

(d) Ability for end-user to diagnose problems and 'self-help' (e.g. LED/alarm access and interpretation; testing at service interfaces of NTU)

(e) Responsibility for backup power source battery

(f) Fault repair, i.e. ease of repair or replacement of faulty NTU, power source and backup power source

(g) Operational support

(h) Operational/Service Level Agreements including reliability/ network availability requirements

(i) Lifecycle upgrade and replacement, i.e. ability and cost to upgrade NTU in future (lifecycle and new functionality/capability)

(j) Security of NTU (including accessibility to service interfaces)

(k) Ability to add or churn services (with multiple RSPs, ASPs)

(l) Physical or electrical Interference with any existing EUP networks that will remain operational after NBN NTU installation

4.6.19 End-user - migration considerations

It is expected migration issues will be address in more detail in the End User Migration stream, however some of the considerations include the following:

(a) Customer initiated/agreed

(b) 'Forced' migration (of some or all services)

(c) Responsibility for migration (including operational and financial responsibilities)

(d) Services migrated to NTU

(e) Single or multiple RSPs migrating services

(f) Access to existing premises cabling (if required)

(g) New cabling/allplates/sockets required

(h) Requirement for customer to provide suitable power outlet

(i) Standard installation and fee-for-service add-ons

(j) Co-existence with services delivered by other access infrastructure

(k) Service(s) disruption impact

4.6.20 End-user - service fulfilment

(a) Self-installation (e.g. 'plug-and-play') option (versus professional install required)

(b) Number of service interfaces provided for each service class

(c) Ability to support multiple RSPs simultaneously

(d) Professional install

4.7 NTU to Power Supply connection (Reference Point 7)

4.7.1 This connection provides for transmission of power from the power supply (Reference Point 8) to the NTU (Reference Point 6). Key points to note regarding this connection are:

(a) The distance of the cabling between the DC power connector on the power supply and the NTU must be within the manufacturer's/supplier's specification.

(b) For the purposes of power backup source monitoring and control, an interface that supports the transmission of alarm and control information between NTU and Power Supply can be used, in addition to the power delivery cabling.

(c) Standardised pluggable connectors should be used at least at the NTU end of this connection to allow easy change out or relocation of NTU or power supply hardware. If monitoring and control interfaces for the power supply are also carried on this connection, the plug should also handle the wiring required for these control interfaces.

4.8 Power Supply (Reference Point 8)

4.8.1 The power supply may be incorporated with the power backup source (Reference Point 9). It is also possible for the power supply (and power backup source) to be integrated physically with the NTU (Reference Point 6), however current practices keep the power supply (Reference Point 8) and NTU (Reference Point 6) separate to allow greater flexibility of installation and simplify ongoing maintenance and upgrades. Key points to note regarding the power supply include:

(a) The power supply converts AC input power (240 V) to DC output power suitable for the NTU and/or power backup source.

(b) The power supply must be protected from moisture (e.g. either via installation in a hardened enclosure or within a protected part of the EUP).

(c) The power supply output specifications (i.e. DC voltage, current, power) must be appropriate for the NTU and/or power backup source for which it is intended.

(d) The power supply will have a number of mounting options, e.g. a wall mounting option, power brick (like a laptop) or 'wall wart'.

(e) The power supply may need to provide a protective earth (derived from the AC power source) to the NTU for shielding purposes (e.g. EMC compliance) or for safety isolation of the NTU interfaces.

4.9 Power Backup Source (Reference Point 9)

4.9.1 The Power Backup Source is an optional component used to provide power to the NTU power supply (and hence the NTU) during a failure of the main power source. Because FTTP technologies do not offer any network delivered power by default, a power backup source is required if service is to be maintained during a local power failure. When implemented and operational, the power backup source will keep the NTU powered during the local mains failure, allowing it to still communicate with the NBN equipment at the local exchange (as typically exchange equipment also has its own backup power supply systems). This is useful for allowing critical services to continue to operate during the local power failure, such as voice telephony services or security alarm services.

4.9.2 It must be noted that the EUP device or appliance (Reference Point 16) to be used in a local power failure scenario must also be connected to a power backup source in order to make use of the power backed up NTU. Some devices, such as a telephone connected to an integrated basic voice interface (Reference Point 11) may receive enough power to operate from the attached interface (depending on the configuration and features of the NTU).

4.9.3 Further information regarding the power backup source is described in this section.

NTU Power Backup Source Deployment Scenario Assumptions

4.9.4 The NTU will be locally powered from an AC power source within the end-user premises.

4.9.5 The NTU and/or power supply (Reference Point 8) must have the capability for an optional power backup (also known as a battery backup unit) to be installed. As a minimum the backup battery shall allow the NTU to continue operating so it can support a telephone service connected to the NTU via an integrated basic voice interface (Reference Point 11).

Note: Cordless telephones generally require external power supplies and would not be powered by the NTU basic voice interface alone.

4.9.6 The power backup source will be an optional component installed at the choice of the end-user.

4.9.7 Remote monitoring of the power backup source and associated battery will not be provided by a service provider or NBN operator (however this is technically possible with many NTUs on the market).

4.9.8 The NTU power backup source is based on a battery that has a limited lifespan and the end-user will be responsible for ensuring the backup battery is adequately charged to power the NTU in the event of a power blackout, and to maintain and/or replace the battery when required.

4.9.9 The backup power source shall automatically supplant loss of primary power without service interruption.

Typical NTU Power Consumption

4.9.10 The power consumption of a GPON ONT depends on many factors including the number and type of interfaces provided and which ones are active.

Power Backup Source Alarms and Diagnostics

4.9.11 The power backup source should be equipped with intelligent internal diagnostics that provide power supply alarm signals which can be monitored locally by the end-user so that corrective actions can be taken. These alarms may include all or some of the following:

(a) *On-Battery* The ONT is being powered by the power backup source battery.

(b) *Replace Battery* The battery failed a periodic test. It should be replaced because NTU availability during a power blackout has been or may be compromised.

(c) *Battery Missing* The battery is disconnected. The NTU's load will not be supported during a power outage.

(d) *Low Battery* The battery has been reduced to the point that roughly 20% of the available runtime is available.

(e) *Loss of external power* The AC power input for charging the power source backup is not available.

4.9.12 In addition to local monitoring features (e.g. audible alerts or status lights) for the power backup source, it is possible for the NBN provider to monitor some or all of the above specified alarms. This requires the NTU to power supply connection (Reference Point 7) to support control and alarm cabling between the power supply and power backup source and the NTU. The response to these alarms can vary from notifying the end-user (e.g. via SMS), notifying the end user service provider(s), or actioning a maintenance procedure. The impacts of doing such monitoring on a large national scale should be carefully considered by any NBN operator.

4.9.13 To alert the end-user to replace the battery before it loses capacity to effectively support the NTU during a power blackout, the power backup source should have the following characteristics and functionality:

(a) The capability to accurately predict the remaining service life of a battery (e.g. by measuring the battery's voltage and discharge characteristics and applying an appropriate algorithm).

(b) An audio/visual indicator/alarm that alerts the end-user that the battery requires replacement.

(c) If audible alarms are provided, then an option for the end-user to suppress (silence) the audible alarm(s) temporarily (e.g. 24 hours) or 'permanently' should be provided (e.g. by a button/switch). Note that NTUs can also provide a 'dying gasp' alarm (i.e. back to the network provider's element/network management system) indicating that all power has been lost to the NTU.

Location of power backup source

4.9.14 With the end-user likely to be responsible for the maintenance and replacement of the optional battery backup, it is recommended that it be located where it is readily monitored by the end-user and sufficient physical access is available to replace the battery.

4.9.15 In general, battery life will be longer and more predictable in a relatively stable environment (i.e. indoors). If the power backup source is located outdoors, then appropriate environmentally hardened components and enclosures should be used. It should be noted that battery life in outdoor power backup sources is generally significantly shorter than when they are installed indoors. For lead acid batteries, expected life varies with their temperature. Factors affecting battery temperature include climate, electronic load, and solar load.

Power Shedding Profiles

4.9.16 Power shedding profiles can generally be established for NTUs that determine the length of time that a class of service to an NTU or an interface on the NTU is to remain operational when the power source for the NTU transitions to a power backup source during a power outage. This allows for optimisation of backup power for essential services.

4.9.17 An example power shedding profile commonly used for carriers in GPON ONT deployments is one where the basic voice interface (Reference Point 11) is considered essential and powered for the longest period of time after the main power supply is lost. This is done by disabling other ONT interfaces considered non-essential, an example of such a power shedding profile is:

(a) RF video port (Reference Point 12) is shut off after 30 seconds of mains power failure.

(b) Ethernet data port (Reference Point 13) is shut off after 5 minutes of mains power failure.

(c) Basic voice interface (Reference Point 11) is supported for the duration of backup power support.

4.9.18 Other power shedding profiles for the ONT can be used (but cannot be configured by end-user) to suit the service or customer needs:

(a) For example, if voice services were provisioned from ATA ports on a Routing Gateway (RG) that interfaces into an Ethernet port of the NTU (Reference Point 13), then a profile could be selected that keeps the NTU Ethernet port operational when running on backup power, however the RG and telephone (if applicable) would also require their own power backup source.

4.9.19 For an NTU power shedding profile to operate, the NTU relies on control and alarm information from the power backup source via the power supply. This requires control and alarm interface cabling to exist between these components (Reference Point 7).

4.9.20 The support of power shedding profiles is dependant upon the NTU, power supply and power backup source used in the EUP installation.

4.9.21 The NTU power backup source may also have a function to use the backup battery 'on demand', i.e. by pushing an 'Emergency Use' button.

Backup Reserve Time for Power Backup Source

4.9.22 Backup reserve time generally depends on a number of factors including:

(a) Type of battery.

(b) How fully charged the battery is.

(c) Power use by the equipment, including idle power (Minimum power) and incremental service power.

(d) Distance of the equipment (e.g. NTU) from the battery (powerline resistance).

(e) Temperature of the battery.

(f) Age of the battery.

(g) Quality/design of the battery.

(h) Manufacturing variations.

Battery Recharge Time

4.9.23 The time to return the ONT backup power source (battery) to a practically useful capacity after a discharge event should be reasonably short.

Backup Power Source Maintenance and Replacement

4.9.24 Information must be made readily available to the end-user on the optional power backup source functions, expected battery reserve times for each service provided from the NTU and under what conditions; replacement battery details, and instructions for battery replacement.

4.9.25 The backup power source (including battery) should require no periodic maintenance, except for battery replacement, to remain useful to the end user.

4.9.26 The NTU (Reference Point 6) and power supply (Reference Point 8) design shall permit the replacement of the backup power source (battery) without service interruption (except during a power outage).

4.9.27 The backup battery should be readily available type and of generic design (e.g. as commonly used for domestic security alarm systems).

End-user Education regarding power backup source

4.9.28 Information regarding power backup source options for NTUs (and customer equipment), maintenance (e.g. battery replacement), responsibilities, functions and limitations needs to be disseminated to end-users. Options include:

(a) Government (and agencies)

(b) NBN provider/Retail Service Provider

(c) At time of sale (retailer)

(d) At time of installation

(e) User manuals/brochures

(f) Customer (service) terms and conditions

(g) Billing advice

(h) Directories/websites

(i) Customer care/support

4.10 Power Source (Reference Point 10)

4.10.1 The power source in an EUP is generally a 240 V AC power outlet as per Australian electrical standards. The power outlet must be accessible and convenient for the installation of the power supply

(Reference Point 8). There are two primary options for connection of the power supply (Reference Point 8) to the power source:

(a) Via a standard Australian Grounded Power Outlet with standard consumer plug.

(b) Via direct feed cabling to the power circuitry of the EUP. This would require installation by a licenced electrician and may be suitable for power critical applications or where the NTU is used to support electrical supply monitoring and control (e.g. smart metering).

4.11 Basic Voice Interface[1] (Reference Point 11)

4.11.1 The basic voice interface is an optional interface that would be deployed as an inbuilt part of the NTU (or add on module).

4.11.2 The primary reason for inclusion of a basic voice interface in the NTU is to allow a service provider to easily support existing voice telephony devices in an EUP, without the end user needing to purchase or install additional hardware (other than the NTU and associated infrastructure provided by the NBN provider).

4.11.3 Equipment at the NBN POI and/or Service Provider is necessary to provide a complete service to this interface, however this document focuses on the EUP considerations. Please refer to the outputs of the Communications Alliance NBN Wholesale Services working group for more information on the service delivery architecture.

4.11.4 Devices which operate in the voice band (300 Hz to 3400 Hz) on the existing PSTN could be connected to the NBN using a voice service terminating at the basic voice interface on the NTU. Examples include:

(a) Standard voice telephony services (using existing single pair analogue handsets as the terminal). Note that voice services delivered to a basic voice interface on the NTU will likely have a different feature set and behaviour than those delivered by the Australian PSTN today. The feature set delivered will be a function of the NTU hardware used and the service provider equipment deployed.

(b) Consumer grade alarm systems.

(c) Pay TV STBs that use a voice back channel for billing and content ordering.

(d) Fax machines.

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[1] The term 'Basic Voice Interface' is currently under review. The NBN Wholesale Services Working Group has proposed the new term 'Telephony Access Service' (TAS). The applicability of this new term or a modification of the current 'Basic Voice Interface' term is still to be considered by the NBN End User Premises Working Group.

(e) Dial-up modems.

(f) Monitoring and research equipment (e.g. free-to-air TV ratings system).

(g) Personal alert/nurse call systems.

4.11.5 It is recommended that the basic voice interface be standards-based so that it could then be assigned to any nominated or user requested Service Provider by the NBN. The individual services and support provided through the interface are then the scope of the Service Provider, allowing for service differentiation and market innovation.

4.11.6 Based on existing technology and methods, the following provisions should be made in regards to the NTU basic voice interface:

(a) Support for at least one NTU based voice provider per EUP or NTU (in the case of multiple EUP per NTU). Support for more than one voice provider per NTU will involve additional technical and operational complexity.

(b) Support for at least one 2-wire interface (e.g. RJ11) per NTU. In the case of a single NTU per dwelling, one interface can be wired to multiple outlets within the EUP (all with the same telephone number) similar to existing PSTN installs.

(c) For multiple EUP or Voice services per NTU, a single voice ATA software instance and provider can be used to support multiple individual phone lines, these would be presented on separate 2-wire interfaces.

(d) Business or Commercial users will require multiple 2-wire interfaces and associated phone numbers (still with a minimum of one voice provider per EUP) to allow for greater equivalence with existing installations.

(e) The 2-wire interface used to deliver the basic voice interface could also be used to simultaneously deliver an xDSL service (fed from the NTU or another device) to the EUP. This would require appropriate xDSL/Voice splitters to enable this.

4.12 RF Video Interface (Reference Point 12)

4.12.1 The RF video interface is an optional interface that would be deployed as an inbuilt part of the NTU (or add on module). It is suited to delivery by FTTP (PON or Point-to-Point).

4.12.2 The inclusion of an RF video interface in the NTU allows for easy support of existing EUP devices which are currently delivered using cable, satellite or terrestrial TV technologies. An RF video interface is particularly attractive for Greenfield areas serviced by FTTP where the installation of traditional TV antennas, satellite

dishes or cable TV systems is either banned or difficult to facilitate; or in areas where a terrestrial TV signal is currently unavailable.

4.12.3 An RF video interface can either be one way (communication signals delivered to the EUP) or two way (communication signals delivered to and received from the EUP). (The video service return path can also be via VF or data interface.)

4.12.4 Equipment at the NBN POI and/or Service Provider is necessary to provide a complete service to this interface, however this document focuses on the EUP considerations. Please refer to the outputs of the Communications Alliance NBN Wholesale Services working group for more information on the service delivery architecture.

4.12.5 Example services that could use the RF video interface include:

(a) DVB-Terrestrial based video, radio and information services (including existing free-to-air channels).

(b) DVB-Satellite based video, radio and information services (including existing free-to-air and Pay TV channels).

(c) DVB-Cable based video, radio and information services (including existing Pay TV channels).

(d) DOCSIS based data communications (including existing cable internet services, cable voice services and DOCSIS back channel Pay TV services). Note that this requires the RF video interface to operate in a two-way mode.

4.12.6 Based on existing technology and methods, the following provisions should be made in regards to the NTU RF video interface:

(a) A minimum of one F-connector type RF coaxial interface.

(i) Multiple RF outlets within a single EUP can be achieved through the use of conventional coaxial cabling and amplification methods.

(ii) Multiple RF outlets from a single NTU in a multi-EUP scenario can be achieved through the use of conventional coaxial cabling and amplification methods.

(b) Coaxial cabling inside the EUP from the RF video interface should follow existing cabling guidelines as required by the service to be delivered.

4.13 NTU to RG data interface (Reference Point 13)

4.13.1 The Data interface would be deployed as an inbuilt part of the NTU (or add on module). This interface delivers the Ethernet Line Access Service (ELAS) defined in the *National Broadband Network Wholesale Service Definition Framework – Ethernet specification* at the Service Boundary Point.

4.13.2 The data Interface will support the end-user Premises Interface defined in the National Broadband Network Wholesale Service Definition Framework – Ethernet specification. Section 6 of this specification defines the following:

Layer 1 Physical Interface Options

4.13.3 The options for physical interface specifications include:

(a) Fast Ethernet:

(iii) Fibre – IEEE 802.3 Section 3

(iv) Copper

(b) Gigabit Ethernet:

(i) Fibre – IEEE 802.3 Section 3

(ii) Copper

4.13.4 The NTU may have single or multiple standard Ethernet ports (i.e. 10/100BASE-T 'Fast Ethernet' and/or 10/100/1000BASE-T 'Gigabit Ethernet') to support multiple services within the EUP. The connection to each port is provided with an Ethernet (e.g. Cat 5e or Cat 6) cable with 'RJ-45' (i.e. 8P8C – 8 position 8 conductor) connector (i.e. the interface at the NTU shall be a female connector). In the case where the NTU has multiple Ethernet ports, then one (or more) different Ethernet port(s) may be provisioned for each service provider. Each service provider can provide their own RG and customer equipment (e.g. Home Gateways, Set Top Box, VoIP phones) to its customer in order to deliver its retail services (see Reference Point 16). Where the NTU is located externally, the Ethernet ports should be hard-wired to the end-user access point. RJ45 connectors should not be used for cable connection within an external NTU for security and reliability reasons and to assure compliance with the *Telecommunications Act 1997* and the *Types of Cabling Work Declaration 1997*.

4.13.5 To aid installation in existing premises where retrofit of new cabling (e.g. Cat 6) is not feasible, alternative delivery mechanisms for Ethernet connections could be integrated with the NTU (6) or deployed as add on modules. Such interfaces include:

(a) HPNA (Ethernet over telephone wiring)

(b) ADSL/ADSL2/ADSL2+/VDSL2 (Ethernet/ATM over telephone wiring)

(c) MoCA (Ethernet over Coaxial cable)

(d) EPL (Ethernet over Power Line)

These options will be further discussed in section 7.

4.13.6 In Multi Dwelling or Multi Tennant (MDU/MTU) situations where individual fibre NTUs cannot be provisioned to each end-user (e.g. due to accessibility, cost or aesthetic reasons), MDU NTUs that can interface to existing premises internal cabling at the building MDF. These NTUs can have multiple Ethernet (if existing in building Ethernet cabling is available) or VDSL2 ports. In the latter case, compatible VDSL2 modems are required in the end-user premises to receive data based services over the internal telephone wiring of the building. Generally only a single data interface is provisioned per end-user in these situations. Multiple data interfaces per end user require additional hardware and management complexities, see Figures 3 and 4.

Layer 2 Logical Interface Options

4.13.7 An ELAS will, by default, be terminated on un-tagged, with respect to 802.1Q, interfaces at the end-user premises.

4.13.8 There will be options for the end-user premise to support priority tagged frames, with respect to 802.1Q to support the ELAS Service Attributes defined in ELAS Service Attributes specified in Clauses 4.2.8 to 4.2.13 of the *National Broadband Network Wholesale Service Definition Framework – Ethernet* (Release 1).

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

End-User Premise Delimiter

4.13.10 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 of the *National Broadband Network Wholesale Service Definition Framework – Ethernet* (Release 1). As a result two primary options are possible for the ELAS identifier; a physical port on an NTU or a VLAN on a port of an NTU.

Standards

4.13.11 It is recommended that the data interface be standards-based so that it could then be assigned to any nominated or user requested Service Provider by the NBN. The individual services and support provided through the interface are then the scope of the Service Provider, allowing for service differentiation and market innovation.

4.13.12 Based on existing technology and methods, the following provisions should be made in regards to the NTU data interface:

(a) Standards exist for implementing Ethernet services over Broadband network:

(i) TR-101 provides an Ethernet-based architecture that has become a global standard for broadband delivered services.

(ii) TR-156 strengthens the TR-101 requirements as applied to GPON by providing more detailed and specific requirements.

(iii) TR-94 defines requirements and capabilities that a home network should provide to take advantage of the full capabilities of multi-service, broadband access services.

(b) Support Single and multi dwelling residential environments as well as single and multi-dwelling business environments.

4.13.13 Broadband Forum TR-101 identifies the Data interface as the U interface. Figure 6 depicts the generalised protocol stacks supported by the data interface over the range of physical Premises Distribution Networks above.

4.13.14 In Figure 6 below:

(a) Option a represents an Ethernet network access using an IP over Ethernet stack.

(b) Option b represents the same for a PPPoE access stack.

(c) Option c represents a stack that could be used to provide a Business Ethernet service, commonly referred to as a Transparent LAN Service (TLS).

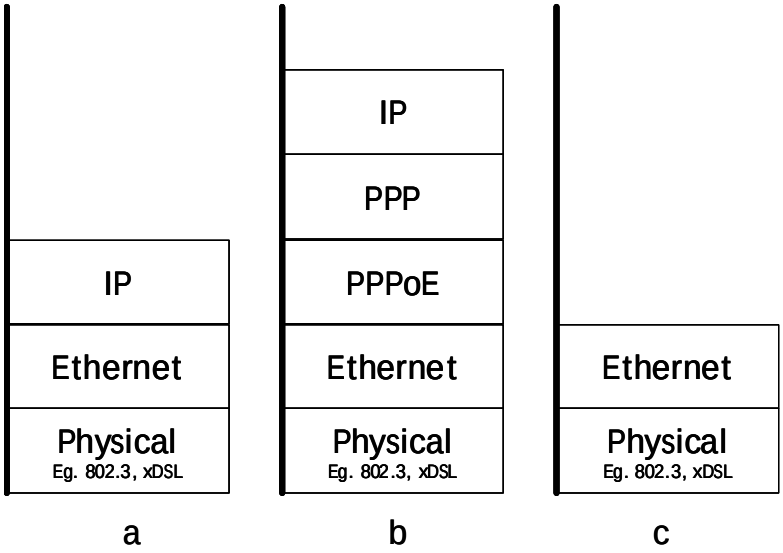

FIGURE 6
Protocol stacks for data interface

4.13.15 All of these options may also include 802.1Q and option c, in Clause 4.13.14, may also include 802.1ad headers to carry VLAN Tags and p-bits.

4.13.16 There may be multiple NTU to RG interfaces available on the NTU to support the case of multiple NSPs delivering their services on separate physical ports.

4.14 Routing Gateway (RG) (Reference Point 14)

4.14.1 The Routing Gateway (RG) may or may not be integrated with the NTU function. In the integrated scenario, the NTU to RG data interface (Reference Point 13) is encapsulated and is not physically available or accessible. In the non-integrated case, the RG is physically separate from the NTU customer Device/Appliance (Reference Point 16) environment.

4.14.2 The principal tasks of the RG are to:

(a) shape upstream traffic to the policed rate;

(b) provide appropriate queuing and precedence for QoS traffic; and

(c) allow a home network to share a single public network address for network access.

4.14.3 Both integrated and non-integrated RG are supported in this specification.

4.14.4 The RG should be able to support remote software upgrades.

Standards

4.14.5 Broadband Forum TR-101 section 2.1 describes the Routing Gateway function for Ethernet based broadband. The key requirements identified for the RG are:

(a) Support sending the following frame types in the upstream direction for stacks a, b and c in Figure 6:

(i) Untagged frames

(ii) Priority tagged frames

(iii) VLAN-tagged Ethernet frames

(b) Support setting the priority tag and VLAN ID values.

(c) Support receiving untagged and VLAN tagged Ethernet frames in the downstream direction, and be able to strip the VLAN tagging from the ones received tagged.

RG Multicast

4.14.6 The *National Broadband Network Wholesale Service Definition Framework – Ethernet* (Release 1) specification defines the Ethernet Multicast Service (EMCS) which will need to be supported by the RG. The key features of this definition that the RG needs to support are:

(a) Independence of EMCS services from multiple WSAs (i.e. no restriction on the use of IP Multicast group addresses).

(b) Support for IPv4 and IPv6 Multicast.

(c) Support for communication of multicast control traffic from end-users to the WSAs (e.g. IGMP).

(d) The RG provides the multicast router function into the home subnets and appears to the access network as a host device. As typical for RG deployments, multiple sessions must be supported.

Multicast Standards

4.14.7 Section 6.2.1 of the Broadband Forum TR-101 describes the multicast requirements for the Routing Gateway function for Ethernet based broadband.

4.14.8 TR-101 describes the RG as a layer 3 router that uses IPoE to receive multicast from the access network and forward it to the home network. It also provides local DHCP and NAT capabilities into the home networking environment - including the multicast host equipment.

4.14.9 With the addition of multicast hosts in the home the RG needs additional mechanisms to forward IGMP reports to the access network and distribute the multicast within the home environment.

4.14.10 The key requirements identified for the RG are:

(a) Support of an IGMP proxy-routing function.

(b) Support of IGMP version 3 as per RFC 3376.

(c) Support IGMP forwarding with local NAT and firewall features including:

(i) establishing any pin-holes in the firewall for the multicast streams received (after join);

(ii) be able to multicast upstream IGMP messages to all or a configured subset of those WAN interfaces when the RG is configured with multiple WAN-facing IP interfaces (e.g. PPP or IPoE);

(iii) be able to classify IGMP requests according to source IP/MAC address or incoming LAN physical port on the RG to distinguish between multicast services (e.g. IPTV and some other Best Effort (BE) Internet IGMP application); and

(iv) have a way of suppressing the flooding of multicast on selected ports.

4.14.11 Refer to TR-101 Section 6.2.1 for the complete Multicast requirements for the RG.

RG Operations Administration and Maintenance (OAM)

4.14.12 Ethernet OAM mechanisms provide Layer 2 OAM capabilities end-to-end. The key standards are IEEE 802.1ag, and ITU Y.1731. These standards define the concept of a Maintenance association End Point (MEP) and Maintenance association Intermediate Point (MIP), which are configured on a per port, per VLAN and per Maintenance Domain Level.

4.14.13 MEPs initiate Connectivity Fault Management (CFM) OAM8 messages and are configured at the far end of the service perimeter or S-VLAN (e.g. in the BNG and Access Nodes).

4.14.14 MIPs are configured across the path of the S-VLAN (e.g. in Ethernet Aggregation Nodes). Various Domain Maintenance Entity (ME) Levels can be configured, allowing the network administrator to divide the network into multiple administrative OAM domains and to allow nesting of OAM domains, where an ME Level corresponds to an OAM domain.

4.14.15 The key requirements for RG OAM are:

(a) support of a Maintenance association End Point (MEP) on a per VLAN basis;

(b) support a Loopback Message;

(c) support a Linktrace Reply (LTR) function towards its peer MEP(s); and

(d) trigger the appropriate alarms for Loss of Continuity.

4.14.16 Refer to TR-101 Section 7.3.1 for the complete Multicast requirements for the RG.

4.15 RG to End Device/Appliance data interface (Reference Point 15)

4.15.1 The RG to Device/Appliance interface provides connectivity to the EUP LAN, or provides a dedicated LAN for a certain service provider, device or appliance. This interface is in the realm of the Service Provider. It is likely the data Interface will need to interwork with a range of EUP distribution network types for both new structured cabling installs and existing network types (e.g. telephone cabling, internal power lines, coaxial cable, wireless networks).

4.15.2 Examples of current technologies that can be used for this interface are:

(a) Ethernet on Cat 5 or Cat 6 cabling.

(b) xDSL on Cat 2 (telephone) cabling.

(c) Basic Voice on Cat 2 cabling.

(d) HPNA over Cat 2 (telephone) cabling.

(e) MOCA over Coaxial (television) cabling.

(f) DOCSIS over Coaxial (television) cabling.

(g) EPL (Ethernet over Power Line) over internal power cabling.

(h) WiFi (IEEE 802.11x Wireless).

(i) Zigbee.

(j) WiMax.

(k) 3G/HSPA/LTE (Femtocells).

(l) Bluetooth.

(m) ISDN/E1

(n) POE (Power Over Ethernet).

Standards

4.15.3 It is recommended that the RG to Device/Appliance interface be standards based so that it could then be assigned to any nominated or user requested Service Provider by the NBN. The individual services and support provided through the interface are then the scope of the Service Provider, allowing for service differentiation and market innovation.

4.15.4 In particular, the Broadband Forum TR-094 defines requirements and capabilities that a home network should provide to take advantage of the full capabilities of multi-service, broadband access services. The following outlines information contained within TR-094.

Layer 1 Physical Interface Options

4.15.5 The options for physical interface specifications include:

(a) Fast Ethernet:

(i) Fibre – IEEE 802.3™ Section 3.

(ii) Copper (Cat-5e/Cat-6, Coaxial cable, Cat 2 telephone cable).

(iii) Air Interface (IEEE 802.11x Wireless, Zigbee, WiMax, LTE, 3G, Bluetooth).

(b) Gigabit Ethernet:

(i) Fibre – IEEE 802.3™ Section 3.

(ii) Copper.

(iii) Air Interface (IEEE 802.11x Wireless, Zigbee, WiMax, LTE, 3G, Bluetooth).

Layer 2 Logical Interface Options

4.15.6 Data Link Layer

(a) Must support Ethernet in accordance with IEEE 802.2/ IEEE 802.3 (Ethernet).

(b) Must support the transport of PPP over Ethernet frames in accordance with IETF RFC 2516.

(c) Should support Ethernet precedence of LAN traffic (IEEE 802.1Q and IEEE 802.1d Annex H).

4.15.7 Logical Link Controller (LLC) Sublayer

The subinterface must support Ethernet in accordance with IEEE 802.2.

4.15.8 Medium Access Control (MAC) Sublayer

The subinterface must support Ethernet in accordance with IEEE 802.3.

4.15.9 Layer 3 Logical Interface Options

The Layer 3 Logical interface must be capable of supporting IP Packets encapsulated in IEEE 802.3 Ethernet frames.

4.15.10 The Network Layer must support IPv4 in accordance with IETF RFC 1042 and IPv6 in accordance with IETF RFC 2460.

4.15.11 The Home Network must support:

(a) DHCP functions;

(b) DNS functions;

(c) NAPT functions; and

(d) UDP and TCP.

4.15.12 Additional information on EUP distribution networks can be found in the associated topic in this document.

4.16 End Device or Appliance (Reference Point 16)

4.16.1 End Devices or Appliances may be specific to a service (e.g. a television set top box) or be general in nature (e.g. a personal computer). They may be provided by the service provider or by the end user and connect to the EUP network (Reference Point 15) or (Reference Point 13) via a routing gateway (Reference Point 16) or directly to the NTU (Reference Point 6).

4.16.2 As described in the Communications Alliance NBN Reference Architecture, an End Device or Appliance (Reference Point 16)

does not necessarily require a Routing Gateway (Reference Point 14) for connection to the NTU (6). The End Device or Appliance can directly connect to the NTU (6) at the Service Delivery Point (Reference Point 13).

4.16.3 At a minimum, the End Device or Appliance will be compatible with the Wholesale Service Construct (e.g. ELAS) when connected directly to the NTU, or a standard as dictated by the Routing Gateway when in place.

5 NBN EUP INSTALLATION ARCHITECTURE – WIRELESS/SATELLITE ACCESS

A number of elements in the wireless NBN EUP will be common to the NBN fixed network EUP, however specific elements important to the deployment of EUP that are connected to the NBN via wireless or satellite technologies will be further described in a future release of this document.

Contributors and persons commenting on this document are encouraged to advise of any issues regarding the wireless and satellite access aspects of the EUP installation architecture at the earliest possible opportunity.

6 NBN EUP INSTALLATION PRACTICE

The EUP installation practice options have not yet been assessed.

However, contributors and persons commenting on this document are encouraged to advise of any issues regarding EUP installation practice options at the earliest possible opportunity.

7 NBN EUP DISTRIBUTION PRACTICES

The EUP distribution practice options have not yet been assessed.

However, contributors and persons commenting on this document are encouraged to advise of any issues regarding EUP distribution practice options at the earliest possible opportunity.

8 NBN EUP TESTING AND DIAGNOSTICS

The EUP testing and diagnostic options have not yet been assessed.

However, contributors and persons commenting on this document are encouraged to advise of any issues regarding EUP testing and diagnostic options at the earliest possible opportunity.

9 SUSTAINABILITY

9.1 Power consumption of active equipment

9.1.1 In the EUP architecture there are three core active components, the NTU (Reference Point 6), Power Supply (Reference Point 8) and Power Backup Source (Reference Point 9). These

components, once installed, are intended to be in operation continuously as they underpin all other devices and services in the EUP. For this reason they should target low continuous power consumption, or intelligent use of standby modes to reduce consumption wherever possible.

9.1.2 Other active components in the EUP architecture are embodiments of services and so will be potentially different in design and quantity for every Service Provider. They include the RG (Reference Point 14), the Devices and Appliances (Reference Point 16) and any active components of the EUP distribution networks ((Reference Point 13) and (Reference Point 15)).

9.1.3 The European Union is in the process of introducing an agreement referred to as the 'Code of Conduct' which will require all electronic equipment (such as the above listed components of the EUP architecture) to adhere to certain power efficiency and environmental sustainability requirements, such as the inclusion of a physical power button to enable total shut down of any device. It is anticipated that this European Code of Conduct will be followed by many international equipment suppliers or even adopted by Australian regulations such that similar sustainability improvements will be applied to devices supplied into Australia.

9.2 Manufacturing materials and process

9.2.1 The materials and energy used during the manufacture of equipment that may be used in EUP is just as important as its ongoing power consumption. The European Union *Restriction of Hazardous Substances Directive* (RoHS) was introduced in February 2003 and progressively places limits on the use of 6 toxic substances including lead. This and other similar directives apply to the manufacture of devices that may be used in the EUP, and are frequently adopted by international equipment vendors even when supplying outside of the EU.

9.3 Disposability of components

9.3.1 Due to the recognised limited life span of consumer and electrical appliances, standards for waste recovery and disposal have been created. In particular, there is a strong focus on the recovery of toxic metals and substances that may have been used during manufacturer. The *European Union Waste Electrical and Electronic Equipment Directive* (WEEE) introduced in 2002 offers guidelines and rules for the safe recovery and disposal of such materials. End-users and service providers should be made aware of the proper disposal process for items within the EUP. Any batteries (such as used in the backup power source (Reference Point 9)) are of particular concern.

10 ROBUSTNESS

10.1 Installation technique and locations

10.1.1 In any NBN EUP installation there will be internal and external components and their placement and fixing should be considerate of the corresponding impacts to robustness of services delivered over the NBN EUP infrastructure.

10.1.2 External EUP components (e.g. lead-in, NTU, fibre junction boxes) should be made to standards that provide longevity in external environments, including extreme heat, UV and extreme cold, protection from physical abrasion or wear, protection from vermin or insect damage and protection from moisture.

10.1.3 Internal EUP components, although not as susceptible as external components, should still consider the impact of location to avoid things such as trip hazards, unplanned disconnects, etc. while allowing status lights and alarms to be easily seen/heard and routine maintenance to be performed easily to ensure the ongoing operation of any NBN services.

10.2 Power backup source

10.2.1 Due to the fact that fibre based equipment does not offer any network fed power, for services to maintain operation during a local power failure (where the exchange equipment still has power), a power backup source (reference Point 9) may be deployed at the EUP.

10.2.2 The power backup source (Reference Point 9), if installed, will power the NTU to allow all or some service interfaces to remain operational during the local power failure. Any devices required for essential or emergency services should also be connected to a separate power backup source to ensure operation during the outage.

10.2.3 The power backup source should be dimensioned to protect service for a specified minimum time period without local power. This figure should take into account the typical power outage occurrence rate and typical length of outage as well as the nature of the services being protected and the life span characteristics of the backup power source (e.g. battery).

10.2.4 Generally, the power backup source utilises a battery. To ensure robust operation of the power backup source, this battery must be monitored and maintained by the end-user. To aid in this various alarms or notifications may be used by the service provider or equipment provider to inform the user when battery maintenance is required.

See section 4.9 for more information on power backup sources.

11 SECURITY

11.1 Physical

11.1.1 In addition to considerations already mentioned in the section 10 on robustness, any external or internal EUP components should be secured from tampering or theft.

(a) External components should be firmly attached to their mounting fixtures and secured using devices that prevent tampering. These may include security screws and tamper proof tags (keyed locks are a possibility but are generally considered too expensive and ineffective in large scale deployments of EUP equipment). Any openable or removable covers, flaps, cables, connectors or devices should be similarly secured.

(b) Internal components are not as vulnerable as external components, however may still be installed in shared facilities or subject to intentional or non-intentional tampering by end-users. Shared devices (for multiple services or multiple users) in particular (e.g. the NTU) should be secured from basic tampering. This may include security screws or tags to prevent opening a device (moving a device may be allowed) and self locking connectors on any power or communications cabling. This will increase protection against the intentional or un-intentional impact to services.

(c) In addition to physical protection against service impacts, it is important to note the importance of physically securing optical fibre based and high current/high voltage electrical devices and connections to avoid any health and safety problems such as eye damage from exposed lasers or electrocution. Standards Australia is finalising the AS/NZS 2211.2 standard on optical fibre communication systems safety which may be applicable to the deployment of FTTP networks.

11.2 Software

11.2.1 Due to the increasing sophistication of software and increased ease of access to software analysis, modification and connectivity tools software security is an important topic of consideration for the NBN EUP.

11.2.2 Software stability, especially in shared components or components delivering essential or emergency services, is important to prevent unintentional service outages. The software design and testing of devices such as the NTU (Reference Point 6) should attempt to ensure stability and service separation even during abnormal events.

11.2.3 Software components should also be secured against local or remote attacks on their processes or components. Focus should

be specifically applied to the NBN to ensure that vulnerability in a single EUP component such as the NTU (Reference Point 6) cannot be leveraged to affect other remote EUP or the network side components of the NBN.

11.2.4 Password and User identity security is an important consideration, although typically in the realm of a service provider rather than NBN operator. The service provider should ensure proper use of security mechanisms and encourage education of end users on the importance of security and good security practice.

12 IPV6

The components of the EUP architecture potentially impacted by the evolution from IPv4 to IPv6 are the NTU (Reference Point 6), NTU to RG interface (Reference Point 13), RG (Reference Point 14), RG to End Device/Appliance interface (Reference Point 15) and the End Device/Appliance (Reference Point 16).

12.1 NTU (Reference Point 6)

12.1.1 The aims of the Communications Alliance Reference Architecture has the NTU as a layer 2 (Ethernet) device, however there may be some minor requirements for IPv6 awareness in the NTU. Requirements that may be relevant to the NTU include the following:

(a) IPv6 multicast support (the NTU may have snooping/proxy functions relating to multicast).

(b) IPv6 auto-configuration and/or DHCPv6 plus IPv6 routing stack if any inbuilt basic voice interface is to support IPv6.

(c) IPv6 filter support if required for basic voice interface traffic or management traffic.

(d) IPv6 line identification parameter insertion (DHCP or PPP based) if required by the network design.

12.2 NTU to RG Interface (Reference Point 13)

12.2.1 This interface will be in accordance to the wholesale service definition prescribed at the EUP Service Delivery Point.

12.2.2 Implementation of IPv6 over this interface will be at the discretion of the service provider.

12.2.3 The interface should support IPv6 in accordance with RFC 2460.

12.3 Routing Gateway (Reference Point 14)

12.3.1 The implementation of IPv6 on the routing gateway is at the discretion of the service provider.

12.3.2 If implemented, it would be expected to provide IPv6 routing capabilities in accordance with RFC 2460 with implementation specifics left up to the design of the service provider.

12.4 RG to End Device/Appliance Interface (Reference Point 15)

12.4.1 Implementation of IPv6 over this interface will be at the discretion of the service provider.

12.4.2 The interface should support IPv6 in accordance with RFC 2460.

12.5 End Device or Appliance (Reference Point 16)

12.5.1 The implementation of IPv6 on the End Device or Appliance is at the discretion of the service provider.

12.5.2 If implemented, it would be expected to provide IPv6 end point capabilities in accordance with RFC 2460 with implementation specifics left up to the discretion of the service provider.

13 FUTURE PROOFNESS

13.1 Modular components and installation practice

13.1.1 In order to support future enhancements or modifications to the NBN EUP, the reference architecture as described in this document and in the broader Communications Alliance NBN Reference Architecture describe clear separation between functional components of the NBN EUP network.

13.1.2 This allows any component to be replaced, upgraded or changed with minimal impact on the other components (depending upon the severity of the change).

13.1.3 All wiring and installation practices should be designed in a way that they can be reversed to allow upgrade or replacement of any one component of the NBN EUP installation.

14 EUP INDUSTRY CODES AND PRACTICES

14.1 Introduction

14.1.1 Relevant mandatory Standards and Codes that are legislated under the *Telecommunications Act 1997* are listed in Section 14.2. Voluntary Standards and Codes, providing guidance and best practice for the industry, are listed in Section 14.3. Other relevant industry documents are referred to in Section 14.4.

14.2 Registered Standards and Codes

Customer equipment and cabling component Standards

14.2.1 Customer equipment and customer cabling product Standards are made by the ACMA under Section 376 of the

Telecommunications Act 1997. These Standard specify minimum requirements for protecting the integrity of a telecommunications network, protecting the health or safety including those of end users, providing access to emergency call services and the interoperability of equipment (for the Standard Telephone Service).

14.2.2 The *Requirements for Customer Cabling Products* Standard (AS/ACIF S008) applies to cabling products (including cable and related customer equipment) intended for connection to the customer side of the boundary of a telecommunications network.

Cabling Standards

14.2.3 Standards for cabling work are called up by the ACMA under section 421 of the *Telecommunications Act 1997*,

14.2.4 The *Installation requirements for customer cabling (Wiring rules)* Standard (AS/ACIF S009) applies to the installation and maintenance of fixed or concealed cabling or equipment that is connected, or is intended to be connected, to a telecommunications network, including any cord or cordage, or that part of any cord or cordage, that is connected as fixed or concealed cabling.

Industry Codes

14.2.5 Industry Codes are registered with the ACMA under Part 6 of the *Telecommunications Act 1997*. Although these Codes do not apply to customer equipment or customer cabling, the *ULLS Network Deployment Rules* (ACIF C559) has provisions to limit the risk of interference between systems and services (such as DSL services) that operate using the Unconditioned Local Loop Service (ULLS).

14.3 Other Standards and Codes

14.3.1 The Standards Australia *Communications Cabling Manual Package* is a set of Standards Australia's Standards, Codes and handbooks on communications cabling, including for residential, commercial and industrial premises, testing, administration, pathways and spaces and also includes information on Australian regulatory arrangements.

14.3.2 The Communications Alliance *External Communication Cable Networks* Code (ACIF C524) provides guidance on the basic principles of installation, maintenance and safety of external telecommunication networks with the purpose of achieving the requirements for electrical, structural and network reliability, as well as setting out the provisions that are considered necessary for the safety of Employees and the public under the specified conditions.

14.3.3 The Communications Alliance *Building Access Operations and Installation* Guideline (ACIF G571) provides guidance to facilitate a cooperative and timely process for access to commercial multi-

tenanted or single occupant high rise buildings for the purpose of installing in-building subscriber connection equipment as defined in the *Telecommunications Act 1997*.

14.4 Industry practices

14.4.1 In addition to Standards and Codes that are called up under legislation and the national voluntary Standards, Codes and Guidelines listed above, there are a number of industry specifications and guidelines available that have been developed by individual organisations which provide information relevant to the scope of this Handbook. These publications are listed under *Other industry references* in the References section.

REFERENCES

Publication	Title
Standards Australia	
CCM Volume 1—2007 (includes the following):	Communications Cabling Manual Volume 1 - 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 (includes the following):	Communications Cabling Manual Volume 2 - 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
AS/NZS 2211.2 (to be published in 2010)	Optical fibre communication systems safety

Communications Alliance Standards	
AS/ACIF S008:2006	Requirements for Customer Cabling Products
AS/ACIF S009:2006	Installation requirements for Customer Cabling (Wiring Rules)
Communications Alliance Codes/Guidelines	
ACIF C524:2004	External Communication Cable Networks
ACIF C559:2006	ULLS Performance Requirements Industry Code
ACIF G571:2002	Building Access Operations and Installation
Communications Alliance NBN Publications	
Draft National Broadband Network Reference Architecture – High Level Architecture Options for the NBN	
National Broadband Network Wholesale Service Definition Framework – Ethernet (Release 1)	
ITU-T Recommendations	
G.657 (11/09)	Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network
Y.1731 (02/08)	OAM functions and mechanisms for Ethernet based networks
IEEE Standards	
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
802.1ag-2007	IEEE Standard for Local and Metropolitan Area Networks Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management
802.1D-2004	IEEE Standard for Local and Metropolitan Area Networks--Media access control (MAC) Bridges (Incorporates IEEE 802.1t-2001 and IEEE 802.1w)
802.1Q-2005	IEEE Standard for Local and Metropolitan Area Networks—Virtual Bridged Local Area Networks—Revision
802.1X-2004	IEEE Standard for Local and Metropolitan Area Networks—Port-Based Network Access Control
802.2-1998 (ISO/IEC 8802-2:1998)	IEEE Standard for Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements--Part 2: Logical Link

	Control
802.11-2007	IEEE Standard for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
802.3-2008	IEEE Standard for Information technology-Specific requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CMSA/CD) Access Method and Physical Layer Specifications
IETF RFCs	
RFC 1042	Standard for the transmission of IP datagrams over IE
RFC 2460	Internet Protocol, Version 6 (IPv6) Specification
RFC 2516	A Method for Transmitting PPP Over Ethernet (PPPoE)
RFC 3376	Internet Group Management Protocol, Version 3
DSL Forum	
TR-094	Technical Report - Multi-Service Delivery Framework for Home Networks (August 2004)
TR-101	Technical Report - Migration to Ethernet-Based DSL Aggregation (April 2006)
TR-156	
Other industry references	
Telstra Available from http://www.telstra.com.au/smartcommunity/mybuilder.html	
Telstra Velocity® Home Cabling Summary – Information for property developers, consultants, builders and customers	
Network Engineering Access Technology - Cabling of New Homes for Telstra Velocity® - Information for Builders and Telecommunications Cablers (Issue 7, April 2009) (Guideline 013234)	
Home cabling for Telstra Velocity® networks - Information for Property Developers, Builders and Customers (Issue 6, 22 April 2009) (Document No. 013234A02)	
Cable entry facilities for Telstra Velocity® networks - Information for Builders (Issue 5, 22 April 2009) (Document No. 013234A03)	
Network Engineering Access Technology - Combined Utilities Enclosures (Issue 4, 21 October 2009) (Specification No. 010062)	

Network Engineering Access Technology Alteration of Telstra Facilities in Homes and Small Businesses Information for Cabling Providers (Issue 3, 22 June 2009) (Specification No. 012882)
OptiComm
Available from http://www.opticomm.net.au/html/services.htm
OptiComm brochure - Info pack for residents includes the following: Supported Home Gateways (12/17/2008) Cable Entry Guide (14/01/2009) (Document No: TG-001) Home Wiring Guide (14/01/2009) (Document No: TG-002) Wiring Your Home - A quick guide for home owners building in an OptiComm Fibre Connected Community Simplifying technology - Free to Air TV demystified Guide Battery Guide (Ref 94) User Guide - A guide to connecting and using OptiComm's Fibre to the Home Network FOXTEL factsheet - Pre Wiring for FOXTEL - Stand Alone Residential Dwelling (May 2007) (also available from http://www.foxtel.com.au/support/developers-contractors/installation-aids/default.htm) ACMA Factsheet – Phone, data or alarm cabling? Play it safe. Only use a registered cabler (also available from http://www.acma.gov.au/WEB/STANDARD/pc=PC_310076) OptiComm's End User Brochure
TransACT
Available from http://www.transact.com.au/broadband/fibretothehome.aspx
Preparing a Home for TransACT Fibre-to-the-Home (FTTH) Services - Guidelines for Builders, Telecommunications Cablers and Home Owners
Comverge
Available from http://www.comverge.com.au/our-solutions/residential/Comverge_Guidelines_for_FTTH.pdf
Guidelines For FTTH Deployment In Greenfield Developments
Legislation
Telecommunications Act 1997

Communications Alliance was formed in 2006 to provide a unified voice for the Australian communications industry and to lead it into the next generation of converging networks, technologies and services.

In pursuing its goals, Communications Alliance offers a forum for the industry to make coherent and constructive contributions to policy development and debate.

Communications Alliance seeks to facilitate open, effective and ethical competition between service providers while ensuring efficient, safe operation of networks, the provision of innovative services and the enhancement of consumer outcomes.

It is committed to the achievement of the policy objective of the *Telecommunications Act 1997* - the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry.

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