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NATIONAL BROADBAND NETWORK
END USER PREMISES HANDBOOK

RELEASE 2

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National Broadband Network End User Premises Handbook

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Communications Alliance Ltd (formerly Australian Communications Industry Forum Ltd) 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.

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1   INTRODUCTION

1.1   General

1.1.1   This Handbook has been developed by the NBN End User Premises working group charged with developing a set of high level NBN End User Premises (EUP) 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 the EUP.

1.1.2   An EUP in the context of Australia's National Broadband Network (NBN) includes any home, business or service site that may be connected to an NBN via FTTP or a fixed wireless/satellite service. Once connected to an NBN, an EUP will be able to access services provided by RSPs that are delivered over the NBN infrastructure. It is expected that each EUP will be able to access one or more Service Providers, for different or similar service types, simultaneously.

1.2   Relationship with other Communications Alliance NBN Working Groups

1.2.1   The work of the NBN End User Premises working group is related to activities within other NBN Project working groups in Communications Alliance. The general relationships can be seen in Figure 1.
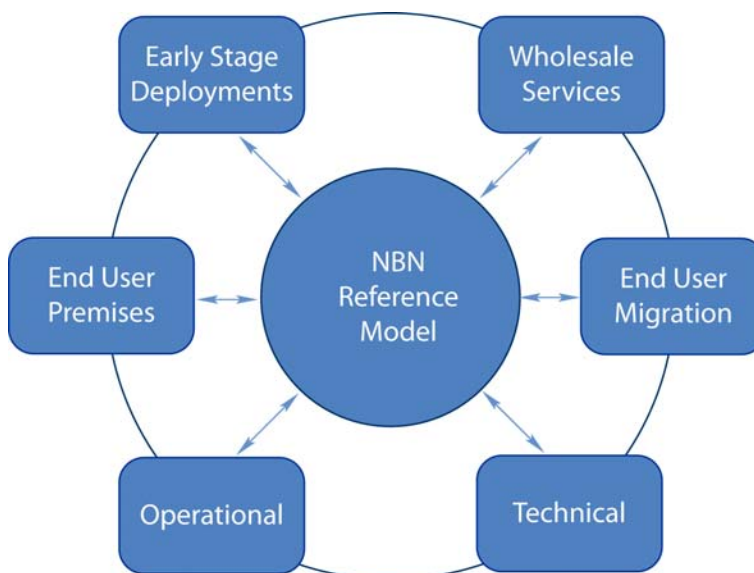
Communications Alliance - NBN Reference Architecture - Release 1 - Jan 2010

FIGURE 1

Communications Alliance NBN Project Working Group Structure

1.2.2   The NBN End User Premises working group is one of seven working groups established by Communications Alliance to address industry requirements for the NBN. The other six working groups address the following:

(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 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)   **Technical** - The Technical working group is identifying appropriate international standards (or domestic standards and codes if available) and their features which meet the characteristics required by the wholesale services, to demonstrate that the wholesale services can be implemented, and to facilitate the sourcing and configuration of network elements.

(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   Target audience

1.3.1   The target audiences of this handbook are NBN infrastructure providers, retail and wholesale Service Providers, data, video and voice cabling professionals, building owners and managers (single and multi-dwelling units), design and construction groups,

regulatory and policy bodies and telecommunications equipment vendors.

1.3.2   Due to the focus on technical facts and terminology, this Handbook is not written for general End Users.

1.4   Scope

1.4.1   This Handbook includes information relevant to fixed, wireless and satellite NBN access technologies and architectures.

1.4.2   The following EUP types are covered by this Handbook:

(a)   Single Dwelling Units (SDUs).

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

(c)   Non-premises locations.

The Handbook covers both existing premises (i.e. Brownfields) and new premises (i.e. redevelopment and Greenfield new estates).

1.4.3   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 Handbook are equally applicable to these networks in order to allow commonality of practices 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 analysis as part of more detailed Communications Alliance work stream activities.

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

2.2 Acronyms

The acronyms used in the Guideline and their meanings are:

AC	Alternating Current
ACMA	Australian Communications and Media Authority
ADSL	Asymmetric Digital Subscriber Line
ASP	Application Service Provider
ATA	Analogue Terminal Adaptor
ATM	Asynchronous Transfer Mode
BAP	Broadband Access Provider
BEP	Building Entry Point
BNG	Broadband Network Gateway
BR	Border Router
CE	Customer Equipment
CFM	Connectivity Fault Management
CISPR	Comité International Spécial des Perturbations Radioélectriques (Special international committee on radio interference)
DC	Direct Current
DECT	Digital Enhanced Cordless Telecommunications
DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data Over Cable Service Interface Specification
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DVB	Digital Video Broadcasting
EAS	Ethernet Aggregation Switch
ELAS	Ethernet Line Access Service
EMC	Electromagnetic Compatibility

EMCS	Ethernet Multicast Service
EPL	Ethernet over Power Line
EU	European Union
EUP	End User Premises
FAN	Fibre Access Node
FDH	Fibre Distribution Hub
FTA	Free To Air
FTTP	Fibre To The Premises
GPON	Gigabit Passive Optical Network
GSM	Global System for Mobile
HFC	Hybrid Fibre-Coaxial
HPNA	Home Phoneline Networking Alliance
HSPA	High Speed Packet Access
HV	High Voltage
ID	Inside Diameter
IDC	Insulation Displacement Connector
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IGMP	Internet Group Management Protocol
IPoE	Internet Protocol Over Ethernet
IPTV	Internet Protocol TeleVision
IPv6	Internet Protocol version 6
ISDN	Integrated Services Digital Network
ISO	International Organisation for Standardization
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
L2TP	Layer 2 Tunnelling Protocol
LAC	L2TP Access Concentrator
LED	Light Emitting Diode
LNS	L2TP Network Server
LTE	Long Term Evolution

LTR	Linktrace Reply
MATV	Master Antenna Television
MDF	Main Distribution Frame
MDU	Multi-Dwelling Unit
MEP	Maintenance association End Point
mHUB	Multi-dwelling Connection Hub
MIP	Maintenance association Intermediate Point
mNTU	Multi-dwelling Network Termination Unit
MoCA	Multimedia over Coax Alliance
NAT	Network Address Translation
NBN	National Broadband Network
NSP	Network Service Provider
NTD	Network Termination Device
NTU	Network Termination Unit
OAM	Operations Administration and Maintenance
ODF	Optical Distribution Frame
OH&S	Occupational Heath and Safety
OLT	Optical Line Termination
ONT	Optical Network Termination
PCP	Property Connection Point
PDA	Personal Digital Assistant
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
SATV	Satellite Television
SBP	Service Boundary Point
SDP	Service Delivery Point
SDU	Single Dwelling Unit
SLA	Service Level Agreement
SMS	Short Message Service
sNTU	Sub Network Termination Unit
SOHO	Small Office/Home Office
STB	Set Top Box
TCA	Telecommunications Cabling Advice
TIA	Telecommunications Industry Association
TLN	Telecommunications Labelling Notice
TLS	Transparent LAN Service
TO	Telecommunications Outlet
UMTS	Universal Mobile Telecommunications System
UNI	User Network interface
UV	Ultraviolet
VDSL	Very high speed Digital Subscriber Line
VLAN	Virtual Local Area Network
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
WEEE	Waste Electrical and Electronic Equipment
WiMAX	Worldwide Interoperability for Microwave Access
WSA	Wholesale Service Acquirer

2.3   Definitions

For the purposes of this Handbook, the following definitions apply:

Customer Equipment (CE)

Customer Equipment is equipment not under the direct control or ownership of the NBN. It is provided by either an End User or a Service Provider. It includes telephony devices, routing gateways, set top boxes, computers and other devices.

Customer Equipment is defined under section 21 of the *Telecommunications Act 1997*.

End User Premises and Non-premises

An End User Premises in the context of this Handbook includes residential, business and infrastructure premises which may all be serviced by the NBN. Sites serviced by the NBN which are not typically inhabited or staffed by people are referred to as 'non-premises'. Non-premises have been considered in the development of this handbook and the descriptions and practices apply to both End User premises and non-premises.

Network Termination Unit (NTU)

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

Note: The NTU is fully described in Sections 4.6 and 5.7. In FTTP networks the NTU is often referred to an Optical Network Terminal (ONT). *(See Reference Point 6)*

Multi-dwelling Connection Hub (mHUB)

The mHUB acts as a collection point for multiple NTU devices associated in a common premises (e.g. an apartment block). The mHUB may be passive (e.g. an ODF) or active (e.g. a multi-port VDSL2 DSLAM). The mHUB does not directly provide UNI ports, these are provided by sNTU devices attached to the mHUB (one for each End User Premises).
(See Figure 5 and Reference Point 6b)

Multi-dwelling Network Termination Unit (mNTU)

The mNTU could be installed as an alternative to an mHUB with associated sNTUs. If an mNTU is used, the End User UNI ports are provided directly from the mNTU, but with enough for one or more for each End User premises associated to the mNTU. An example is an mNTU in a small office block providing 12 UNI interfaces for service to three separate office tenants.
(See Figure 4 and Reference Point 6)

NBN Infrastructure Owner

The organisation that has supplied, installed and maintains the infrastructure on a wholesale/open access basis.

NBN Installer

The installer that is engaged by either the NBN Infrastructure Owner and/or the RSP(s) to install the NBN Termination Equipment (ONT/NTU) and/or Distribution Equipment at the End User Premises. This installer would hold suitable qualifications and may or may not be the installer responsible for the migration of legacy infrastructure.

Optical Distribution Frame (ODF)

An optical distribution frame allows the cross connection of multiple input and output fibre connections to one another. It may be located at an End User Premises or at a network site.

Note: For more information see Sections 4.2, 4.4 and 4.6.

Routing Gateway (RG)

The routing gateway is fully described in Section 4.14. It includes and supersedes the terms Home Gateway and Residential Gateway. An RG is considered a type of Customer Equipment (CE).

(See Reference Point 14)

Sub Network Termination Unit (sNTU)

Used in conjunction with an mHUB in a multi-dwelling or multi-tenant premises, an sNTU is installed in each individual End User Premises and provides the ports for use by End User services. It may be identical to a regular NTU, or have a subset of features with a different network side interface (e.g. VDSL2 towards the mHUB).

(See Figure 5 and Reference Point 6a)

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 *National Broadband Network Reference Architecture – High Level Architecture Options for the NBN* paper. This reference model, shown in Figure 2, shall be used to put into context the EUP definitions within this Handbook.

3.1.2 It is intended that, as much as is possible, the EUP architecture in Figures 3, 4 and 5 will be applicable to the delivery of NBN services and infrastructure into the EUP as described in the *National Broadband Network Reference Architecture – High Level Architecture Options for the NBN* paper.
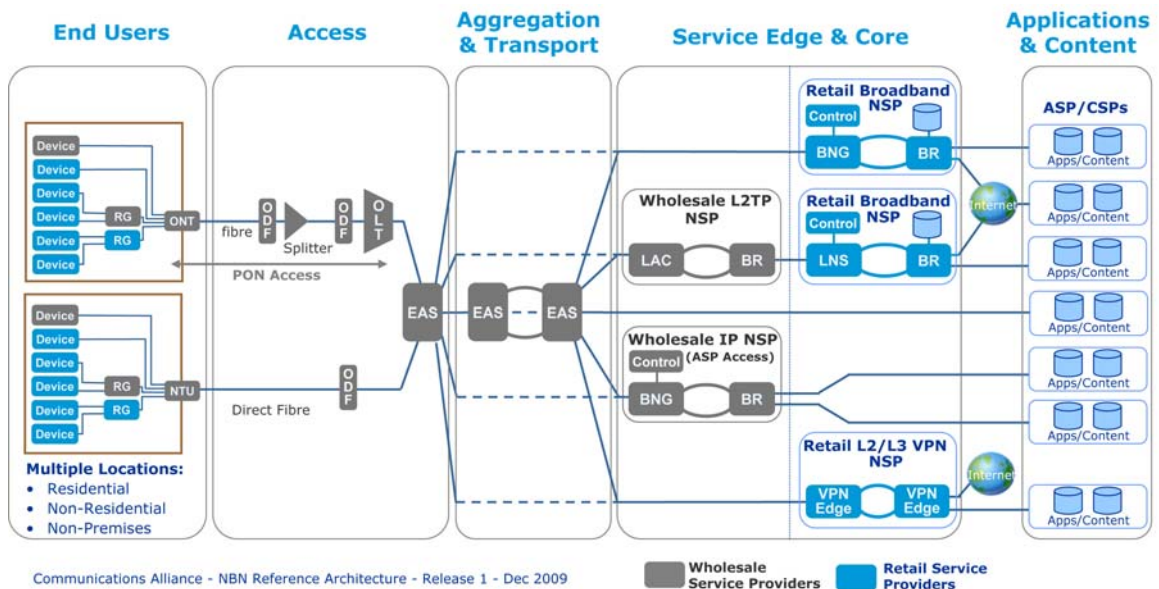
FIGURE 2

Broadband Network Reference Architecture - FTTP Access

3.1.3 In FTTP networks the NTU is often also referred to as an Optical Network Terminal (ONT). 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 Handbook 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

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

(a) An EUP with a single NTU dedicated to the premises (e.g. stand-alone house or traffic monitoring station) as shown in Figure 3. A variant of Figure 3 utilising wireless NBN access is shown in Figure 8.

(b) A collection of EUP which share a single common NTU (e.g. residential apartment block or shopping centre) as shown in Figure 4.

(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 5.

3.2.2 Although the categories in Sections 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 in Section 4.6 of the Handbook.

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 3, 4 and 5.

3.2.4 Section 5 provides additional information in addition to that in Section 4 for elements specific to NBN wireless or satellite access EUP installations.
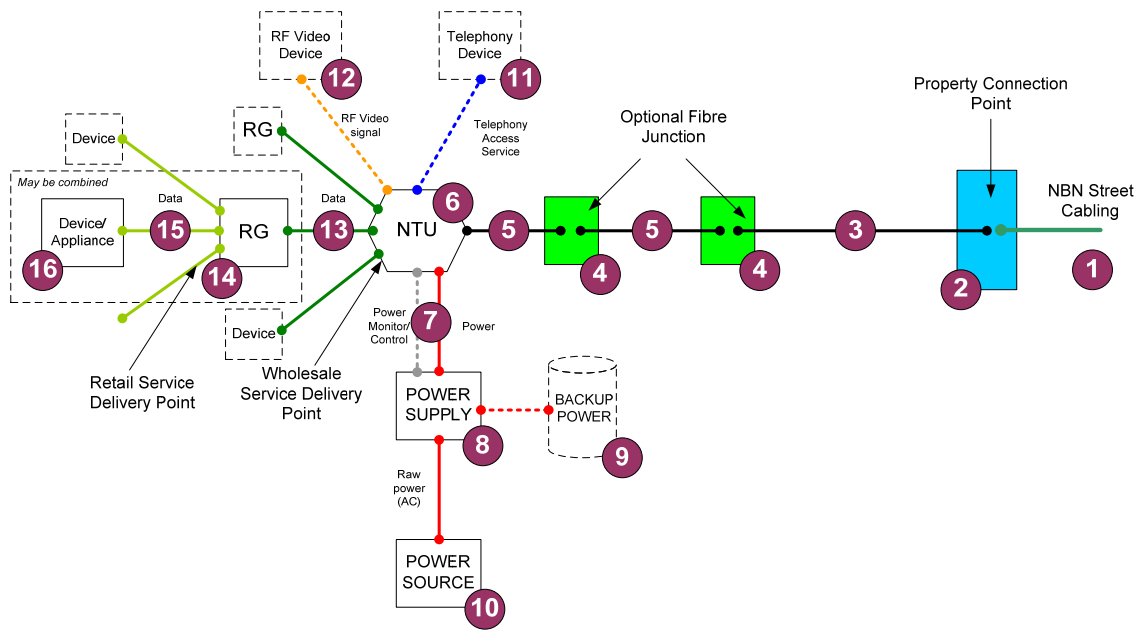
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FIGURE 3

EUP Functional Diagram (Fixed Access) – Single NTU per premises
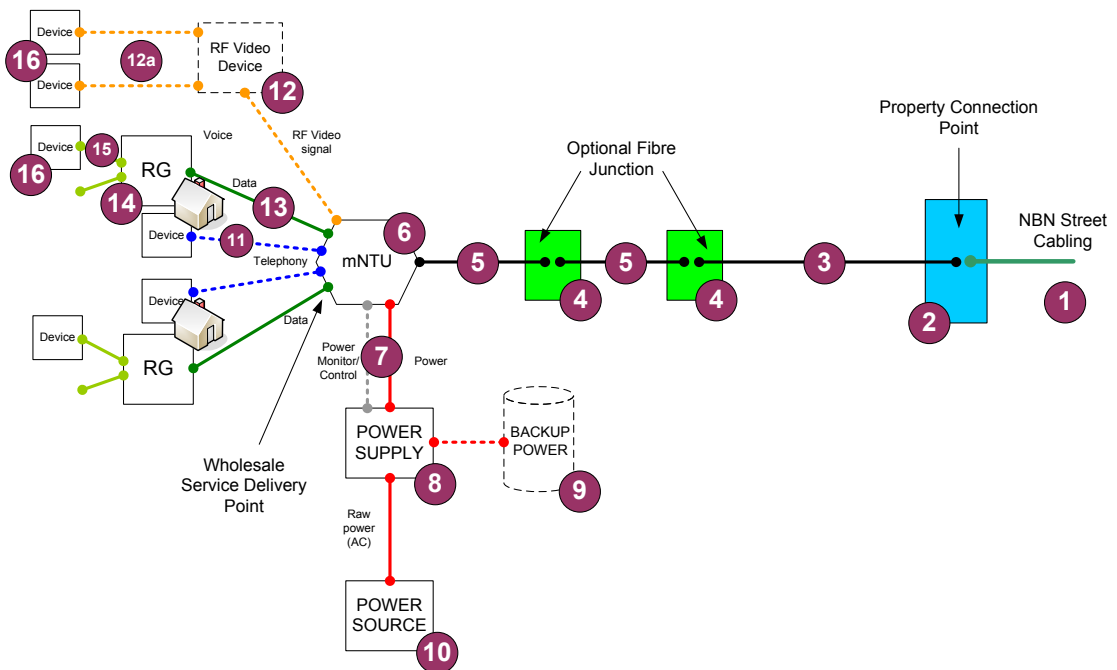
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FIGURE 4

EUP Functional Diagram (Multiple User NTU shared for all premises)
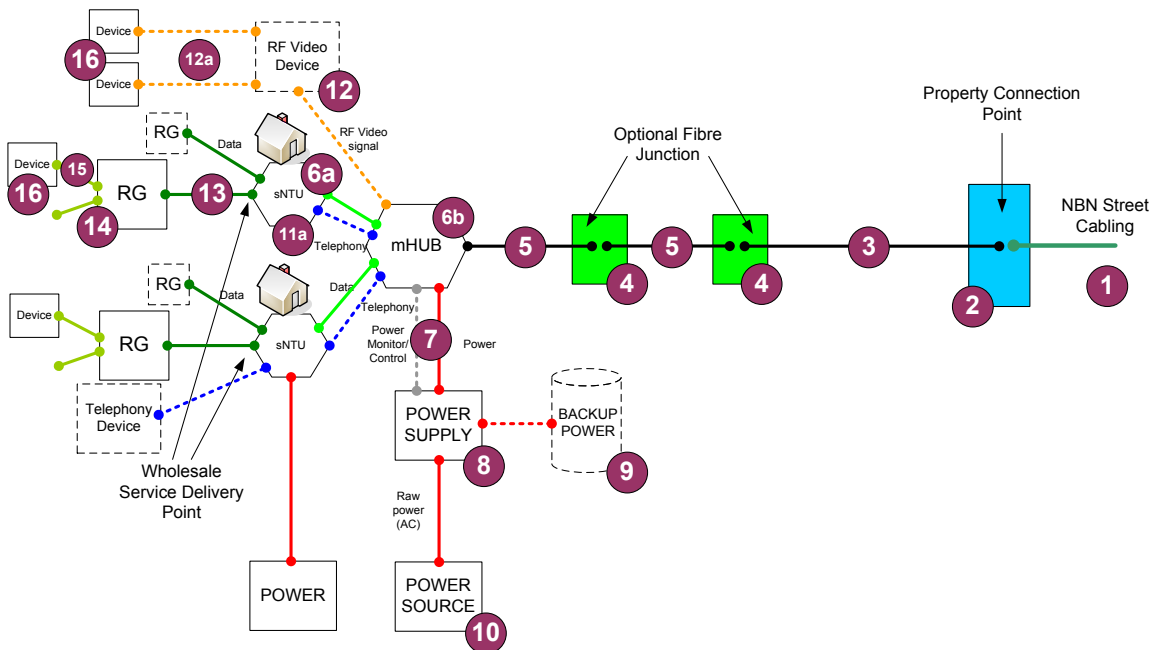
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FIGURE 5

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 next-generation access network to be deployed throughout Australia. This network will include Points of Interconnection (PoI) 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 (SDP).

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.

4.2.3   The Property Connection Point can be a Fibre Distribution Hub (FDH).

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 Point (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 End User's building and not easily accessible by the network provider, and/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 building. 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 could be pre-terminated and made to a fixed length or terminated or spliced on site to a custom length by an appropriately trained and qualified 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.

4.4.4   The optional fibre junction can be an Optical Distribution Frame (ODF).

4.4.5   In a multi-dwelling unit scenario, multiple EUP connections may aggregate to a single fibre junction for consolidated connection

to the NBN. The EUP handbook refers to this as an mHUB (see Section 2.3 and 4.6).

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 (Reference Point 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 could be pre-terminated and made to a fixed length or terminated or spliced on site by an appropriately trained and qualified 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.B3 optical fibre, designed for minimum bend radius of 5.0 mm for use in the EUP. Compared to ITU-T G.652 optical fibre, 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 and sub-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 Network Reference Architecture High Level Architecture Options for the NBN* [Release 1], there is a range of potential Service Boundary Points (SBPs) as per Figure 6.
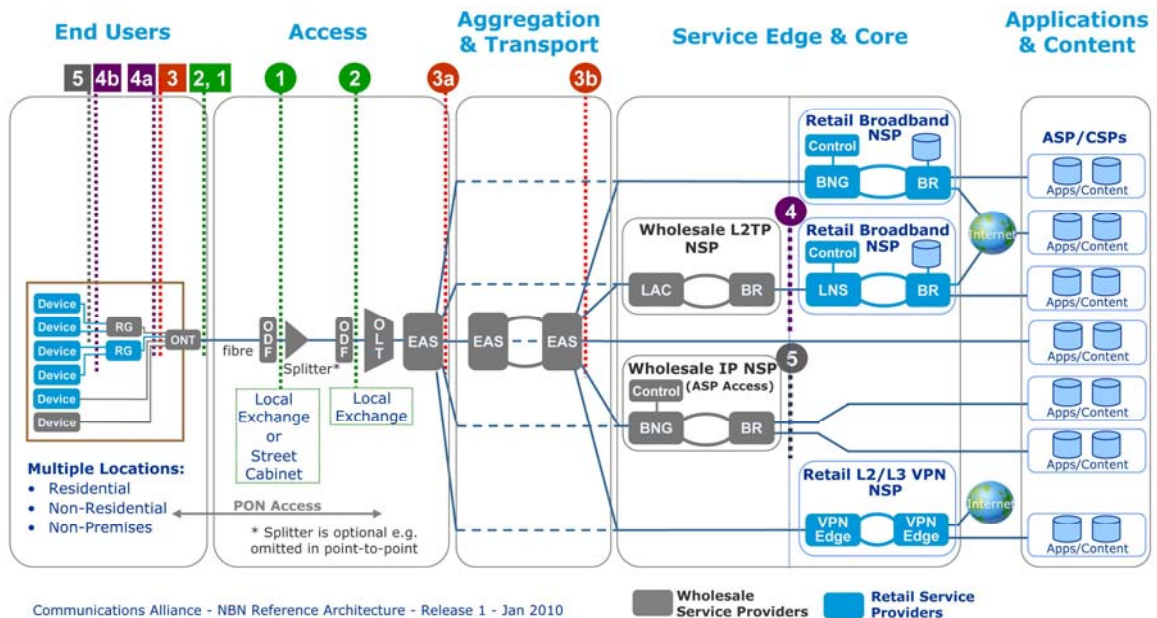
FIGURE 6

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

4.6.5   At the EUP, it is assumed that the physical SDP is the NBN End User service interfaces of the NTU (i.e. corresponding to the potential logical scenarios 3 and 4 in Figure 6). 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/RSP 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 expected that only a single fibre will be terminated 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. Coexistence with other access retailers is out of scope of this Handbook.

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 DSL 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 – High Level Architecture Options for the NBN* paper.

4.6.10   NTUs will be locally powered (i.e. from the EUP).

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, however the capability to allow connection of a power backup source is required.

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 NTU (Single Dwelling Unit 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 NTU (Multi-Dwelling Unit 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 EUP for a variety of reasons. Normally, existing building wiring is utilised to provide services from the MDU NTU to each EUP. MDU NTUs may have modular plug-in units so that the NTU can be tailored for the number of EUP within the MDU. Figures 4 and 5 show two types of MDU NTU installations.

(c)   In Figure 4, an MDU NTU which provides one or more service delivery points (SDPs) directly to each EUP within the MDU has been defined as an mNTU. In this scenario, End User services would be provided by direct connection of either a device or RG to the mNTU via the internal wiring of the MDU (e.g. Ethernet, voice grade cabling, or VDSL2).

(d)   In Figure 5, each EUP within the MDU is provided with an individual NTU referred to as the sNTU (Reference Point 6a). The connections to each sNTU are aggregated within the MDU site utilising an mHUB (Reference Point 6b). The mHUB may be passive (e.g. an ODF) or active (e.g. an Ethernet switch or VDSL2 DSLAM) and provides a consolidated entry point from the NBN into the MDU site.

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 EUP building 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 the EUP building. 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. Specifically, business 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 the 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 Sections 4.6.17 to 4.6.21.

4.6.17   Installation

(a)   Cost (labour, equipment and materials).

(b)   Complexity.

(c)   Access to existing premises cabling (if required).

(d)   Access to and location of power source and power backup source.

(e)   Access to optical lead-in.

(f)   Ability to install fibre to each EUP (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).

  (k) Environmental reasons.

 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 the End User to diagnose problems and 'self-help' (e.g. LED/alarm access and interpretation, testing at service interfaces of NTU).

  (e) Suitability of NTU type to the End User's needs and capability.

  (f) Responsibility for backup power source battery.

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

  (h) Operational support.

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

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

  (k) Security of NTU (including accessibility to service interfaces).

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

  (m) 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 addressed 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/wallplates/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.

(l)   Interoperability with existing customer equipment (e.g. alarm and medical equipment).

4.6.20   End User service fulfilment

(a)   Self-installation (e.g. 'plug-and-play') option (versus required professional install) for RSP customer equipment connected to the NTU.

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

(c)   Ability to support multiple RSPs simultaneously.

(d)   Professional install.

4.6.21 External NTU installation considerations

Where the NTU is designed to be installed external to the building, the interfaces provided may need to be extended to the interior of the building, noting the following:

(a)   It is assumed that the NTU will be a designated 'network termination device' in accordance with section 22 of the *Telecommunications Act 1997*, that the NTU telephony, RF video and data interfaces will be the network boundary point and that the wiring connected to them will be customer cabling (refer to Appendix J of AS/ACIF S009 on the network boundary).

(b)   For improved reliability it is recommended that the telephony and data interfaces be hard-wired (via Insulation Displacement Connectors on the NTU) to an internal wall plate or patch panel. This does not preclude the use of a 'test' socket on the 'network' side of the interface for End User or Service Provider testing purposes as long as the connection of fixed wiring to this socket (e.g. by terminating the fixed wiring on a mating plug) is precluded by design or appropriate labelling (see Figure 7). If any socket is used in an external NTU, then the socket type described in Section 4.11.6 or Section 4.13.4, as applicable, should be

used and the NTU enclosure should be designed to provide adequate environmental protection to the socket.

(c) The Insulation Displacement Connectors should use tool-less terminations for the fixed wiring and should meet the relevant requirements of Clause 5.7 of AS/ACIF S008 on connecting hardware. Gel-filled connectors and sockets (where used) may be required in tropical, sub-tropical, humid or salt-laden environments.

(d) The End User may legally access a 'test' plug/socket on the 'network' side of the interface for testing purposes if authorised to do so by the NTU owner. The End User cannot legally access any fixed wiring on the 'customer' side of the interface (even if it is terminated on a plug/socket) unless the End User is a registered cabling provider. Where the End User may be required to access a 'test' socket in the NTU enclosure, there should be no metallic terminals, connections or live parts exposed to touch by the End User.
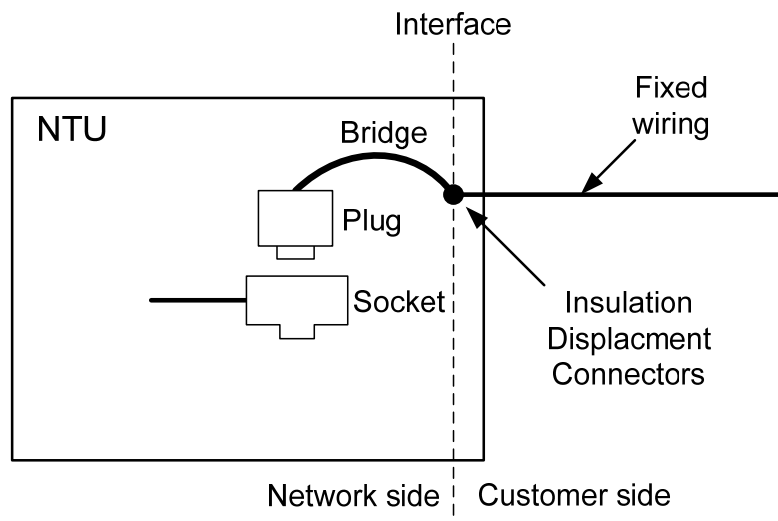
FIGURE 7
External NTU Telephony/Data Interface with Optional 'Test' Socket

4.7 NTU to power supply connection (Reference Point 7)

4.7.1 The NTU to power supply 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 could 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) and it is 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. for EMC compliance) or for safety isolation of the NTU interfaces.

(f) The power supply should be protected from accidental disconnection or switch-off.

(g) Alternative power sources may also be supported, including wind and solar energy.

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 telephony services, a cordless telephone or security, medical or alarm services.

4.9.2   It should 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 telephony 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   The power backup source may be used only to power the NTU, or the NTU may be one of many devices connected to a common power backup source available in the EUP. An example of the latter is a household Uninterrupted Power Supply (UPS) which may power a cordless telephone, a computer, storage devices and the NTU or a business office with a large UPS or generator to power IT equipment and the NTU.

4.9.4   Further information regarding the power backup source is described in the following section.

NTU power backup source deployment scenario assumptions

4.9.5   The NTU will be locally powered from an AC power source at the EUP.

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

NOTE: Cordless telephones generally require external power supplies and would not be powered by the NTU telephony interface alone but by a separate UPS.

4.9.7   Provision for management (collection of status and alarms via the network) of the power backup source is optional. As a minimum support for connection of an unmanaged power backup source is required.

4.9.8   The power backup source might be an optional component installed at the choice of the End User or RSP.

4.9.9   Remote monitoring of the power backup source and any associated battery or batteries (a managed power supply) is optional and implemented at the discretion of the NBN operator or RSP.

4.9.10   The NTU power backup source may be based on a battery that has a limited lifespan and the End User, ASP or RSP 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.

4.9.11   The backup power source should automatically supplant loss of primary power without service interruption.

4.9.12   The NTU power backup source and any power connectors, plugs or switches (connecting to the NTU or to the power supply) should be designed to avoid accidental disconnection or switch-off.

Typical NTU power consumption

4.9.13   The power consumption of an NTU depends on many factors including the number and type of interfaces provided and which ones are active.

Power backup source alarms and diagnostics

4.9.14   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.

4.9.15   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 and/or pass on these alarms to one or more RSPs relevant to the individual End User. 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 RSPs, or actioning a maintenance procedure. The impacts of doing such monitoring on a large national scale should be carefully considered by any NBN operator and/or RSP.

4.9.16   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

4.9.17   With the End User likely to be responsible for the maintenance and replacement of the stand-alone optional battery backup or UPS internal battery, 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.

4.9.18   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, batteries 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 example, lead acid battery life varies with their temperature. Factors affecting battery temperature include climate, electronic load, and solar load.

Power shedding profiles

4.9.19   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.

4.9.20   An example power shedding profile commonly used for Carriers in GPON ONT deployments is one where the telephony 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, a North American example of such a power shedding profile is:

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

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

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

4.9.21 Other power shedding profiles for the ONT can be used (but cannot be configured by End User) to suit the service or customer needs. For example, if telephony 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.

4.9.22 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).

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

4.9.24 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

4.9.25 The determination of the required reserve backup time for an NTU will depend on a number of factors including:

(a) The nature of the service(s) being protected and if there are any legal requirements regarding backup time for that service or services.

(b) The health, lifestyle and location of the End User (as related to the service being delivered).

(c) The reliability of the local power supply.

(d) The features and capability being offered by the RSP.

4.9.26 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.

Typical Power Outage Lengths

4.9.27 For informational purposes only, a review of typical outage times reported by electricity suppliers in Queensland, New South Wales and Victoria over the past few years indicates the following:

(a) Urban area average length of an outage is between 60 and 90 minutes.

(b) Rural area average length of an outage is two to three hours.

(c) Remote area average length of an outage is one or two days.

(d) Outages of up to twelve hours Urban, one to two days Rural and three to four days remote do occur occasionally.

NOTE: Actual outage times may well vary from the average with some outages being short when automatic actions quickly restore mains electricity supply while other outages may be many hours in urban areas or days in rural areas when work teams are required to repair damaged power lines.

Battery recharge time

4.9.28 The time to return the ONT backup power source (e.g. a battery) to a practically useful capacity after a discharge event should be reasonably short. The power source should be charged according to the manufacturer's recommendation.

Backup power source maintenance and replacement

4.9.29 Information must be made readily available to the End User on the optional power backup source functions, expected reserve times for each service provided from the NTU and under what conditions; replacement battery details, and instructions for battery replacement (if a battery is fitted).

4.9.30 The backup power source (including battery if required) should require no periodic maintenance, except for battery replacement, to remain useful to the End User.

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

4.9.32　The backup power supply, battery or UPS, if fitted, should be a readily available type and of generic design (e.g. as commonly used for domestic security alarm systems or small computers).

End User education regarding power backup source

4.9.33　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 230 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).

NOTE:　It is recommended that the power supply connection be protected against accidental disconnection to avoid inadvertent service interruption.

4.11 Telephony interface (Reference Point 11)

4.11.1 The telephony 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 telephony interface in the NTU is to allow an RSP to easily support existing 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 Handbook focuses on the EUP considerations. 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 telephony access service terminating at the telephony interface on the NTU. Examples include:

(a) Standard telephony services (using existing single pair analogue handsets as the terminal). Note that services delivered to a telephony 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) Text Telephone/Telephone typewriter (TTY) devices.

(c) Consumer grade alarm systems.

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

(e) Fax machines.

(f) Dial-up modems.

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

(h) Personal alert/nurse call systems.

NOTE: The telephony interface on the NTU should be able to support multiple End User devices connected on a single voice-grade pair as per existing telephony services.

4.11.5 It is recommended that the telephony 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 telephony interface:

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

(b) Support for at least one two-wire interface 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.

NOTE 1: Where the NTU is designed to be located inside the building, it is recommended that a 6P2C (6-position 2-contact) modular socket (commonly known as 'RJ11') be used for the telephony interface for connection to the fixed wiring via a fly lead to a wall plate or patch panel. The use of a 6P2C socket will enable direct connection of customer equipment to the NTU by the End User (either as a permanent arrangement or for testing purposes). The use of a 6P2C socket will also prevent the accidental connection of an Ethernet device to the telephony interface, which may cause damage to the Ethernet device and/or result in the End User receiving an electric shock. The socket should meet the relevant requirements of Clause 5.7 of AS/ACIF S008 on connecting hardware.

NOTE 2: Section 4.6.21 provides some notes on the NTU interface options for telephony and data when the NTU is installed externally to the building.

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

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

(e) The two-wire interface used to deliver the telephony interface could also be used to simultaneously deliver a DSL service (fed from the NTU or another device) to the EUP. This would require appropriate xDSL/telephone splitters to enable this.

(f) Support for Metallic Line Test (MLT) functions may be required depending upon the NTU installation circumstance.

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 connected to 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 not permitted 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 unidirectional (communication signals delivered to the EUP) or bidirectional (communication signals delivered to and received from the EUP). The video service return path can also be via RF 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 Handbook focuses on the EUP considerations. 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 be delivered over the NBN from the Point of Interconnect and utilise the NTU RF video interface include:

(a)   DVB-Terrestrial, DVB-Cable or DVB-Satellite type video, radio and information services (including existing free-to-air and Pay TV channels).

(b)   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 bidirectional mode.

NOTE: Depending on the source format of these services, transcoding, conversion or frequency shifting may be required before and after transmission across any FTTP network in order for them to co-exist with other services and maintain compatibility with both the transmission medium and the attached devices.

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 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.

NOTE: For more information on interface connector types and practices, refer to Section 7 on NBN EUP installation practices.

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* paper at the Service Boundary Point.

4.13.2   The data Interface will support the EUP Interface defined in the *National Broadband Network Wholesale Service Definition Framework – Ethernet* paper. 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:

(i) Fibre – IEEE 802.3 Section 3

(ii) Copper (8P8C) – IEC 60603-7

(b) Gigabit Ethernet:

(i) Fibre – IEEE 802.3 Section 3

(ii) Copper (8P8C) – IEC 60603-7

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. 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).

NOTE 1: Where the NTU is designed to be located inside the building, it is recommended that an 8P8C (8-position 8-contact) modular socket (commonly known as 'RJ45') be used for the data interface for connection of the RG or for connection to the fixed wiring via a fly lead to a wall plate or patch panel. The socket should meet the relevant requirements of Clause 5.7 of AS/ACIF S008 on connecting hardware.

NOTE 2: Section 4.6.21 provides some notes on the NTU interface options for telephony and data when the NTU is installed externally to the building.

4.13.5   To aid installation in existing premises where retrofit of new cabling is not feasible, alternative delivery mechanisms for Ethernet connections could be integrated with the NTU (Reference Point 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 6 on NBN EUP distribution technologies.

4.13.6   In MDU 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 may be used. 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 EUP 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 4 and 5.

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 EUP.

4.13.8   There will be options for the EUP to support priority tagged frames (with respect to 802.1Q) to support the ELAS Service Attributes defined in ELAS Service Attributes specified in Sections 4.2.8 to 4.2.13 of the *National Broadband Network Wholesale Service Definition Framework – Ethernet*.

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

End User Premises delimiter

4.13.10 The ELAS identifier at the EUP 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* paper. 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 service:

(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 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   Typical tasks of the RG are to:

(a)   shape upstream traffic to the subscribed 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   The RG should be able to support remote software upgrades.

Standards

4.14.4   Section 2.1 of the Broadband Forum TR-101 Technical Report 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:

(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 tags from frames received tagged.

RG Multicast

4.14.5   The *National Broadband Network Wholesale Service Definition Framework – Ethernet* paper 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

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

4.14.7   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.

4.14.8   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.

4.14.9   The key requirements identified for the RG are:

(a)   Support of an IGMP (IPv4) and/or MLD (IPv6) proxy-routing function.

(b)   Support of IGMP version 3 as per RFC 3376 (IPv4).

(c)   And/or support for MulticastListener Discovery (MLD) as per RFC 2710 (IPv6).

(d)   Support IGMP or MLD forwarding with local NAT, routing and firewall features including:

(i)   establishing any forwarding rules in the firewall for the multicast streams received (after join);

(ii)   be able to multicast upstream IGMP/MLD 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/MLD 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.

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

RG Operations Administration and Maintenance (OAM)

4.14.11   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.

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

4.14.13 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.

4.14.14 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.

4.14.15 Refer to Section 7.3.1 of TR-101 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 (wired or wireless) 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) 3G/HSPA/LTE (Femtocells).

(b) Basic Voice on voice-grade cabling.

(c) Bluetooth.

(d) DOCSIS over Coaxial (television) cabling.

(e) DSL on voice-grade (telephone) cabling.

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

(g)   Ethernet on Category 5 or Category 6 cabling.

(h)   HPNA over voice-grade (telephone) cabling.

(i)   ISDN/E1.

(j)   MoCA over Coaxial (television) cabling.

(k)   POE (Power Over Ethernet).

(l)   WiFi (IEEE 802.11x Wireless).

(m)   WiMAX.

(n)   Zigbee.

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. 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 Technical Report 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 (Category 5 or better).

(b)   Gigabit Ethernet

(i)   Fibre – IEEE 802.3™ Section 3.

(ii)   Copper (Category 5 or better).

(c)   Wireless

(i)   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   Additional information on EUP distribution networks can be found in the associated topic in this Handbook.

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 RG (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 RG (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 RG when in place.

5   NBN EUP INSTALLATION ARCHITECTURE – WIRELESS/SATELLITE ACCESS

5.1   Introduction

5.1.1   The NBN EUP practices described in this Handbook are intended to be common to all NBN access types including fixed and

wireless technologies wherever possible. However, it is noted that certain elements of the NBN EUP architecture are implemented slightly differently for Wireless access networks (e.g. LTE, WiMAX or Satellite). The key EUP architecture components different for Wireless NBN access networks when compared to Fixed NBN access networks are identified in this Section.

5.1.2   At present, it is not envisaged that wireless or satellite access will be provided for shared services to MDUs.
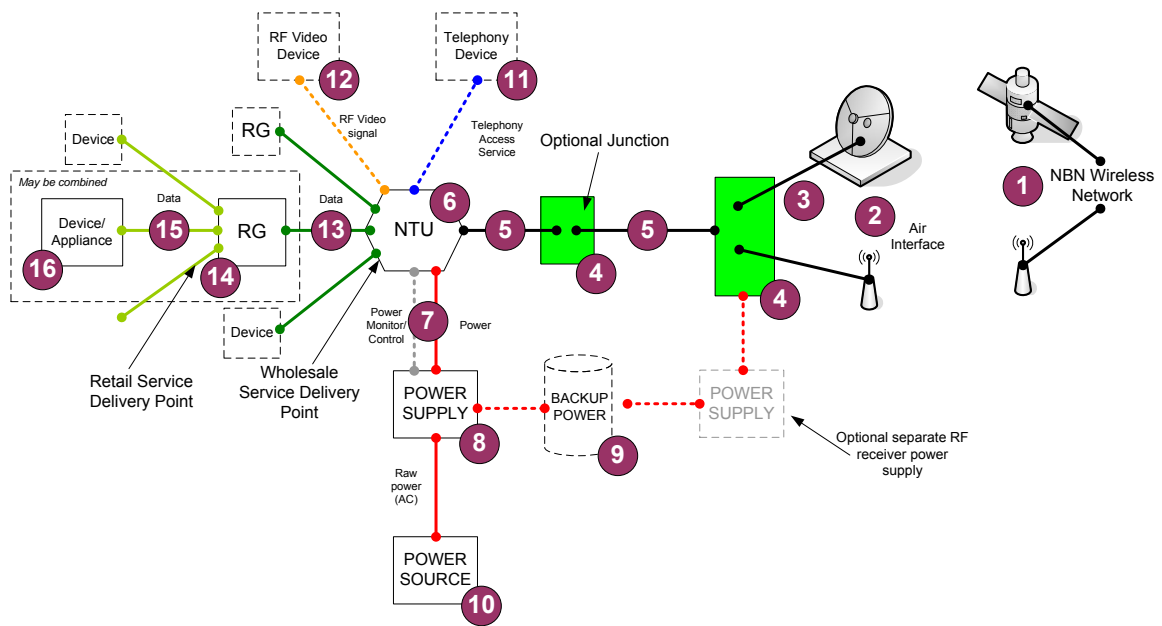
FIGURE 8

EUP Functional Diagram (Wireless access) – Single NTU per premises

5.2   NBN wireless network infrastructure (Reference Point 1)

5.2.1   In addition to the main NBN infrastructure which is similar or common to both fixed and wireless access types (e.g. Points of Interconnection (POIs) and backhaul networks), it is expected that both satellite wireless access and terrestrial wireless access (e.g. 3G, WiFi, LTE or WiMAX) will augment fixed access NBN deployments in areas where fixed access is infeasible (e.g. low density or remote premises areas).

5.2.2   To deliver wireless access, the NBN wireless network infrastructure will include (owned or leased services) satellite transponders or channels, ground stations, transmission towers, antennas and wireless transmission equipment. These elements are expected to connect to the rest of the NBN infrastructure using a combination of Ethernet and IP technologies.

5.3 Antenna (Reference Point 2)

5.3.1   Each EUP, or collection of EUPs, will use an antenna to connect to the NBN wireless access network.

5.3.2   The antenna required will vary based on the technology chosen, the bandwidth provided and the distance between the EUP and the transmitter.

5.3.3   The antenna may be located indoors or outdoors.

5.3.4   Due to the variability of reception with antennas the access provider may not guarantee service levels unless the antenna is in a fixed location and installed by an appropriately trained and qualified installer.

5.3.5   The installation of a fixed antenna may require special mounting and OH&S practices, as antennas can be quite large and heavy, and also require strengthened mounting systems in areas with high wind and cyclone exposure.

5.3.6   The antenna may or may not be integrated with the NTU (Reference Point 6).

5.3.7   The antenna may or may not require a separate power supply (Reference Point 8).

5.4 Receiver/Antenna first stage lead-in (Reference Point 3)

5.4.1   In the case where the antenna is separate to the NTU (Reference Point 6), a lead-in cable will be required to connect the antenna (Reference Point 2) to the NTU to carry both signal and power between the antenna and NTU (and/or power supply).

5.4.2   This lead-in may be contained indoors within an EUP, be outdoors only (where the NTU is also located outside) or extend from inside to outside (when the NTU is located inside and the antenna is outside).

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

5.4.4   Lead-in cables could be pre-terminated and made to a fixed length or more commonly terminated on site to a custom length by an appropriately trained and qualified installer.

5.4.5   The lead-in cable is not required if the NTU and antenna are integrated.

5.5 Optional connection junction (Reference Point 4)

5.5.1 The optional connection 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 together.

5.5.2 In the case of Wireless NBN access, the optional connection junction may also combine a power signal needed for the antenna with the transmission signal from the wireless NTU (Reference Point 6) if required.

5.6 Secondary lead-in (Reference Point 5)

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

5.7 Wireless Network Termination Unit (Reference Point 6)

5.7.1 The wireless NTU is expected to provide similar End User functions to that of the fixed NTU. See Section 4.6 for more information on the NTU in general.

5.7.2 It is assumed that the NTU for wireless NBN access will incorporate the wireless receiver functions.

5.7.3 The NTU and antenna (Reference Point 2) could be combined and mounted indoors or outdoors to the EUP.

5.7.4 In the case where the NTU and antenna are separate devices, the lead-in cables (Reference Points 3 and 5) and optional junctions (Reference Point 4) will connect the two devices and any additional antenna powering if required.

5.8 NTU to power supply connection (Reference Point 7)

5.8.1 The NTU to power supply for wireless NBN access is as per the fixed access situation. For more information see Section 4.7.

5.9 Power supply (Reference Point 8)

5.9.1 The power supply for wireless NBN access is as per the fixed access situation. For more information see Section 4.8.

5.9.2 In some cases, a second power supply or the same power supply as used for the NTU (Reference Point 6) may need to provide power to the antenna directly. The power and transmission signals

would be combined at an optional connection junction (Reference Point 4).

5.10 Backup power source (Reference Point 9)

5.10.1   The backup power source for wireless NBN access is as per the fixed access situation. For more information see Section 4.9.

5.10.2   In some cases, a second power supply (Reference Point 8) or the same power supply as used for the NTU (Reference Point 6) may need to provide power to the antenna directly. If a power backup source is utilised, this should be provided for both the NTU power supply and the antenna power supply in this case.

5.11 Telephony device (Reference Point 11)

5.11.1   The telephony interface is an optional interface that would be deployed as an inbuilt part of the NTU (or add-on module).

5.11.2   As for the Fixed Network case, the primary reason for inclusion of a telephony interface in a wireless NTU is to allow a Service Provider to easily support existing telephony services 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 and RSP).

5.11.3   The capabilities of a telephony interface on a wireless NTU should be as close as possible to those on a fixed NTU to simplify network deployment and migration (and vice-versa). In addition to the capabilities described in Section 4.11, the telephony interface should support a codec option that is spectrally efficient for use over wireless access technologies.

5.12 RF video device (Reference Point 12)

5.12.1   It is expected that an RF video device output will not be provided on the NTU (Reference Point 6) used for wireless NBN access.

6   NBN EUP DISTRIBUTION TECHNOLOGIES

6.1 Introduction

6.1.1   As introduced in Section 4.13.5 there are a number of mechanisms that can be employed to extend the UNI interfaces of the NTU into the EUP for connection to RGs and End User devices. These can be divided into three categories: data distribution, telephony and RF video distribution.

6.2 Data distribution

6.2.1   In recent years Ethernet and IP have become the de facto standards for data distribution. Their popularity has led to a number of lower layer protocols and technologies to be developed that specialise in their transmission. This section will

outline and describe the major technologies that can deliver and distribute Ethernet and/or IP in an EUP and the scenarios in which they are most applicable.

Structured cabling

6.2.2   The traditional Ethernet delivery medium (for speeds 100 Mbps and above) has been Class D cabling using Category 5 components (cable, connectors, etc.). Category 5 unshielded twisted pair (UTP) cable was originally designed to support Fast Ethernet (100BASE-T) at 100 Mbps using unidirectional signalling over two pairs (i.e. one pair for send, one pair for receive). Gigabit Ethernet (1000BASE-T) supports 1000 Mbps (1 Gbps) over Category 5 UTP cable using bi-directional signalling on all four cable pairs. While properly installed Category 5 cable will support Gigabit Ethernet, Enhanced Category 5 (Category 5e) UTP cable provides more consistent Gigabit Ethernet performance over extended distances (up to 100 metres including 10 metres of patch cable). Category 5 products manufactured to current standards are equivalent to Category 5e but modern Category 5 cables and components are invariably sold as 'Category 5e' to remove doubt. Class E cabling using Category 6 components provides superior performance and is capable of supporting transmission of up to 10 Gbps.

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

6.2.3   DSL technologies are designed to operate over extended distances using existing telephony grade cabling. Most variants have the ability to coexist with regular voiceband services. DSL is usually used for connecting an EUP to a Carrier's central office or cabinet based equipment for data access services. In the context of EUP distribution, it could be used over shorter distances to facilitate data connectivity using existing telephone wiring from one point in the EUP to another.

6.2.4   It is particularly useful in an MDU scenario, where a single compact DSLAM could redistribute incoming fibre access to each individual dwelling without requiring any replacement of existing building wiring. In this scenario, VDSL2 30a profile can achieve more than 100 Mbps symmetrical transmission over approximately 300 metres using the existing telephone wiring of the building (and coexist with telephone services on the same cabling).

HomePNA (Ethernet over telephone wiring)

6.2.5   The HomePNA Alliance is a collection of companies who together developed a standard of local area networking that can operate over existing telephone or coaxial wiring within an EUP. The HomePNA specifications were later adopted into ITU, with HomePNA version 3.1 labelled ITU-T G.9954.

6.2.6   The latest iteration of products offer up to a 320 Mbps Ethernet connection across a bus topology with up to 64 end points.

6.2.7   HomePNA and other similar standards with related aims are now being consolidated into the ITU-T G.hn family of standards, see also ITU-T G.hn below.

Multimedia over Coax Alliance (MoCA)

6.2.8   Similar to the HomePNA Alliance, the Multimedia over Coax Alliance (MoCA) is a collection of companies who developed a standard for transmission of 175 Mbps Ethernet over a bus topology to up to 16 devices across standard EUP coaxial cabling (MoCA 1.1).

6.2.9   MoCA and other similar standards with related aims are now being consolidated into the ITU-T G.hn family of standards, see also ITU-T G.hn below.

EPL (Ethernet over Power Line) / HomePlug Powerline Alliance

6.2.10   The HomePlug Powerline Alliance was formed to develop specifications for both high speed data communications and low speed command and control applications (e.g. home security) across regular EUP power cabling.

6.2.11   HomePlug 1.0 offered speeds of up to 14 Mbps, HomePlug AV supported up to 189 Mbps and HomePlug AV2 is currently in development targeting speeds up to 600 Mbps.

6.2.12   HomePlug and other similar standards with related aims are now being consolidated into the ITU-T G.hn family of standards, see also ITU-T G.hn below.

ITU-T G.hn (also known as ITU-T G.9960)

6.2.13   Recently, the ITU-T has provided an initial release of the 'G.hn' standards family (ITU-T G.9960 and G.9970). These standards attempt to build upon and rationalise the work done by separate bodies with technologies such as HPNA and MoCA. The aim of the G.hn standard set is to provide Gigabit per second data speeds over a variety of common EUP distribution mediums, including voice-grade wiring, Coaxial cable and home power wiring.

6.2.14   Due to the significance of ITU-T standards within the industry, it is likely that device manufacturers will progressively adopt G.hn and thereby allow more successful interoperability between devices from different manufacturers. This will greatly benefit the EUP distribution environment.

Wireless (WiFi)

6.2.15   The IEEE 802.11 standards family provides for transmission wirelessly with speeds up to 150 Mbps (ITU-T 802.11n). It has proved immensely popular and has become almost ubiquitous in the

connectivity of computers and other connected devices (e.g. games consoles, phones, fridges) to networks.

6.2.16   Although WiFi is often criticised for its variability of performance, the convenience of wireless connectivity has helped accelerate its almost universal adoption.

6.2.17   The primary concern regarding the use of WiFi in an NBN EUP is that multiple wireless networks (operating in the same frequency space) interfere with one another and thereby reduce the achievable throughput across all networks. This is especially significant if extended high throughput data such as video is being transmitted.

Bluetooth

6.2.18   The Bluetooth standard was developed as a short range, simple, low power and moderate throughput specification designed to be complimentary to other higher power standards such as WiFi. It has become most popular in providing connectivity between mobile devices including mobile phones, audio headsets, computers and PDAs.

6.2.19   Bluetooth does not transmit Ethernet data directly, but can be added to be used for point to point interfaces and IP connections. In an NBN EUP context it is likely to be used as a short distance supplementary transmission technology for interaction with low power devices such as mobile phones, watches and alarm clocks.

Zigbee (IEEE 802.15.4)

6.2.20   The Zigbee standard was defined by companies in the Zigbee alliance to provide a low cost, low power, low speed wireless mesh networking connection. Data transmission rates up to 250 kbps are possible and the specification focuses specifically on very low power control devices. The Zigbee standard has been widely adopted by the Utility industry for use in smart metering and control applications.

6.2.21   It is frequently discussed in the NBN EUP context as a viable way of connecting smart meter devices (power meters, water meters) to a Utility monitoring and control network provided through the NBN.

6.2.22   MiWi and WirelessHART are similar specifications also building upon IEEE 802.15.4.

6.3   Telephony Distribution

Twisted pair

6.3.1   Voice-grade paired cabling is the most prevalent way of distributing telephony services throughout an EUP. Typically one or more ports can be connected in parallel to the telephony source (e.g. the telephony interface on the NBN NTU) to allow multiple

devices to be connected simultaneously to a single service (although only one device can properly operate on the line at a time). If the voice-grade wiring is used to also distribute data services throughout the EUP (e.g. using DSL, HPNA or similar) then filtering devices will be required in order to avoid interference between the data link and the telephony service.

DECT

6.3.2   Operating in the shared public use frequency bands, DECT is commonly used in modern digital cordless telephones and is widely supported throughout Asian and European markets, making electronics readily available and very cost effective. With a range of up to 100 metres (line of sight) it can cover most residential EUP sites easily from a single basestation. Commercial sites and campuses may require more advanced systems with multiple basestations for full coverage.

6.3.3   In Australia, DECT generally operates in a different frequency band to common Wireless Ethernet standards (WiFi), however if a DECT device and WiFi device are using the same frequency band within a single premise interference between both technologies causing degraded service is possible, although unlikely to be a concern for most users.

GSM, UMTS and other Mobile technologies

6.3.4   It is possible to use GSM, UMTS or other Mobile standards for distribution of telephony within an EUP. The main barrier is the fact that these standards operate in closed spectrum and require a licence for operation. They are mentioned here primarily in the context of emerging 'Femto' capabilities. Femto cells are deployed by operators with co-operation of their End Users directly into EUP, much in the same way a wireless router is installed in many EUP already. The Femto then connects to the Carrier's mobile network and acts as an additional basestation (with or without hand-off support) within the EUP for enhanced coverage for the EUP and to reduce the backhaul load on the main mobile network.

6.3.5   As mobile telephony and data services continue to grow, it is likely the Femto concept will further evolve in order to augment the capacity and coverage of the main mobile networks.

6.4   RF video distribution

6.4.1   The information in Section 6.4 describes the existing use of RF video technologies within typical EUP. Typically, unique RF video distribution systems are required for each service provider providing services within an EUP. In most cases it is unlikely that existing RF video distribution can be re-used with new service providers (including those connected to an NBN) due to regulatory issues, so a number of RF video distribution systems may exist within one EUP.

Coaxial cable

6.4.2   Coaxial cable is used for distributing RF terrestrial, satellite and cable TV service and data within an EUP. The coaxial cable may connect external terrestrial and/or satellite antennas or other cable service to a range of consumer multimedia equipment. It can also be used for broadband data communication purposes. The proper design and installation of an RF distribution system will depend on individual circumstances, in particular single residences and MDUs normally require a different approach to the system design. However, broadly speaking RF distribution systems are based on a star topology which permits a system with multiple outlets for a variety of RF applications to be designed and installed. The key design and installation principles can be found in the Australian Standard for coaxial cable systems used for RF distribution, AS/NZS 1367: 2007, and a variety of industry codes of practice.

6.4.3   In single residences it is common to use separate RF distribution systems for separate services. For example, satellite subscription TV Service Providers will normally install a system designed and installed to its specification and dedicated to the carriage of its service. The same will normally apply in MDUs where coaxial cable RF distribution system can be quite complex. RF distribution of satellite services requires two separate cables and terrestrial TV a third cable. However, in Greenfield Multiple Residential Estates (MRE) the RF overlay component of a single optical fibre and coaxial cable distribution systems may carry a variety of RF services, such as analogue and digital terrestrial TV, multiple subscription TV service and other TV services. Systems designed to carry multiple TV services need to allow for differing requirements for the individual RF signals. For example, analogue TV performance parameters are different to those for digital terrestrial and cable TV. The system needs to be able to deliver a signal to the receiving device, say TV or Set-top Box, while maintaining the appropriate signal parameters.

Wireless RF video distribution

6.4.4   In addition to coaxial cable, there are many devices available which can transmit RF video signals over publicly accessible wireless bands for short distances, using either analogue or digital modulation. These could also be used to provide connectivity from an End User device (e.g. Set Top Box) to an RF Video port on the NTU, however their impact on and from other wireless services within the same EUP or nearby area must be considered in order to ensure adequate performance of all EUP wireless networks.

Other RF video transmission mediums

6.4.5   Like many other communications systems, there are other technologies for distribution of RF video within an EUP. Devices are available that can modulate RF video over all sorts of conductors, including telephone wire, Category 5 (or better) cabling or even power cabling. Although they can be very

effective in certain scenarios, it is recommended that coaxial cable or wireless be the main mediums considered for RF Video distribution within the EUP.

6.5   Interconnecting different distribution networks

6.5.1   Since the NBN encourages an open access network concept where it is possible to have multiple Service Providers co-existing within a single EUP, there may be times where there is a need to interconnect two separate Service Provider networks in order to facilitate easier access by the End User or for sharing of data directly between the two devices where each is connected to a different Service Provider network within the EUP.

6.5.2   A common example of this concept is allowing interconnectivity between a Utility network within the EUP and the End User's default internet data network. This could be required to allow easy End User monitoring of their Utility status (e.g. power consumption) or for allowing a smart meter device to intelligently control other home appliances such as computers, water heaters or air conditioners.

NOTE: AS 4755 provides a type of interface between the appliance and the meter.

6.5.3   Groups such as the Zigbee Alliance and Smart Grids Australia promote the concept of a proxy between the 'Home Area Network' (standard internet data network) and the Utility Private Network. Figure 9 illustrates this concept.

6.5.4   If this concept of a proxy was to be considered as a standard way of interfacing multiple EUP networks, it is advisable that a common standard or guideline be developed by the Service Provider and Utility community in order to allow predictable and repeatable interworking behaviour.

NOTE: Even if a formalised method for interconnecting multiple EUP networks is not developed, it is likely End Users will begin to 'dual home' some devices such as PCs into two or more Service Provider networks within the home simultaneously (e.g. WiFi to one provider, wired Ethernet to another). An End User may also (intentionally or not) simultaneously connect two or more Service Provider connections into a single EUP network. The Service Provider network design and security should consider this scenario in order to ensure services are unaffected where possible, or at a minimum the Service Provider network is protected from any adverse effects of this interconnection.
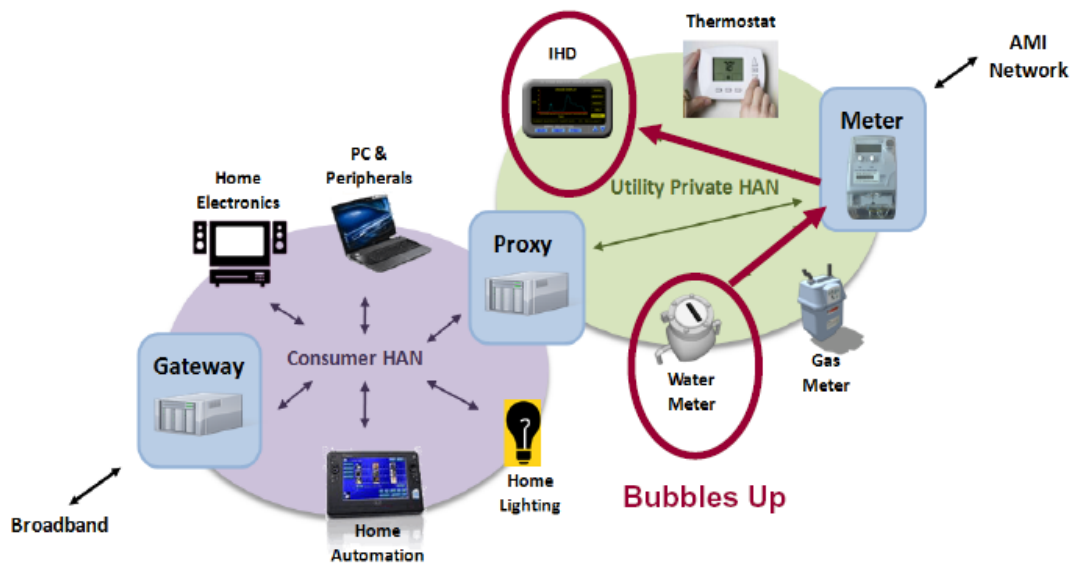
FIGURE 9
Interconnectivity between networks within an EUP

[From Zigbee Alliance: http://www.zigbee.org/imwp/download.asp?ContentID=16700]

6.6   Interference between multiple networks within an EUP

6.6.1   It is expected that NBN connected EUPs and End Users may receive services from multiple RSPs simultaneously.

6.6.2   In many cases, different RSPs operating within a single EUP will use similar technologies to distribute services throughout the EUP. In order to ensure that this situation is workable for the End User, RSPs must consider the following example interference scenarios:

(a)   Multiple wireless LAN (WiFi) networks within an EUP:

(i)   Although most WiFi equipment is able to scan and select less congested channels automatically, frequently multiple WiFi networks operating in close proximity interfere with one another and cause reduced performance.

(ii)   Encouraging the use of independent fixed networks or alternative delivery technologies (e.g. G.hn) per RSP may reduce this problem, especially for bandwidth sensitive applications (e.g. broadcast video).

(iii)   Where WiFi networks are used, RSPs should work to educate End Users on the potential interference concerns and methods to reduce the impact.

(b)   Multiple HPNA/MoCA/G.hn networks within an EUP:

    (i)   Similar to WiFi networks, it is difficult for multiple overlay networks (e.g. HPNA, MoCA and G.hn) to operate on a single transmission medium such as the power circuits of an EUP.

    (ii)   Where such networks are used, RSPs should work to educate End Users on the potential interference concerns and methods to reduce the impact.

(c)   Multiple RSPs:

    (i)   Connections from two or more RSPs may be cabled into a single in-premises network (intentionally or unintentionally by the End User), such that each SDP is visible to and receives traffic from other SDPs of other RSPs.

    (ii)   RSPs should ensure they adequately filter traffic entering their network from the premises to prevent network issues such as routing loops from forming and ignore management traffic such as broadcast router advertisements originating from other RSP networks.

6.6.3   Multi-dwelling EUPs add an additional dimension of complexity; not all dwellings may receive services from a common access network and the behaviour of multiple multi-dwelling distribution technologies needs to be carefully considered and monitored:

(a)   The coexistence of both Central Office fed ADSL/ADSL2+ services and 'basement' fed ADSL/ADSL2+/VDSL2 services on in-building cabling needs further investigation and regulation.

(b)   Further investigation and regulation is also required to ensure the satisfactory mutual coexistence of services where 'basement' fed DSL systems are deployed on in-building multi-pair cables using two or more Standard transceiver configuration options.

6.6.4   It is feasible that a single EUP distribution network could be used for all RSP services provided to a single EUP (using technologies such as 802.1Q VLANs); however this would require the development and agreement of usage and implementation guidelines between all RSPs providing services over the NBN.

NOTE: Interference of technologies outside the EUP is beyond the scope of this document.

7   NBN EUP INSTALLATION PRACTICE

7.1   Introduction

7.1.1   This Section focuses mainly on single dwelling units, lateral multiple dwelling units and small business premises of similar construction. There is great diversity in the way premises are cabled and this Handbook does not, and cannot, cover all variants. NBN Installers should consult with the various references listed in Section 7.11 for further guidance.

7.1.2   Larger business premises and vertical multiple dwelling units are invariably cabled via a customer main distribution frame (MDF), which removes many of the cabling constraints applicable to the types of premises described in Section 7.1.1.

7.1.3   This section addresses the two main components of the EUP installation:

(a)   the network 'lead-in' cabling from the Property Connection Point to the network side of the NTU, and the NTU itself — this cabling is subject to the requirements of relevant land access legislation, network Codes and facility access agreements but is not subject to ACMA cabling regulation (e.g. cabler registration, wiring rules).

(b)   the customer cabling between the NTU and the End User service access point (nominally the wall plate or 'outlet') — this cabling is subject to ACMA cabling regulation but not land access legislation or network Codes.

7.1.4   There are two main classes of deployment within an NBN rollout that need to be considered, that of Greenfield and Brownfield.

Greenfield deployment

7.1.5   Greenfield deployment is the installation of NBN infrastructure in a new development provided as part of the overall utility infrastructure. In such cases, the cabling within the EUP is usually installed at various stages of construction. With Greenfield deployment, there is opportunity to standardise the way new premises are cabled to accommodate known variables (e.g. external NTU versus internal NTU, RF TV distribution versus IPTV) and probable technological advances (e.g. even faster broadband).

7.1.6   The NBN Installer is not only required to follow the various Industry Standards and Codes of Practice as a minimum but may also be required to install the cabling and equipment to specific requirements set out by the NBN Infrastructure Owner and/or the Service Provider(s).

7.1.7   Further information regarding Greenfield deployment may be found within the output from the Communications Alliance *Early Stage Deployment* working group. Refer to the *National Broadband Network – Planning Express Conduit* paper and the

National Broadband Network – Fibre Ready Distribution Networks paper.

Brownfield deployment

7.1.8 Brownfield deployment is the installation of the NBN infrastructure as an overlay to, or in place of, existing 'legacy' infrastructure serviced by incumbent Carriers and/or Service Providers. In such cases, the cabling within the EUP may already exist and some or all of it may require migration to the NBN provider's services.

7.1.9 The NBN Installer is not only required to follow the various Industry Standards and Codes of Practice as a minimum but may also be required to install the cabling and equipment to specific requirements set out by the NBN Infrastructure Owner and/or Service Provider(s).

7.1.10 Furthermore the NBN Installer will need to conduct an audit of the existing EUP cabling, where practicable, before the commencement of any works to:

(a) identify the facilities owned or operated by the incumbent Carrier(s) and Service Provider(s) to avoid illegally tampering or interfering with those facilities; and

(b) be satisfied that the legacy cabling that can be legally used is not only serviceable but meets the relevant mandatory standards.

7.1.11 It is recommended that NBN Installers employ the ACMA *Telecommunications Cabling Advice* (TCA2) form) as part of the auditing and compliance assessment process.

NOTE: The ACMA TCA forms are available from http://www.acma.gov.au/WEB/STANDARD/pc=PC_1469.

7.1.12 Whilst installation standards and requirements between Greenfield and Brownfield developments should not differ, complications may arise when migrating legacy cabling to an NBN provider's services and therefore it is this area that is the main focus of this Section of the Handbook.

7.2 General

7.2.1 The installation of a NBN service in an EUP consists of four key steps:

(a) Installation of lead-in cable from the Property Connection Point (Reference Point 2) to the End User's building.

(b) Installation of the NTU at or in the End User's building.

(c) Acceptance, migration and/or installation of customer cabling.

(d) Testing of all services.

Installation of lead-in cable from the Property Connection Point to the End User's building

7.2.2 A fibre optic lead-in cable of an appropriate length will be installed between the Property Connection Point (PCP) and the NTU in the EUP. The lead-in cable to the building may be installed aerially or underground or a combination of both.

7.2.3 In some cases the lead in cable will be allocated to an EUP on initial construction. The fibre will be pre-connected to the optical splitters. The correct fibre allocation needs to be established and tests carried out to confirm continuity between the Fibre Access Node (FAN) and the PCP.

Installation of NTU in the EUP

7.2.4 The NTU will either be an outdoor device, in which case it is mounted onto an external surface of the End User's building, or an indoor device located within the building. It is important to note that the NTU cannot usually be mounted away from the building (e.g. at the fence boundary) for the following reasons:

(a) The NTU requires power from the building to operate, i.e. derived from 230 V a.c. on the End User side of the consumer power meters.

(b) The NTU interfaces would need to be designed to withstand possible lightning overvoltages induced into the cabling between the NTU and the building.

(c) The NTU would need to be designed to support long cabling lengths to the End User equipment in the building.

(d) Multiple underground/aerial grade cables would need to be installed between the NTU and the building.

7.2.5 The cables entering/exiting the NTU itself will need to be run to ensure there is no strain or tight bends on the cable.

7.2.6 If the NTU is outdoor, the NTU power supply is typically installed indoors and provided with a long power supply tail. The power supply must be mounted adjacent to an internal 230 V socket-outlet made available by the End User and then the power supply tail routed to the NTU using conduit as required. The power tail is then terminated on the NTU. Any power supply that houses, or is capable of housing, a backup battery should not be installed externally as daily and seasonal extremes in temperature will reduce battery life (see Section 4.9.16).

7.2.7 If the NTU is indoor, the power supply and NTU are usually co-located near a 230 V socket-outlet made available by the End User. The indoor NTU may be connected via an external Optical Fibre Junction (e.g. wall box) to transition from aerial or underground cable to internal cable and to provide an external test point. In addition, an internal Optical Fibre Junction (e.g. an optical wall plate) may be required to transition from fixed optical

cabling to a fly lead for connection of a moveable (shelf or table mounted) NTU.

Precautions

7.2.8   The installer will need to take all necessary precautions to establish the building's construction method and materials used to establish the appropriate fixings to facilitate the NTU's secure and correct fixing to the building.

Connection of NBN services to the internal copper cabling

7.2.9   If the NTU is outdoor:

(a)   New voice grade cabling may need to be installed to supply a basic voice service to wall plates in the building or existing internal cabling may be able to be used, depending on the existing cabling arrangements and any agreement with the incumbent carrier or Service Provider.

(b)   The installation of new RG6 coaxial cabling will usually be required to connect internal TV appliances to the RF video interface.

(c)   The installation of new Class D (Category 5) or Class E (Category 6) Ethernet cabling will usually be required for connection of the indoor RG to the data interface.

NOTE: Category 5 cable may be marketed as 'Category 5e' but cable manufactured to the current Category 5 standard meets or exceeds the Category 5e specifications. Similarly, Category 6 cable may be marketed as 'Category 6a' but either category is suitable for NBN data.

7.2.10   If the NTU is indoor:

(a)   It will usually be possible to connect a basic voice service to any existing internal cabling via a fly lead from the basic voice interface of the NTU or RG and an existing wall plate, as long as any existing telephone service can be isolated from the internal cabling at the incumbent Carrier's or Carriage Service Provider's network boundary point.

(b)   The installation of new RG6 coaxial cabling will usually be required to connect TV appliances to the RF video interface although it may be possible for the End User to connect a TV appliance directly to the RF video interface of the NTU (an attenuator may be required in such cases).

(c)   The RG may connect directly to the NTU and provide wireless access to the data service and/or the End User equipment may connect directly into the RG, thus obviating the need for Ethernet cabling.

Service testing

7.2.11 Prior to installation of customer equipment, all connections should be tested in accordance with Section 8 of this Handbook.

7.3 Installation of lead-in cable

7.3.1 Ideally, the lead-in cable will be supplied in various lengths with factory-fitted optical connectors at each end. In cases where it is not possible to install cables with factory-fitted connectors (e.g. through undersize or congested underground conduits), it will be necessary to employ on-site fusion or mechanical splicing techniques.

7.3.2 There are two options for installing the customer lead-in cable to the End User's building; aerial or underground. Subject to any local authority, pole owner or duct occupancy constraints, the standard lead-in cable for the installation of a customer service would normally follow a path similar to that of the existing utilities.

NOTE: State/Territory regulations may apply 'exclusion zones' around aerial and underground utilities such as aerial power lines, underground HV power cables, gas pipelines, water mains and sanitation pipes. Specific approval or accreditation may be required to work within any exclusion zone defined by the relevant authority.

Installation of aerial lead-in

7.3.3 Where an aerial lead-in cable will need to encroach on an adjacent property, the respective property owner and occupant will need to be consulted prior to installation. Should the proposed route not be acceptable to either the owner or the occupant, it may be necessary to consider the following:

(a) use of another pole from which to run the lead-in.

(b) underground lead-in.

(c) use of intermediate pole.

(d) mid-span, frontage tee (where the NBN distribution network is aerial construction).

7.3.4 The aerial lead-in cable should be installed in accordance with ACIF C524.

7.3.5 The PCP will usually comprise a pole mounted optical distribution module connector. The optical distribution module may be across the road, requiring a road crossing for the lead-in cable, or it may be some distance up the footway, requiring additional spanning of the lead-in cable to the property entry point.

7.3.6 Subject to the approval of any affected third party (see Section 7.3.3), the aerial lead-in cable should by preference be installed from the nearest pole to the End User's building.

Alternatively, where the NBN Distribution Network is aerial construction, the aerial lead-in cable can be attached mid-span to the distribution cable. This may require the use of an elevated work platform (e.g. a 'cherry picker') or the installation of a separate catenary wire on which to slide the cable from a pole to the fly-off point to meet occupational health and safety requirements.

7.3.7   The lead-in cable will either:

(a)   have an integral bearer cable or catenary attached to it; or

(b)   be a self-supporting cable.

NOTE: Ideally, the integral bearer, strengthener or catenary will be electrically non-conductive to maintain the insulating properties of the cable. This may simplify compliance with joint use codes for shared poles with power.

7.3.8   Building or pole hooks (generally known as 'P' or 'J' hooks) are fixed to the pole and building fascia or other suitable mounting point. Where the pole, fascia, mounting point, cable, bearer or catenary is electrically conductive, the hook may need to be insulated from the attachment to comply with applicable aerial cabling joint use codes.

7.3.9   For lead-in cable with a catenary, the catenary cable must be firmly attached to the pole hook so that no stress is placed on the lead-in cable. Excess catenary must be removed from the cable and the cable must be fed into the building space via a suitable sized hole.

7.3.10   There should be a drip point on the lead-in cable at the point of attachment (e.g. fascia) to divert any water running down the cable away from the surface of the building. The cable should enter the building at a point that is protected from direct exposure to the weather (e.g. under the eaves) to ensure there is no access route for water ingress into the building.

7.3.11   Any building entry point directly exposed to the weather should be drilled upwards into the building fabric and then sealed after the cable has been installed to prevent the ingress of water and minimise deterioration of the building material due to weathering.

7.3.12   The lead-in cable must conform to the minimum height above finished ground level at the specified measuring points (e.g. highway, roadway, footpath, driveway, private land) in accordance with ACIF C524.

7.3.13   When the customer's land falls away from the road or the span length is excessive, there may be a requirement to install a riser bracket at the building or an intermediate pole to achieve the required ground clearance.

Installation of underground lead-in

7.3.14   For SDUs or adjoining MDUs that are individually fed by underground lead-in cabling, a conduit with a minimum inside diameter of 23 mm should be installed from the pit, pedestal, cabinet or base of the pole (as applicable) to the End User's building. There should be no more than a total of three bends between cable draw points — two underground bends with a minimum bend radius of 300 mm and one aboveground bend with a minimum bend radius of 100 mm. The total length of conduit between draw points should not exceed 60 metres. Intermediate access pits may be required where this length would be exceeded or more than three bends are required between access points. Rigid conduit should be used underground and within building cavities. Flexible or corrugated conduit may be used on the surface of external or internal walls. The depth of cover for the conduit shall comply with ACIF C524.

NOTE: While AS/ACIF S009 does not apply to lead-in cabling, some of its requirements in respect of underground cabling are instructive for preventing such things as water and insect/vermin entry to buildings and service cabinets.

7.3.15   For MDUs fed by aggregated fibre lead-ins or a multi-fibre lead-in, one or more lead-in conduits with a minimum inside diameter (ID) of 53 mm or 105 mm, as appropriate, will be required. Any bend in 53 mm ID conduit that is within 500 mm of a cable draw point (e.g. a pit) should have a minimum bend radius of 300 mm; otherwise the minimum bend radius should not be less than 800 mm. Any bend in 105 mm ID conduit that is within 500 mm of a cable draw point (e.g. a pit) should have a minimum bend radius of 800 mm; otherwise the minimum bend radius should not be less than 5 m.

7.3.16   For rural areas and large acreage urban properties, direct burial techniques may be employed as long as the cable route is clearly identified for future location and repair.

7.3.17   If the PCP is pit mounted then care needs to be taken when resealing the enclosure after connecting to the PCP to ensure all seals are closed properly to prevent ingress of water.

7.3.18   If the PCP is pole mounted, a conduit will need to extend up to the PCP for at least 3 m above the ground to protect the lead-in cable. In addition, a metal mower guard and/or cover strip should be provided for a height of up to 1800 mm from the base of the pole to protect the conduit and cable against impact and vandalism.

NOTE: It may not be appropriate or practicable to extend the conduit up to the PCP. If the PCP is an enclosure that is not manufactured to accept pre-terminated cables, there may be the need to remove it from the pole for fusion splicing. Generally in this situation sufficient slack cable is installed and coiled on a

bracket to facilitate its removal. Conduit may restrict this practice.

7.3.19   An underground rated lead-in cable must be installed from the pit, pedestal, cabinet or base of the pole (as applicable), to the Optional Fibre Junction or NTU at the End User's building.

7.4   Installation of internal cabling

Indoor NTU

7.4.1   If the NTU is indoor, internal optical fibre cable must be installed between the building entry point or an Optional Fibre Junction (e.g. a wall box) and the NTU location. If the NTU is fixed to an internal wall, the optical fibre cable may connect directly to the NTU; otherwise it should connect to the NTU via an internal Optional Fibre Junction (e.g. an optical connector on a wall plate) and a fly lead. Any Optional Fibre Junction needs to be factored into the optical signal loss budget of the distribution network design.

7.4.2   For MDUs, internal optical fibre cable may need to be run to an internal fibre distribution hub from which additional optical fibre cables may radiate to intermediate distribution terminals on various floors. Individual optical fibre cables will then run from the distribution terminals to indoor NTUs in the living units. The NTUs should not be located in a common area outside the living units.

7.4.3   Internal optical fibre cables generally require a minimum bend radius of 10 times the cable diameter when installing them within building cavities, laying them, for example, on cable trays or in ducts. A minimum bend radius of 30 times the cable diameter is usually required when drawing the cable through bends in conduits.

7.4.4   It is assumed that the internal optical fibre cabling up to and including the optical fibre connection on the NTU will be network cabling and will not be subject to the technical regulation described in Section 7.4.5. For this to be the case, it may be necessary for the NTU to be marked 'Network Termination Device' or 'NTD' or for the definition of 'Network Termination Device' in the AS/ACIF S009 to be revised to specifically include the optical NTU. Refer to Section 7.5.6 for details.

Customer Cabling - general

7.4.5   All internal cabling on the customer side of the network boundary (e.g. the customer side of the NTU) is 'customer cabling' and is subject to the *Telecommunications Cabling Provider Rules 2000*. Accordingly, such cabling must be installed in accordance with AS/ACIF S009 and must be performed by a registered cabling provider.

7.4.6   Cabling is defined in AS/ACIF S009 to include the telecommunications cables, cable distribution/connection

equipment, telecommunications outlets (TOs), etc. installed in an EUP on the customer's side of the NTU (Reference Point 6) or on the customer's side of the incumbent carrier's network boundary.

7.4.7 For practical guidance on safety precautions and safety practices for the installation of Customer Cabling, refer to HB 252

Outdoor cabling

7.4.8 Outdoor cabling (e.g. to a detached garage or 'granny flat') should not be connected to the NTU or RG unless this is supported by the NTU/RG manufacturer's specifications. The service interfaces may not support the connection of outdoor cabling and to do so may put the safety of the End User and the integrity of the equipment at risk.

Data cabling

7.4.9 If the NTU is outdoor, the installation of new Class D (Category 5) or Class E (Category 6) Ethernet cabling will usually be required for connection of the NTU data interface to the indoor RG or end-user device. This cabling should terminate on a modular connector described in Section 7.4.11, which is either mounted on a suitable wall plate or on a patch panel, for connection of the RG (or end-user device) via a fly lead.

7.4.10 If the NTU is indoor, the RG (or end-user device) may connect directly to the NTU using a fly lead and provide wireless access to the data service, and the End User equipment may also connect directly into the RG (or end-user device) via fly leads, thus obviating the need for Ethernet cabling in some cases. Where the RG (or end-user device) is to be located in a separate room to the NTU, the installation of new Class D (Category 5) or Class E (Category 6) Ethernet cabling will usually be required. Each end of this cabling should terminate on a modular socket described in Section 7.4.11, which is mounted on a suitable wall plate for connection of the NTU and the data interface of the RG (or end-user device) via fly leads. Under no circumstances should fixed cabling connect directly to the NTU or the RG (or end-user device) or it may be technically illegal for the End User to connect or disconnect the plug for testing the service at the NTU/RG/end-user device (unless the End User is a registered cabling provider).

7.4.11 ACMA-compliant 8P8C modular connectors should be used for the data outlets. These outlets should be wired in accordance with the T568A pair assignments for 4-pair cabling (refer to Appendix C of AS/ACIF S009 on *Telecommunications Outlets)*.

7.4.12 The maximum cable length between the NTU and the RG (or end-user device) and between the RG (or end-user device) and the End User access points (e.g. wall plates) should be specified by the respective suppliers but, in any case, should not exceed 90 metres.

RF video cabling

7.4.13   The installation of new RG6 coaxial cabling will usually be required to connect internal TV appliances to the RF video interface although, if the NTU is indoor, it may be possible for the End User to connect a TV appliance directly to the RF video interface of the NTU using a suitable fly lead (an attenuator may be required).

7.4.14   The coaxial cabling should be installed in accordance with Standards Australia Handbook HB 252. AS/NZS 1367 is also relevant. Tri-shield or quad-shield RG6 or RG11 coaxial cable should be used and all connections should be made using 'F' connectors. Multiple outlets will require the use of an RF splitter or RF amplifier. The cable and equipment would normally need to operate within a bandwidth of 5 MHz to 860 MHz (some systems may support a bandwidth higher than 860 MHz). Cable and equipment specifications and NTU RF output levels should be provided by the network operator or the Service Provider.

Fly leads

7.4.15   All equipment interface sockets should be connected to the fixed cabling via compliance-labelled fly leads. It is best practice to connect factory manufactured fly leads to sockets on customer equipment, especially moveable customer equipment, and it may be technically illegal for the End User to connect or disconnect the equipment if it is not connected via a labelled fly lead (refer to the *Telecommunications (Types of Cabling Work) Declaration 1997*).

7.5   Existing service cabling

General

7.5.1   If the NTU is outdoor, new voice-grade cabling may need to be installed to supply a basic voice service to wall plates in the building or existing internal cabling may be able to be used, depending on the existing cabling arrangements and any agreement with the incumbent Carrier or Service Provider.

7.5.2   If the NTU is indoor, it will usually be possible to connect a basic voice service to any existing internal cabling via a fly lead from the basic voice interface of the NTU or RG and an existing wall plate as long as any existing telephone service can be isolated from the internal cabling on the customer side of the incumbent Carrier's or Carriage Service Provider's network boundary point.

7.5.3   For the data service, it will usually be necessary to install new Ethernet cabling whether the NTU is outdoor or indoor, as an existing ADSL service will generally use the same voice grade cabling as the telephone service up to the ADSL modem connection point.

7.5.4   While existing coaxial cabling used to provide pay TV, broadband cable, satellite services or MATV systems may be suitable for connection to the RF video interface of the NTU, the technical and legal issues are complex. For example, ownership issues aside, the existing cabling is invariably on the 'network' side of the network boundary (i.e. the wall plate) and does not need to be ACMA compliant. Cabling connected to the customer side of the NTU will be 'customer cabling' and needs to be ACMA compliant. Consequently, it may not be legal to migrate the existing non-compliant cabling to the NTU without specific changes to ACMA technical regulation.

7.5.5   The incumbent Carrier or Carriage Service Provider owns or operates the network facilities up to at least the network boundary point (and sometimes beyond it) and these facilities are protected from tampering or interference under the *Criminal Code 1995* (Cth) and by common law. Unless the use or alteration of these facilities is authorised by a relevant agreement, contract or other legal instrument, they must not be disturbed.

Network Boundary Point

7.5.6   The network boundary is explained in detail in Appendix J of AS/ACIF S009 on the network boundary. In the case of fibre to the premises, all services are supplied to the End User by means of a line that enters the End User's building, whether this line is the optical fibre lead-in cable or a metallic cable on the customer side of the NTU. To paraphrase section 22, sub-section (4), subparagraph (a) of the *Telecommunications Act 1997*:

(a)   Where a telecommunications network is used to supply a carriage service to an End User in a building by means of a line that enters the building, the network boundary point is the point agreed between the customer and the Carrier or Carriage Service Provider who operates the telecommunications network or, failing agreement, the network boundary point is:

(i)   if the line is connected to a main distribution frame (MDF) in the End User's building, the customer side of the MDF (Note 1); or

(ii)   if (i) does not apply but the line is connected to a network termination device (NTD) located in, on or within close proximity to the End User's building, the customer side of the NTD (Note 2); or

(iii)   if neither (i) nor (ii) applies but the line is connected to one or more sockets in the End User's building, the customer side of the first socket after the building entry point.

NOTE 1: An MDF is defined in AS/ACIF S009 as a device that cross-connects twisted pair cables, e.g. by means of

jumpers or patch cords. A Fibre Distribution Hub (FDH) is not an MDF.

NOTE 2:   An NTD is defined in the AS/ACIF S009 as a device provided by the Carrier or Carriage Service Provider that is permanently marked at manufacture with the words 'Network Termination Device' or the letters 'NTD'. Any device not so marked is not an NTD.

NOTE 3:   The first socket is defined in the Wiring Rules as a TO within a customer's building that terminates a carrier's lead-in cabling, i.e. there is no intermediate MDF or NTD. A TO is defined as a fixed connecting device to which an End User may connect Customer Equipment to telecommunications cabling. Any socket that is not intended to be used by the End User to connect terminal equipment (such as a telephone or modem) is not the first socket whether or not it is inside the building.

7.5.7   For the vast majority of Australian houses (including town houses and terrace houses), the network boundary point is the first TO. A very small proportion of these (less than 5 percent) may have an external NTD or MDF while an even smaller percentage (less than 1 percent) may have an internal MDF.

7.5.8   Conversely, the majority of residential flats, small business offices, multi-storey residential apartments and medium to large businesses have an MDF. Nevertheless, a significant percentage of small businesses only have one or two lines connected directly to TOs (no MDF or NTD).

Greenfield installations

7.5.9   For Greenfield deployment, ideally the home or small business should be cabled in accordance with Standards Australia Handbook HB 252. However, there is currently no mandatory requirement for developers, builders or building owners to provide any internal telecommunications cabling at all, so it is unlikely that anything other than basic internal cabling will be provided in most new homes.

Brownfield installations

7.5.10   Where an existing telephone or ADSL service is active, it must remain operational unless there is an appropriate agreement, authorisation, contract or regulation in force to disconnect or alter it.

7.5.11   Existing facilities up to the network boundary point must not be moved, removed or altered without the prior written authorisation of the Carrier or Carriage Service Provider that owns or operates those facilities — even if there is no active service on those facilities. Where the network boundary point is the first socket, separate cabling can be provided from the NTU to an NBN first socket installed adjacent to the existing first socket and any

existing customer cabling for additional telephone sockets may be cut over from the existing first socket to the NBN first socket.

7.5.12   Where a carrier's NTD is present, the outdoor or indoor NTU can be installed near the NTD and the 'customer' side wiring may be cut over to the NBN service as long as the operation of any existing, active telephone or ADSL service is maintained to the relevant socket(s) inside the building.

7.6   Migrating a legacy telephony service to a NBN-based Telephony Port

7.6.1   Clear identification of the existing network boundary point(s) must be established prior to the commencement of any cabling works or alterations.

NOTE: There may be more than one network boundary point. For example, if there are two telephone services in the building and they are not connected via an MDF or NTD, each service will normally have its own first socket — even if those services are supplied to the building via the same cable. Refer to Appendix J of AS/ACIF S009 on the *network boundary* and to *Telstra Specification 012882*.

7.6.2   The information provided hereunder applies where the existing network boundary point is the first socket (the first TO).

Precautions

7.6.3   The following precautions should be taken:

(a)   The incumbent Service Provider may require the telecommunications cabler to be authorised and/or seek approval to undertake cabling works at the network boundary point.

(b)   Certain restrictions may exist to the relocation and/or alteration of the existing TO and the network boundary point and the cabler should seek advice from the existing Service Provider where required.

(c)   The existing Service Provider may have Service Level Agreements (SLAs) and/or other legal obligations to maintain certain facilities within the EUP and it may prove to be unlawful to alter such facilities.

(d)   The existing Service Provider may have certain protective equipment such as lightning surge protection within the EUP and it may prove to be unlawful and unsafe to alter such facilities.

(e)   Visible separation must be maintained between the existing Service Provider's network and the NBN/telephony network up to their respective network boundary points.

ADSL filters and splitters

7.6.4   Existing cabling may have an ADSL central filter installed in the fixed wiring. This filter may be installed on the external wall or somewhere inside the building. The filter may be installed on the carrier's or customer's side of the existing network boundary, depending on the circumstances. In some cases, the filter will be concealed in a building cavity. Such filters should be removed from any existing cabling that is to be used for connection of a basic voice service from an NTU or RG, as it may degrade service performance.

NOTE: Refer to *Telstra Specification 012882* for guidance about the use and location of ADSL filters and splitters.

External wall boxes

7.6.5   External wall boxes are commonly used by incumbent carriers to joint the underground/aerial lead-in cable to the internal lead-in cable or to derive telephone services from an HFC network. Unless they are permanently marked at manufacture as an NTD, these boxes form part of the carrier's network and must not be disturbed without the authorisation of the relevant carrier.

Daisy chain (Bus) wiring configuration

7.6.6   The cable from the incumbent Service Provider network enters the building via the Building Entry Point (BEP) and is usually continuous and unbroken from the BEP to the first TO. Cable(s) leave the first TO and carry telephony to subsequent Secondary TOs within the customer premises. See Figure 10.
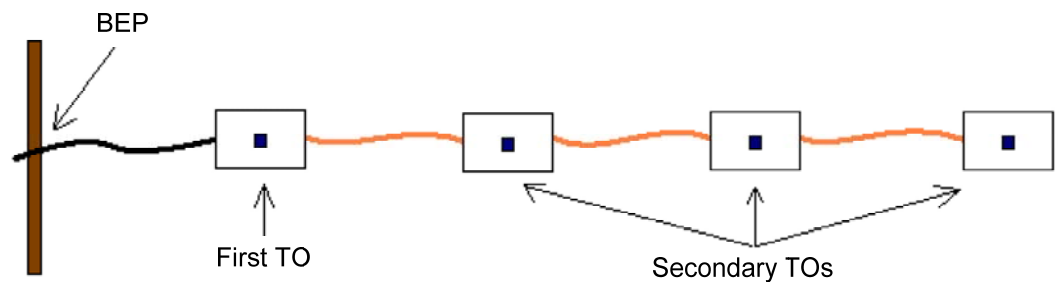
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FIGURE 10

Daisy chain (Bus) wiring configuration

7.6.7   Where it has been established that the first TO is the existing Service Provider's network boundary point.

(a)   A voice grade or, preferably, a Category 5 or Category 6 cable should be run from the location of the NTU/RG

Telephony Port to the location of the existing Service Provider's first TO. See Figure 11.

(b)   A new NBN/Telephony TO should be installed on this newly installed cable in close proximity to the existing Service Provider's first TO.

(c)   Any existing cabling leaving the existing Service Provider's first TO servicing additional TOs within the customer premises can be migrated over to the new NBN/Telephony TO.

BEP

First Incumbent Carrier TO

Secondary TOs

NBN POTS Port   First NBN POTS TO
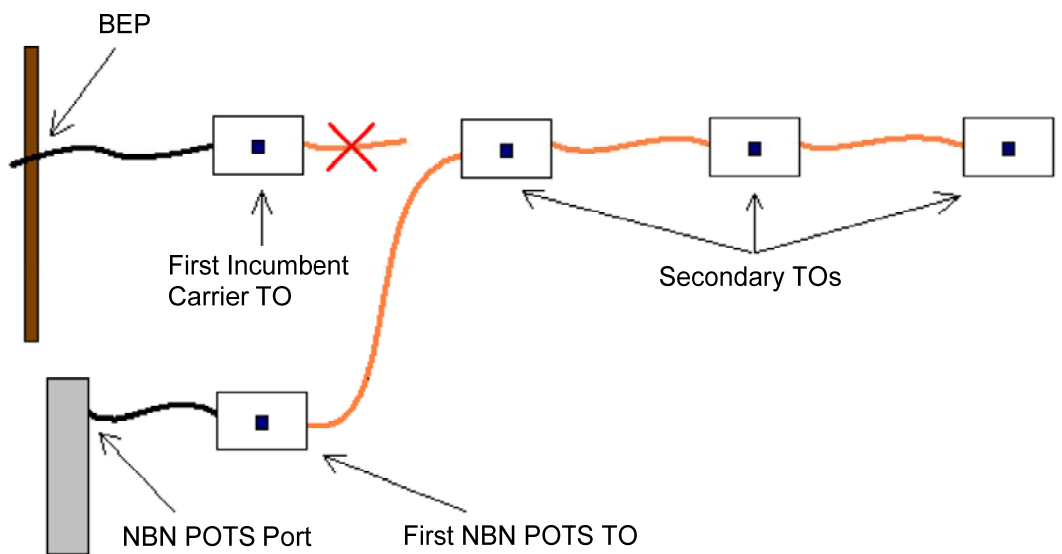
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FIGURE 11
Installation – First standard TO - Daisy chain (Bus) configuration

7.6.8   It is recommended that the existing Service Provider's first TO be clearly labelled with the existing Service Provider's identification to distinguish it from the new first TO connected to the NTU. It is also recommended that where possible this practice be carried out by the NBN Installer for the new first TO.

Star wire configuration

7.6.9   Cables may radiate out from a termination point in a star configuration. The termination point could be the existing Service Provider's external wall box, lightning protector block or NTD, an internal terminal block or cable joint, or a customer MDF. See Figure 12.

BEP

TOs
(Undefined first TO)

Termination
Point
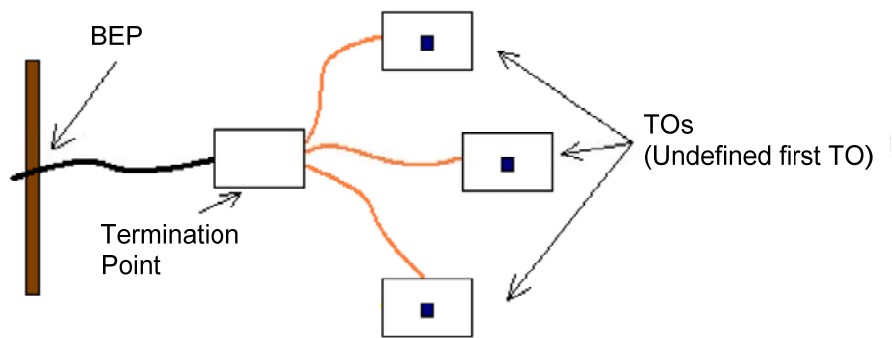
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FIGURE 12

Typical star wire configuration (Internal star wiring point shown)

Installation – Star wire configuration from an NTD/MDF

7.6.10   Where it has been established that the EUP cabling has been installed in a star wire configuration from the existing Service Provider's NTD or a customer MDF, the customer side of the NTD or MDF may be assumed to be the network boundary point in either case.

(a)   A voice grade or, preferably, a Category 5 or Category 6 cable should be run from the new NTU telephony port to the customer side of the existing NTD or MDF.

(b)   If there is an active telephone and/or ADSL service connected to the star wiring, connection of the service(s) should be maintained to internal socket(s) of the customer's choosing. The remaining star wiring may be cut over to the cable from the telephone port of the NTU using discrete connectors (in the case of an NTD) or jumpers (in the case of an MDF)

Installation – Star wire configuration from an external wall box, lightning protector block, internal terminal block or cable joint

7.6.11   Where it has been established that the EUP cabling has been installed in a star wire configuration from the incumbent carrier's wall box, lightning protector block, terminal block or cable joint, the existing cabling up to the first TO that terminates each leg of the cabling is on the carrier's side of the network boundary point and must not be moved, removed or altered without the prior written authorisation of the Carrier or Carriage Service Provider that owns or operates those facilities — even if there is no active service on those facilities. If the incumbent Carrier is Telstra, Telstra authorises limited changes to be made to the existing cabling under certain terms and conditions in *Telstra Specification 012882*.

If the incumbent Carrier is not Telstra, then that carrier needs to be contacted.

Installation – where a monitored service exists

7.6.12 A monitored service can be defined as equipment installed in an EUP for the purpose of security monitoring, medical monitoring and the like. The monitoring of such services can be undertaken by the contacting of a back-to-base monitoring station and/or the contacting of one or more specific contact numbers in the event of an alert.

7.6.13 A monitored service can be installed by one of two methods:

(a) *Dedicated Line* – A service whereby a specific dedicated telephony line is installed and permanently connected to the monitoring equipment. This type of telephony line service does not offer the ability to connect other telecommunications apparatus and may not carry normal dial tone conditions and as such may not be possible to be serviced by an NBN telephony service.

(b) *Mode Configured Line* – A service whereby a standard telephony line is configured, by the use of a mode socket to deliver priority to the monitored service over the basic telephony service in the event of an alert. This type of telephony line service would be supported by an NBN/telephony service, subject to the correct installation techniques being employed.

7.6.14 In order for a monitored service to seize dial tone priority on a mode configured line a mode socket is installed as the first TO within the customer premises. See Figure 13. The mode socket receives the incoming dial tone and passes it through to the monitoring equipment, where in an un-triggered state the monitoring equipment passes the dial tone back to the mode socket and then onto the standard TOs.

7.6.15 When the monitoring equipment is triggered via means of switches within the equipment the dial tone is seized by the equipment and restricted from all other TOs.

7.6.16 Clarification may be required from the existing Service Provider as to whether the existing Mode socket is classified as their network boundary point as this may differ between Service Providers.

7.6.17 Where an existing Service Provider recognises the Mode socket as the network boundary point, then the migration to an NBN/telephony service would be carried out as follows.

(a) A voice grade or preferably a Category 5 or Category 6 cable should be run from the location of the new NTU telephony port to the location of the existing Service Provider's first TO (Mode Socket).

(b)   A new NBN/telephony TO (Mode Socket) should be installed on this newly installed cable in close proximity to the existing Service Provider's first TO (Mode Socket).

(c)   Any existing cabling leaving the existing Service Provider's first TO (Mode Socket) servicing additional TOs within the customer premises may be migrated over to the new NBN/Telephony TO (Mode Socket).

(d)   Upon the completion of the installation, the connection between the existing Service Provider's TO (Mode Socket) and the monitoring equipment would be removed and re-connected to the NBN telephony TO (Mode Socket).

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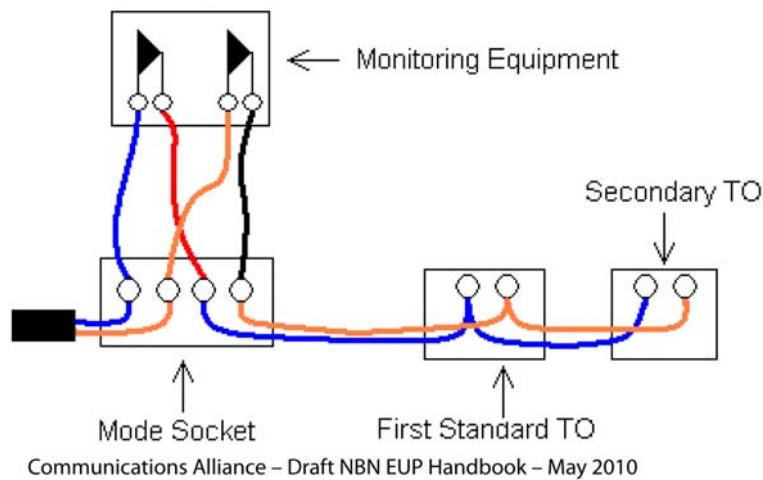
FIGURE 13
Monitored service wiring

7.6.18   Where an existing Service Provider does not recognise the Mode socket as a standard TO then the migration to an NBN/telephony service would be carried out similarly to that previously described but will include the duplication of the Mode socket, the standard TO and all associated cabling between.

Precautions

7.6.19   Prior to any migration, relocation and/or alteration of the existing Mode socket the NBN/telephony installer should ensure the following:

(a)   The monitored service is of a type that is compatible with the new NBN/telephony service.

(b)   The monitoring company is advised prior to and following any migration, relocation and/or alteration works.

(c)   Upon the completion of works, the monitored service is tested and restored to its original conditions prior to the works commencement.

(d)   Where the existing telephone number is not ported across to the new NBN/telephony service, the customer and/or monitoring company is advised of any number change.

(e)   The End User is made aware of the need for and/or regular maintenance of battery backup for the NTU if the monitored service also has battery backup or the monitored service is required to work under power fail conditions.

7.7   Migrating a legacy data service to an NBN-based data port

7.7.1   The existing data service may be distributed around an EUP by wired Ethernet or wireless and the NBN Installer will need to identify which method is employed and supply the NBN data services accordingly were required.

Where no existing data cabling exists - Ethernet solution

7.7.2   Where no existing data cabling exists the installer may be required to install one or more dedicated data outlets at suitable locations around the EUP, subject to the NBN Provider's services and/or Retail Service Provider(s) requirements.

7.7.3   The data service would require a minimum of Category 5 cabling and would be run from the location of the NBN NTU or an indoor patch panel to a point or points suitable for the service(s) delivery.

7.7.4   The data outlet(s) must be installed as per the appropriate standard and must be wired in accordance with the T568A pair assignments for 4-pair cabling.

7.7.5   Prior to the finalising and commissioning of the installation the installer should conduct cable testing to confirm continuity and wire mapping as a minimum.

Where no existing data cabling exists - Wireless solution

7.7.6   Subject to the location of the NBN NTU and to the requirements of the NBN Provider's services and/or Retail Service Provider(s) requirements it may be possible to install a wireless gateway within close proximity to the NBN NTU.

7.7.7   Where this option is practicable the NBN Installer would either connect a pre-terminated fly lead between the NBN NTU and the wireless gateway or would install a cable between the NTU and a suitable wall plate for connection of the gateway via a fly lead.

NOTE: The wireless gateway should be installed in a location that is accessible for future maintenance purposes and not installed in restricted access locations such as, for example, roof spaces.

Where data services cables and/or wireless already exist

7.7.8   Where data services already exist at the EUP and it is the intention that these services be migrated across to NBN-based data port(s), the NBN Installer will need to identify the type of delivery infrastructure employed at the EUP.

Ethernet solution

7.7.9   Where an existing Ethernet solution exists the NBN Installer will need to establish the following:

(a)   The number of existing, serviceable data outlets around the EUP.

(b)   The distribution method employed to facilitate the services to the data outlets.

(c)   The point of interconnect for the existing data services.

(d)   The suitability of the existing legacy data cabling.

7.7.10   If the existing data services are distributed around the EUP via means of, for example, a patch panel, hub, router or switch, the installer should establish the location and suitability of this distributor and if found appropriate, can supply and install a cable between the NBN NTU and the location of this distributor.

7.7.11   The cable to be installed must be a Category 5 cable as a minimum requirement. Termination of this cable at each end will be dictated by the NBN NTU and the distributor types but will either be terminated on Insulation Displacement Connectors (IDCs) or an 8P8C connector, which should be wired in accordance with the T568A pair assignments for 4-pair cabling. (refer to Appendix C of AS/ACIF S009 on TOs)

NOTE: ADSL data services are generally distributed around the EUP by means of telephony grade 4-wire cables and generally employ the use of either centralised or distributed ADSL filters. This infrastructure in general would not be suitable for the delivery of PON data services and new Ethernet cabling would need to be installed. If the existing cabling is to be reused for distribution of the NBN telephony service, the filters should be removed as they would become redundant.

Wireless solution

7.7.12   Where a wireless solution exists the NBN Installer will need to establish the following:

(a)   The owner of the wireless device.

(b)   The suitability of the wireless device.

7.7.13   Where the wireless device is supplied, installed and owned by the legacy Services Provider it may not be possible for the equipment

to be migrated to facilitate the delivery of the new NBN data services and therefore the NBN Installer may be required to supply and install a suitable replacement.

7.7.14   Where the wireless device is found to be unsuitable for the delivery of the new NBN data services the NBN Installer may be required to supply and install a suitable replacement to facilitate the delivery of the new NBN data services.

7.7.15   Where the existing wireless device is found to be suitable and able to be migrated to support the delivery of the new NBN data services, the NBN Installer may be required to relocate the wireless device to within close proximity to the NBN NTU and would either connect a pre-terminated fly lead between the NBN NTU and the wireless device or would otherwise need to install an Ethernet cable between the NTU and the wireless device.

7.8   Migrating a legacy RF service to a NBN-based RF port

7.8.1   Some NBN Infrastructure Owner(s) and/or Retail Service Provider(s) supply RF Services over the NBN infrastructure using a RF overlay solution, such services can include but are not limited to FTA TV Services, FTA Satellite Services and Pay TV SATV Services such as Foxtel/AUSTAR/Select TV.

7.8.2   Generally these types of services are delivered to Greenfield developments and generally involve the employment of a local FAN where FTA MATV Antennae, FTA satellite(s) and Pay TV satellite(s) collect the incoming signals for delivery via the NBN infrastructure.

7.8.3   At the EUP, these RF signals are distributed around the premises via high grade coaxial cabling either tri- or quad-shield RG6 or RG11 cables. In these situations all installed RF outlets have the potential to deliver one or more of the supplied services.

7.8.4   The NBN Installer would be required to install such infrastructure by following the various Industry Standards and Codes of Practice as a minimum but may also be required to install infrastructure to specific requirements set out by the NBN Infrastructure Owner and/or Retail Service Provider(s).

7.8.5   In Brownfield situations RF services are generally delivered via separate solutions:

(a)   FTA TV supplied by either a dedicated FTA antenna (SDU) or a MATV solution (MDU).

(b)   FTA satellite supplied by either a dedicated FTA satellite dish (SDU) or a FTA satellite dish combined with a MATV solution (MDU).

(c)   Pay TV delivered by either a dedicated satellite dish or dedicated cable.

NOTE 1: Products do exist and the NBN Installer may encounter solutions whereby one or more RF service(s) is/are delivered around the EUP from centrally located distribution equipment.

NOTE 2: Currently, Pay TV either delivered by cable or satellite infrastructure is stand alone and is provided by the Pay TV Service Provider, this infrastructure remains the property of the Pay TV Service Provider, inclusive of all cabling and outlets up to and including the Set Top Box and as such is not available for migration to an NBN-based RF Service.

Where no existing RF distribution equipment exists

7.8.6   Where no existing RF distribution equipment exists the NBN Installer may be required to install one or more dedicated RF outlets at suitable locations around the EUP, subject to the NBN Provider's Services and/or Retail Service Provider(s) requirements.

7.8.7   The RF Service(s) would require a minimum of tri-shield RG6 cabling and would be run from the location of the NBN NTU to a point or points suitable for the service(s) delivery.

7.8.8   The RF outlet(s) must be installed as per the appropriate standard and should be terminated using high grade 'F' Type connectors.

7.8.9   Subject to the design of the NBN NTU, and the required number of RF outlets, the RF cabling may be terminated with high grade 'F' Type connectors or similar and connected directly to the NBN NTU or via a suitable and approved RF splitter or amplifier which is then connected to the NBN NTU.

7.8.10   Prior to the finalising and commissioning of the installation the NBN Installer should conduct cable testing to confirm continuity as a minimum.

Where RF distribution equipment already exists

7.8.11   Where RF Distribution Equipment already exist at the EUP and it is the intention that this infrastructure can be migrated across to PON-based RF port(s) and/or new and additional services added, the NBN Installer will need to identify the type of delivery infrastructure employed at the EUP.

7.8.12   Where existing distribution equipment and cable solution exists the NBN Installer will need to establish the following:

(a)   The number of existing, serviceable RF outlets around the EUP.

(b)   The distribution method employed to facilitate the services to the RF outlets.

(c)   The point of interconnect for the existing RF services.

(d)   The existence and type of RF combiner employed.

(e)   The suitability of the existing legacy RF distribution equipment and cabling.

7.8.13   The NBN Installer must establish that the distribution equipment is of a suitable quality and approved for the delivery of the new and/or additional PON-based RF services to be added. Where the distribution equipment is found to be unsuitable the NBN Installer may be required to replace the distribution equipment or install the PON-based RF services independent of the existing infrastructure.

7.8.14   The existing cable must be a tri-shield RG6 cable as a minimum requirement. Where the cable is found to be unsuitable the NBN Installer may be required to replace cable or install the NBN-based RF services independent of the existing infrastructure.

7.8.15   Where all existing components and infrastructure are found to be serviceable and meet all required Standards the NBN Installer may supply and install a new RF cable between the NBN NTU and the location of the existing distribution equipment.

7.8.16   The RF service(s) would require a minimum of tri-shield RG6 cabling and the RF outlet(s) must be installed as per the appropriate standard and should be terminated using high grade 'F' Type connectors or similar.

7.8.17   Prior to the finalising and commissioning of the installation the NBN Installer should conduct cable testing to confirm continuity as a minimum.

NOTE: It is recognised that IPTV and some *pay per view* products may require variants to standard installation products for general RF services such as a fixed telephony service or data cabling and outlets in close proximity to RF outlets, however, these types of installations would all be governed by the applicable Standards.

7.9   Migrating Customer Equipment and cabling where an existing home networking solution exists

7.9.1   A number of proprietary home networking solutions exist on the market that offer a full range of facilities to the home/SOHO. Some solutions offer merely a passive cabling solution whilst others offer active solutions that supply full home automation options. Furthermore, tailor-made solutions may be encountered, whereby patch panels or other interconnecting options exist to deliver a range of services around the home.

7.9.2   The NBN Installer needs to be aware that these products exist, understand the cabling options and requirements and be aware of and take the appropriate precautions to ensure that any migration/alteration works are carried out under the appropriate licenses/registrations and do not interfere with the normal operations of these solutions.

7.9.3   It may be possible to install the NBN NTU in close proximity to the home networking solution which would add to the ease of service migration. However, this may not be possible and in these cases the appropriate cabling will need to be installed between the NBN NTU and home networking solutions.

        (a)   Fixed telephony services would require a minimum of 2-pair (4-Wire) cable typically used for fixed telephony.

        (b)   Data services would require a minimum of Class D (Category 5) cabling.

        (c)   RF services would require a minimum of RG6 tri-shield cable.

Fixed telephony

7.9.4   Where a fixed telephony service is supplied to a home networking solution, the existing fixed telephony cabling should be terminated via a suitable carrier interface (first TO, NTD or MDF) onto IDC terminals and/or a patch field within the home networking solution cabinet.

7.9.5   Where these services are to be migrated across to an NBN NTU, new fixed telephony cable may be required between the NTU and the home networking solution to replace the existing cabling between the carrier interface and the home networking box. The EUP cabling would then simply be connected or patched to the new NBN telephony service(s) in the usual manner.

Data cabling

7.9.6   If the existing home network wiring is found to be serviceable and meets the required standards, the simplest solution is to locate the RG at the home networking box and patch directly from the Ethernet port(s) of the RG to the relevant patch sockets on the patch panel to facilitate access to the NBN data service from the relevant TOs.

RF cabling

7.9.7   Identification would be required to ascertain the RF distribution method within the residence. Identification would be required as to what RF services are currently available to the residence and whether these services can be migrated.

7.9.8   If the existing infrastructure is found to be serviceable and meets the required standards, the existing infrastructure could then be migrated in a manner previously described to incorporate the new NBN RF services.

NOTE: Before migrating the services, the NBN installer should check whether intra-EUP broadcast channels are used (e.g. security cameras, DVD/Blue Ray player or set top box output distribution) to ensure that there is no overlap of NBN-based RF channels and internal broadcast ('RF modulator') channels.

7.10   Installer qualifications

7.10.1   Persons who intend to carry out installation, connection or maintenance of customer cabling (i.e. cabling on the customer's side of the network boundary point) are required to be registered with an ACMA-accredited registrar, as follows:

(a)   Restricted Registration may be sufficient if a distributor (such as a jumperable frame or a patch panel) is not installed in the EUP; or

(b)   Open Registration is required in all other cases.

7.10.2   In addition to Restricted or Open Registration, the cabler should hold the following registration endorsements (however, these are not mandatory):

(a)   Structured Cabling, e.g. Category 5/6/7 cabling (denoted by the letter 'S' on the registration card) (not applicable to Restricted Registration).

(b)   Coaxial Cabling (denoted by the letter 'C' on the registration card).

7.10.3   Persons required to carry out installation, connection or maintenance of lead-in cabling will require the qualifications and experience specified by the NBN Infrastructure Owner or operator, which should include:

(a)   Certificate III, or equivalent, in single mode optical fibre cabling;

(b)   Pole Top Rescue certificate;

(c)   Use of Ladders certificate, or equivalent;

(d)   Power awareness certificate;

(e)   awareness of the requirements of the *Telecommunications Code of Practice 1997*.

7.11   References

7.11.1   The following Standards, Codes and Specifications are referenced in this section:

(a)   ACIF C524 *External Telecommunication Cable Networks*

(b)   AS/ACIF S009 *Installation requirements for customer cabling (Wiring rules)*

(c)   IEC 60603-7 *Connectors for electronic equipment - Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

(d)   Standards Australia Handbook HB 252 *Residential communications cabling handbook*

(e)   AS/NZS 1367 *Coaxial cable and optical fibre systems for the RF distribution of analogue and digital television* and sound signals in single and multiple dwelling installations

(f)   Telstra Specification 012882 *Alteration of Telstra Facilities in Homes and Small Businesses – Information for Cabling Providers*

7.11.2   Registered cabling providers are required to issue the ACMA *Telecommunications Cabling Advice* (TCA1) or similar to their employer and/or the customer to confirm that all cabling work undertaken complies with the appropriate standards.

7.11.3   It is further recommended that cabling providers engaged in migrating legacy cabling to NBN services employ the ACMA *Telecommunications Cabling Advice* (TCA2) or similar to advise that some existing cabling may not comply with the appropriate standards.

7.11.4   Example copies of these forms can be located on the ACMA website at www.acma.gov.au.

8   NBN EUP TESTING AND DIAGNOSTICS

8.1   Background

8.1.1   The successful provision, commissioning, operation and maintenance of an optical fibre connection from EUP to an NBN network requires a defined testing and service diagnostic arrangement.

8.1.2   Specific testing arrangements are required for the optical fibre distribution network, for its construction and commissioning phases and also for the ongoing service and maintenance phases.

8.1.3   In addition further specific testing arrangements are required for the fixed EUP cabling, for newly installed cabling and for existing cabling prior to its connection to the Network Termination Unit (NTU).

8.1.4   Figure 3 sets out in schematic form, a typical layout of the fibre distribution network and the customer cabling in the EUP.

8.2   Optical fibre distribution network testing

8.2.1   For the purpose of this document the optical fibre distribution network is considered to comprise the network elements, the Fibre Distribution Hub (FDH) providing the interface to the main network cable or network head works, intermediate optical splitters and termination boxes, pillars or pits, the Property Connection Point, optional fibre junction and the NTU.

8.2.2   This communications infrastructure may be installed by one or more installers at the same or different times and each part as well as the whole must be tested to ensure its optical performance complies with the allocated portion of the overall optical budget.

8.2.3   Optical test equipment supporting all wavelengths used by the NTU and OLT may be used to determine the optical loss between the FDH and the optical connector or optical fibre cable end which is to terminate at the NTU.

8.2.4   The loss between the FDH optical splitter outputs, any intermediate optical splitter outputs and any intermediate connection points will be very small, as will the overall loss between the FDH optical splitter outputs and the point of connection to the NTU.

8.2.5   The precise maximum optical loss will be specified by the owner/operator of the optical fibre distribution network.

8.2.6   Alternatively, or as a supplementary measure, the network operator may use the optical line supervision capabilities of the system to measure and report the state of the optical link. This information, which may include (as a minimum) the OLT (Optical Line Terminal) transmit and receive power (per NTU), and NTU transmit and receive power, can be used to provide the 'historic' or reference data for a normally operating system. This capability can be used subsequently for degradation detection, i.e. for finding potential faults before they become service-affecting, and identifying the source of the problem (e.g. optical distribution network, OLT or NTU) and for fault management.

8.2.7   Upon commissioning of the End User access optical connection and its connection to the NTU, the network operator would conduct predetermined end-to-end functional tests from their Network Management Centre to confirm the satisfactory functioning of the overall broadband transport service.

8.2.8   The results of this testing process may be recorded and be available as a point of reference in any necessary subsequent fault diagnosis.

8.3   EUP cabling testing

8.3.1   Fixed EUP customer cabling must be installed in accordance with the requirements of AS/ACIF S009 by a registered cabling provider ('cabler'). The AS/ACIF S009 Standard provides minimal requirements that may ensure the safety and integrity of a cabling installation and of the telecommunications network. The cabler is required by the registration conditions to provide the customer and, if applicable, their employer with a declaration of compliance ('Telecommunications Cabling Advice, TCA1') containing the information set out in the Cabling Provider Rules. This information may be presented in an approved form or as an

attachment to, or an entry on, an invoice or receipt that relates to the cabling work. Also see Section 7.10.

8.3.2   This cabling will typically comprise one or more of the following:

(a)   Ethernet cabling (e.g. Category 5/Category 6 copper twisted pair).

(b)   Voice grade telephone cabling (copper twisted pair).

(c)   Coaxial cabling (tri-shield or quad-shield RG6).

8.3.3   It is recommended that the above cabling should also meet with the relevant requirements of AS/NZS ISO/IEC 15018, AS/NZS 1367 and Handbook HB 252. However, these standards and the Handbook are voluntary and compliance with these Standards is not mandatory under current regulatory arrangements unless the Standards are included in the installation contract documents

8.3.4   To ensure the EUP cabling is electrically safe, the cabler must test the cabling in accordance with the above standards, particularly the electrical safety elements, as well as any network operator EUP fixed cabling requirements and provide the End User with a test report and/or a compliance certificate.

8.3.5   The network operator may require the End User to produce a mandatory compliance statement and/or a compliance certificate to the voluntary standards as a prerequisite for connection of the EUP fixed cabling to the NTU.

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 Points 13 and 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 six 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 European Union.

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 indoor and outdoor 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 Outdoor EUP components (e.g. lead-in, NTU, fibre junction boxes) should be made to standards that provide longevity in outdoor 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 Indoor EUP components, although not as susceptible as outdoor 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.

10.2.5   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 Section 10 on robustness, any outdoor or indoor EUP components should be secured from tampering or theft.

(a)   Outdoor 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)   Indoor components are not as vulnerable as outdoor 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. The Standards Australia AS/NZS 2211.2 Standard on optical fibre communication systems safety and the AS/NZS 2967 *Optical fibre communications cabling systems safety* Standard 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 NBN 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 telephony interface is to support IPv6.

(c)   IPv6 filter support if required for telephony 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 (SDP).

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 PROOFING

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 Handbook 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 Standards and Codes called up under legislation

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 and are referenced under the ACMA Telecommunications Labelling (Customer Equipment and Customer Cabling) Notice 2001(the TLN)* . These Standards 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 AS/CA S003 *Requirements for Customer Access Equipment for connection to a Telecommunications Network* Standard covers customer equipment designed with both local and network ports that provides access (gateway functions) to a telecommunications network. This Standard is applicable (via the TLN) to Customer Equipment designed to connect to the PSTN.

NOTE: In the future if requirements for optical fibre interfaces on customer equipment are required, this Standard may need to be revised.

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

Safety

14.2.4 The AS/NZS 60950.1 *Information technology equipment— Safety* Standard specifies the safety requirements intended to reduce risks of fire, electric shock or injury for information technology equipment including telecommunications terminal equipment (customer equipment). The Standard is applicable to all customer equipment listed in the TLN.

14.2.5 For optical fibre safety, the AS/NZS 2211 Standard provides requirements and specific guidance for the safe operation and maintenance of optical fibre communication products and systems.

14.2.6 The new AS/NZS 2967 *Optical fibre communication cabling systems safety* Standard provides safety rules for optical fibre communication systems and associated materials and equipment, covering; handling, use and disposal of optical fibre materials and associated chemicals, the use of laser light sources for testing, and the use, installation and operation of an optical fibre cabling system.

Electromagnetic Compatibility (EMC)

14.2.7 The EMC regulatory arrangements, administered by the *Australian Communications and Media Authority* (ACMA), introduce technical limits for emissions from electrical/electronic products and communications services. The AS/NZS CISPR 22 *Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement* Standard applies to information technology equipment, modems, fax machines and broadband over powerline modems. Further informational EMC legislation and related standards can be found at http://www.acma.gov.au/WEB/STANDARD/1001/pc=PC_310704.

Minimum Energy Performance Standards

14.2.8 The AS/NZS 4665 *Performance of external power supplies* Standard covers no-load and on-load power consumption efficiency targets for external power supplies which may be used for NTUs, RGs or End User devices connected to the NBN. It is noted that it does not mandate any efficiency targets for the devices themselves, for integrated power supplies or power supplies with a battery charger function. Further information on MEPS can be found at http://www.energyrating.gov.au/meps1.html.

Cabling Standards and cabling work

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

14.2.10   The AS/ACIF S009 *Installation requirements for customer cabling (Wiring rules)* Standard 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.

14.2.11   installation and repair of customer cabling is subject to the *Telecommunications Cabling Provider Rules 2000* which require customer cabling work to be performed or supervised by a person with the appropriate cabling provider registration and to be installed in accordance with AS/ACIF S009. This requirement is determined by legislation and subordinate regulatory instruments administered by the ACMA. The *Telecommunications Cabling Provider Rules 2000* requires that a *Telecommunications Cabling Advice Form* be completed after each cabling job. Cablers have to certify that the cabling work complies with the AS/ACIF S009.

Industry Codes

14.2.12   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 ACIF C559 *ULLS Network Deployment Rules* 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 Industry Standards, Codes and Guidelines

Communications Cabling Manual

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 AS/NZS ISO/IEC 15018 *Information technology – Generic cabling for homes* Standard applies to the design, configuration and performance of generic cabling and connecting hardware within EUP.

14.3.3   The Australia Standard AS/NZS IEC 61935.1 included in the *Communications Cabling Manual Package* provides test methods to ensure the performance of balanced communications cabling. The Standard is identical to IEC Standard (IEC 61935-1 Edition 2). A new version of the IEC Standard has been published (IEC 61935-1 Edition 3) which has not yet been adopted as an Australian Standard.

Lightning protection

14.3.4   The ITU-T K Series Recommendations cover the need for lightning protection in devices which connect to external wiring (e.g. telephone cabling) and are at risk of lightning strike. They cover central office equipment, equipment in external enclosures and indoor or outdoor customer equipment.

Codes and Guidelines

14.3.5   The ACIF C524 *External Communication Cable Networks* Code 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.

14.3.6   The ACIF G571 *Building Access Operations and Installation Guideline* 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
Communications Alliance Standards	
AS/CA S003:2010	Requirements for Customer Access Equipment for connection to a Telecommunications Network
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 Industry Code
ACIF C559:2006	ULLS Performance Requirements Industry Code
ACIF G571:2002	Building Access Operations and Installation Industry Guideline
Communications Alliance NBN Publications	
Available from www.commsalliance.com.au/Documents/national-broadband-network	
National Broadband Network Reference Architecture – High Level Architecture Options for the NBN (Release 1)	
National Broadband Network Wholesale Service Definition Framework – Ethernet (Release 1)	
National Broadband Network – Overview of Technical Standards (Release 1)	
National Broadband Network – Planning Express Conduit (Release 1)	
National Broadband Network – Fibre Ready Distribution Networks (Release 1)	
National Broadband Network – Optical Access (Release 1)	
National Broadband Network – Wholesale Service Description Framework – Telephony Access Service (Release 1)	
Draft National Broadband Network – End User Migration Reference Model	
Draft National Broadband Network – B2B Interaction Process Requirements Specification	

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 CISPR 22:2009	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
AS/NZS 1367:2007	Coaxial cable and optical fibre systems for the RF distribution of analog and digital television and sound signals in single and multiple dwelling installations

AS/NZS 2211.1:2004	Safety of laser products - Equipment classification, requirements and users guide (IEC 60825-1:2001, MOD)
AS/NZS 2211.2:2006	Safety of laser products - Safety of optical fibre communication systems (OFCS)
AS/NZS 2967:2010	Optical fibre communication cabling systems safety
AS/NZS 3000:2007	Electrical installations (known as the Australian/New Zealand Wiring Rules)
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
AS 4755-2007	Framework for demand response capabilities and supporting technologies for electrical products
AS/NZS 60950.1:2003	Information technology equipment - Safety - General requirements

IEC Standards

IEC 60603-7:2008	Connectors for electronic equipment - Part 7: Detail specification for 8-way, unshielded, free and fixed connectors

ITU-T Recommendations

G.652 (11/2009)	Characteristics of a single-mode optical fibre and cable
G.657 (11/2009)	Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network
G.987.1 (1/2010)	10-Gigabit-capable passive optical network (XG-PON) systems: General Requirements
G.9954 (01/2007)	Home networking transceivers - Enhanced physical, media access, and link layer specifications
G.9960 (10/2009) (to be published)	Next generation home networking transceivers
G.9970 (01/2009)	Generic home network transport architecture
Y.1731 (02/2008)	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
802.11n-2009	IEEE Standard for Information Technology - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment : Enhancements for Higher Throughput
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
802.15.4-2003	IEEE Standard for Information Technology - Part 15.4: Wireless MAC and PHY specifications for Low Rate Wireless Personal Area Networks (LR-WPANS)
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	Using GPON Access in the context of TR-101 (December 2008)

Australian Building Codes Board (ABCB)	
BCA 2009	Building Code of Australia 2009

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

The info pack includes the following documents:

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

AUSTAR

Available from http://www.austar.com.au/support/buildersanddevelopers.asp

AUSTAR Multi Dwelling Unit Technical Specification. Version 6. 23 September 2008

Performance Requirements for AUSTAR ClearSky Networks. Version 1.0. 27 February 2009

 COPPER DEVELOPMENT CENTRE

Available from http://www.smartwiredhouse.com.au/trade

Code of Practice for Home Wiring - Residential Systems Including Energy Management

Consumer Cabling Handbook for Residential Wiring - Planning the cabling for Residential Technology Services

Installer Cabling Handbook for Residential Wiring - Planning & installing cabling for Residential Technology Services

Legislation and regulatory instruments/forms
Telecommunications Act 1997
Criminal Code 1995
ACMA Telecommunications Labelling (Customer Equipment and Customer Cabling) Notice 2001 (*the TLN*)
ACMA Telecommunications Cabling Provider Rules 2000 (CPRs)
ACMA Telecommunications (Types of Cabling Work) Declaration 1997
ACMA Telecommunications Cabling Advice form TCA1
ACMA Telecommunications Cabling Advice form TCA2

NOTES

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.