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INDUSTRY GUIDELINE

G646:2012

NATIONAL BROADBAND NETWORK

WHOLESALE SERVICE DEFINITION FRAMEWORK – TELEPHONY ACCESS SERVICE

National Broadband Network Wholesale Service Definition Framework – Telephony Access Service

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1 INTRODUCTION

1.1 General

1.1.1 The development of this Guideline has been facilitated by Communications Alliance through a Working Committee comprised of representatives from the telecommunications industry.

1.1.2 The Guideline should be read in the context of other relevant codes, guidelines and documents.

1.1.3 The Guideline should be read in conjunction with related legislation, including:

(a) the Act;

(b) the *Telecommunications (Consumer Protection and Service Standards) Act 1999 (Cth)*;

(c) the *Competition and Consumer Act 2010 (Cth);*

(d) the *Privacy Act 1988 (Cth);*

(e) the *Spam Act 2003 (Cth);*

1.1.4 If there is a conflict between the requirements of the Guideline and any requirements imposed on a Service Provider by statute, the Service Provider will not be in breach of the Guideline by complying with the requirements of the statute.

1.1.5 Compliance with this Guideline does not guarantee compliance with any legislation. The Guideline is not a substitute for legal advice.

1.1.6 Statements in boxed text are a guide to interpretation only and not binding as Guideline rules.

1.1.7 This document builds on the work of the Wholesale Services working group of the Communications Alliance National Broadband Network (NBN) Project.

1.1.8 Some areas of this service definition template will need to be populated by the TSP with values for the service attributes in accordance with the network design and service characteristics.

1.2 Scope

1.2.1 This document provides:

(a) a framework for the definition of a Wholesale Telephony Access Service that may be available on the NBN and potentially by other Wholesale Telephony Access Service Providers.

(b) a description of the key capabilities to be specified in the Wholesale Telephony Access Service.

1.2.2 This document does not address:

(a) end-to-end characteristics of a telephony service.

(b) regulatory aspects for a telephony service such as emergency calling, lawful interception, preselection, number portability.

(c) interconnection arrangements.

(d) the routing of calls.

(e) all potential service types that could be delivered through the Reference Architecture and which may potentially be defined in future versions of this work.

NOTES:

1. There are a number of possible wholesale services that could be utilised for the delivery of a telephony application. The options presented in this Guideline do not preclude other methods for the delivery of telephony.

2. The Communications Alliance NBN Project produced Release 1 of the Wholesale Service Definition Framework – Ethernet paper. The framework in this paper could be utilised to deliver a telephony application that relies on a Layer 2 Ethernet wholesale carriage service for transport.

3. The Wholesale Telephony Access Service leverages the Ethernet framework and couples it with an Analogue Terminal Adaptor (ATA) deployed at the end user premises.

4. This Guideline will form the foundation block for further work around the provision of telephony (i.e. voice and related services such as fax, modem, etc.).

1.3 Guideline review

The Guideline will be reviewed after 5 years of the Guideline being published and every 5 years subsequently, or earlier in the event of significant developments that affect the Guideline or a chapter within the Guideline.

2 ABBREVIATIONS, DEFINITIONS AND INTERPRETATIONS

2.1 Acronyms

For the purposes of the Guideline:

3GPP

means 3rd Generation Partnership Program

ACMA

means the Australian Communications and Media Authority.

AMR

means Adaptive Multi-Rate

AMR-NB

means Adaptive Multi-Rate Narrowband

AMR-WB

means Adaptive Multi-Rate Wideband

ASP

means Application Service Provider

ATA

means Analogue Terminal Adaptor

BBF

means Broadband Forum

BNG

means Broadband Network Gateway

BR

means Border Router

CA

means Communications Alliance

CBS

means Committed Burst Size

CE

means Customer Equipment

CIR

means Committed Information Rate

CLIP

means Calling Line Identification Presentation

CLIR

means Calling Line Identification Restriction

CoS

means Class of Service

CSP

means Carriage Service Provider.

C TAG

means Customer VLAN Tag

DECT

means Digital Enhanced Cordless Telecommunications

DHCP

means Dynamic Host Configuration Protocol

DHCPv6

means Dynamic Host Configuration Protocol for IPv6

DTMF

means Dual-tone multi-frequency

DTX

means Discontinuous Transmission

EAS

means Ethernet Access Switch

EFTPOS

means Electronic Funds Transfer at Point of Sale

EUP

means End User Premises

FTTP

means Fibre To The Premises

IAD

means Integrated Access Device

ID

means Identity

IEEE

means Institute of Electrical and Electronic Engineers

IETF

means Internet Engineering Task Force

IMS

means IP Multimedia Subsystem

IP

means Internet Protocol

IPv4

means Internet Protocol version 4

IPv6

means Internet Protocol version 6

ISDN

means Integrated Service Digital Network

L2

means Layer 2

L2TP

means Layer 2 Tunnelling Protocol

L3

means Layer 3

LAC

means L2TP Access Concentrator

LNS

means L2TP Network Server

MAC

means Media Access Control

MEF

means Metro Ethernet Forum

MEGACO

means Media Gateway Control Protocol

MMTel

means Multimedia Telephony

NBN

means National Broadband Network

NNI

means Network to Network Interface

NSP

means Network Service Provider

NTU

means Network Termination Unit

OAM

means Operations Administration and Maintenance

ODF

means Optical Distribution Frame

OLT

means Optical Line Terminal

OMCI

means ONT Management Control Interface

ONT

means Optical Network Termination

POI

means Point of Interconnection

PON

means Passive Optical Network

POTS

means Plain Old Telephony Service

PSTN

means Public Switched Telephone Network

QoS

means Quality of Service

RFC

means (IETF) Request For Comments

RG

means Residential Gateway

RSP

means Retail Service Provider

RTCP-XR

means Real Time Control Protocol – Extended Reports

RTP

means Real Time Protocol

SBP

means Service Boundary Point

SIP

means Session Initiation Protocol

SIPPING

means Session Initiation Protocol Project INvestiGation

SLA

means Service Level Agreement

SMS

means Short Message Service

SNMP

means Simple Network Management Protocol

TISPAN

means Telecommunications and Internet converged Services and Protocols for Advanced Networking

TSP

means Telephony Service Provider

TTY

means Teletype

UNI

means User Network Interface

VAD

means Voice Activity Detection

VLAN

means Virtual Local Area Network

VPN

means Virtual Private Network

VRRP

means Virtual Router Redundancy Protocol

WTAS

means Wholesale Telephony Access Service

xDSL

means Digital Subscriber Line technologies (e.g. ADSL, VDSL, etc.)

2.2 Definitions

For the purposes of the Guideline:

Act

means the *Telecommunications Act 1997 (Cth)*.

Access Provider

has the meaning given by section 152AR of the *Competition and Consumer Act 2010 (Cth)*.

Access Seeker

has the meaning given by section 152AG of the *Competition and Consumer Act 2010 (Cth)*.

Carriage Service Provider

has the meaning given by section 87 of the Act.

Carrier

has the meaning given by section 7 of the Act.

In Band DTMF

means a DTMF tone transported within the same audio stream as the voice.

National Relay Service

has the meaning given by Section 95 of the *Telecommunications (Consumer Protection and Service Standards) Act 1997*.

Out of Band DTMF

means a DTMF tone transported separately from the audio stream.

Retail Telephony Service

means a Telephony Service provided by a retail Telephony Service Provider.

> *NOTE: This may be provided by using a Wholesale Telephony Access Service, but may also be provided via other means.*

Service Provider

has the meaning given by section 86 of the Act.

Wholesale Telephony Access Service

means a wholesale service offered by an NBN provider that is a combination of an ATA function in the ONT, associated analogue ATA port(s), and logical connectivity to a Point of Interconnect.

> *NOTE: This does not address end to–end requirements. This is not limited to voice telephony e.g. it could be for fax, tones, etc.*

3 WHOLESALE BROADBAND SERVICES OVERVIEW

3.1 Communications Alliance NBN Reference Architecture

3.1.1 The Reference Model working group of the Communications Alliance NBN Project defined a reference model in the paper *National Broadband Network Reference Architecture – High Level Architecture Options for the NBN*. This reference model is used to put into context the wholesale services definitions within this document. Figure 1 illustrates the reference model for the use of Fibre To The Premises (FTTP) in the access domain. The paper has a similar but separate model for the use of terrestrial wireless and/or satellite technologies.

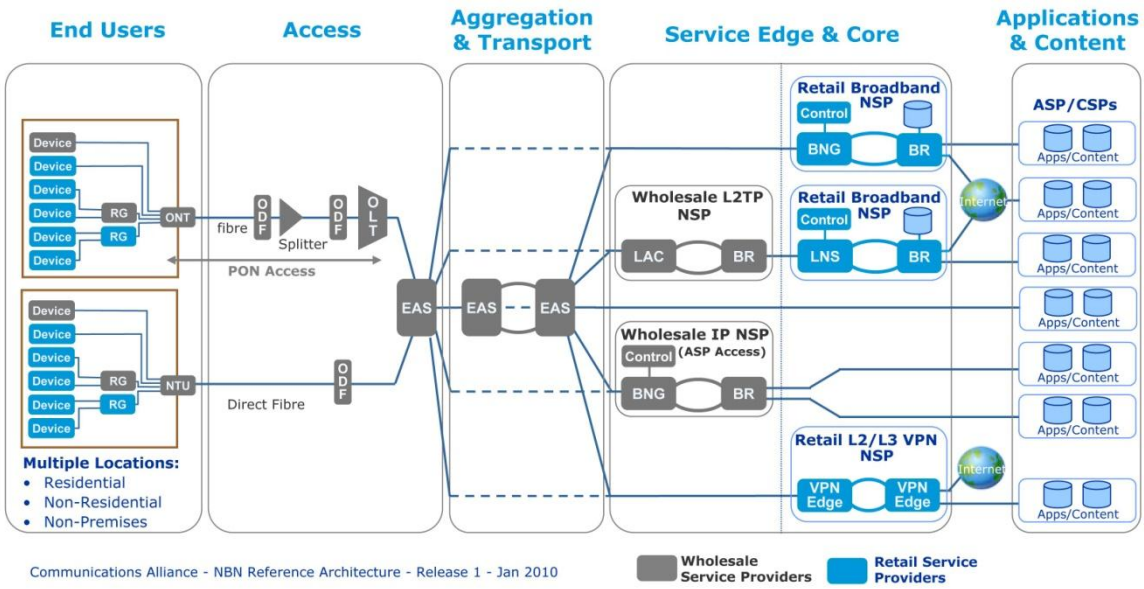


FIGURE 1

Broadband Network Reference Architecture - FTTP Access

3.1.2 It is intended that, as much as is possible, the reference architecture in Figure 1 will be applicable to the delivery of the wholesale telephony services, defined in this document, across all access technologies.

3.2 Service Boundary Points (SBPs)

3.2.1 The reference architecture describes a number of types of services. The services defined in this template relate to telephony wholesale services. The wholesale telephony access services are defined to operate between an analogous point to reference point 3 (e.g. an ATA port on an ONT) at the end-user location and a POI, reference point 3a or 3b as shown in Figure 2 (for FTTP access). The description of reference points 3, 3a and 3b is provided in the *National Broadband Network Reference Architecture – High Level Architecture Options for the NBN* paper.

3.2.2 It should be recognized that the SBP, reference point 3, at the end-user premise is located such that a Network Termination Unit (NTU) device exists that is considered a component of the Broadband Access Provider network.

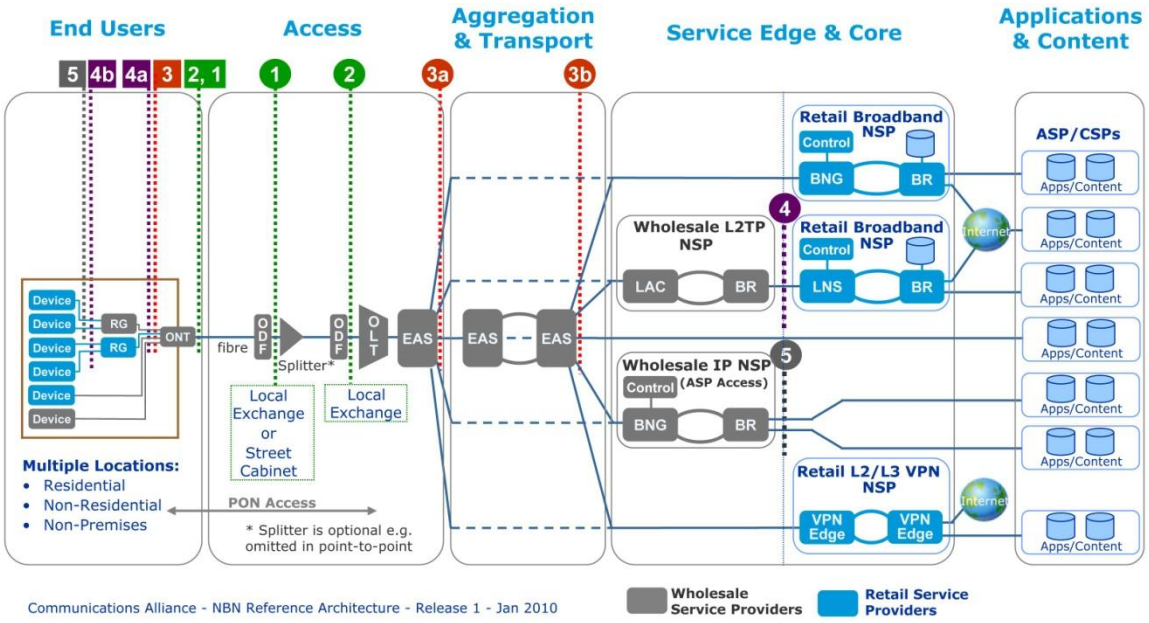


FIGURE 2

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

4 WHOLESALE TELEPHONY ACCESS SERVICE DEFINITION

4.1 Introduction

4.1.1 Service definition templates for the Wholesale Telephony Access Service (WTAS) are described in the following sections.

4.1.2 A Plain Old Telephone Service (POTS) is considered within this document to refer to "narrowband audio" as defined for codec types in ITU-T Y.2201 Clause 14.2.2.

NOTE: Codec types continue to be developed to support a wider range of audio fidelity levels classified as:

- *"narrowband audio" for audio range of 300Hz to 3400Hz;*
- *"wideband audio" for audio range of 50 Hz to 7000 Hz;*
- *"super wideband audio" for audio range of 50 Hz to 14000 Hz;*
- *"full band audio" for audio range of 20Hz ~ 20,000Hz, with associated multi-channel capabilities (mono, stereo, etc).*

However, POTS handsets only support a narrowband experience.

4.2 Characteristics of a Wholesale Telephony Access Service (WTAS)

4.2.1 A Retail Telephony Service is characterised by:

(a) Customers' continued ability to use their existing telephone handset.

(b) A feature set that may be different to the feature set on the current PSTN telephony service.

(c) Real-time service quality (i.e. low IP Transfer Delay, low IP packet Delay Variation, low Packet Loss Ratio).

(d) 'Carrier grade' service quality (e.g. Quality of Service, audio quality and availability approximating current PSTN quality).

4.2.2 "Wholesale Telephony Access Service" is defined as the wholesale function provided by the NBN provider, which is the combination of various product components such as an ATA function in the ONT and connectivity to an NNI at a Point of Interconnect (POI), allowing a TSP to deliver Retail Telephony Services.

4.3 Architecture Overview

4.3.1 Figure 3 shows a high level architecture for a Retail Telephony (POTS-like / POTS-minus) Service.

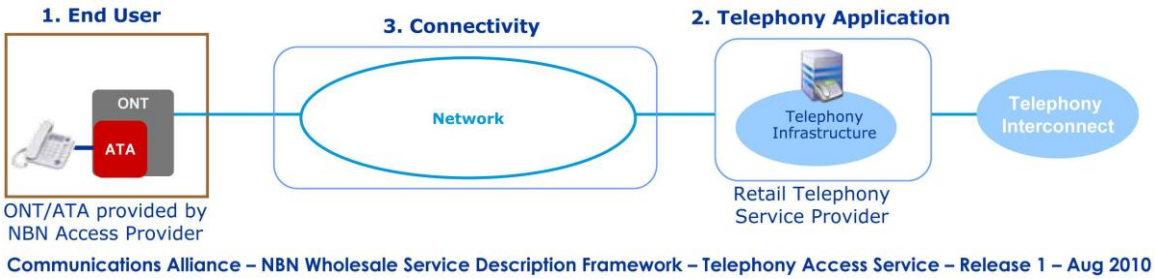


FIGURE 3
High Level Telephony Service Architecture

4.3.2 The main elements of the architecture in Figure 3 are:

(a) ATA function in the ONT

(i) supporting existing POTS handsets for voice (telephony);

(ii) converting non-IP voice signals to Voice over Internet Protocol (VoIP) e.g. for use with SIP/ Real Time Protocol (RTP), or H.248/RTP;

(iii) supporting and interacting with the Retail Telephony Provider's Infrastructure for call control and telephony features (e.g. fax, 3 way conferencing, calling line identity display); and

(iv) provided by the Wholesale Telephony Access Provider.

NOTES:

1. *There is different industry terminology for the ATA function. Other terms include Integrated Access Device (IAD) and Voice Gateway (VGW).*

2. *ETSI standards (e.g. refer to ETSI ES 282 002, ETSI TS 183 043) support both PSTN and ISDN Emulation, using SIP and H.248.*

(b) Telephony Application

(i) provides the telephony call control and features; and

(ii) is provided by retail TSPs.

(c) Network Connectivity

(i) provides the connectivity between the ATA function and Telephony Application; and

(ii) includes IP addressing, guaranteed bandwidth/Quality of Service (QoS), security and reliability.

NOTE: While telephony interconnection is shown, interconnection is the responsibility of the retail TSP.

4.3.3 Figure 4 shows more detail of the architecture, expanding the connectivity details. The Access and Aggregation domains are aligned with the Communications Alliance *NBN Reference Architecture – High Level Architecture Options for the NBN* paper. Key points include:

(a) The end user SBP is the analogue or ISDN telephony port on the ONT.

(b) The TSP SBP is the NNI at the Point of Interconnect.

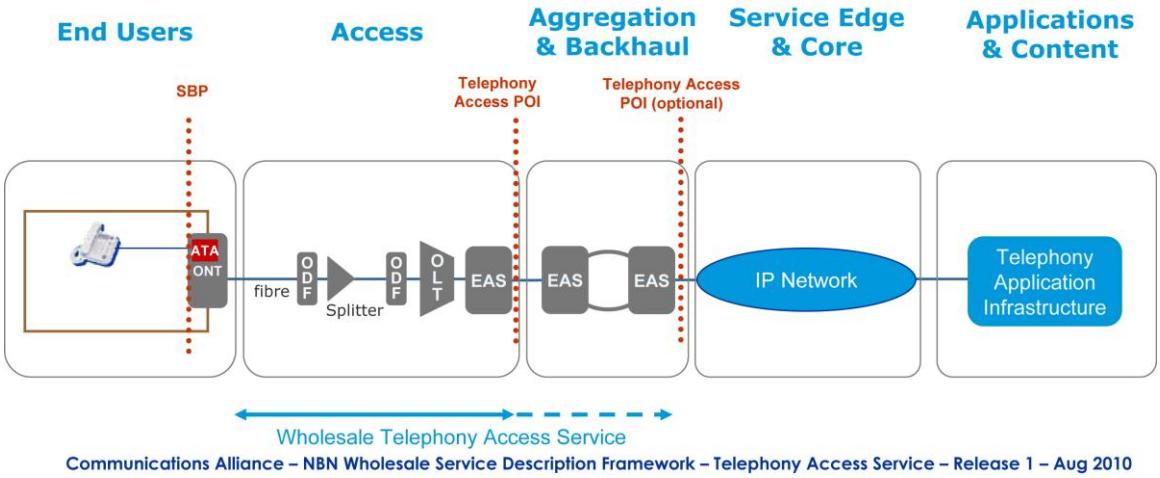


FIGURE 4

Telephony Service Architecture – showing connectivity

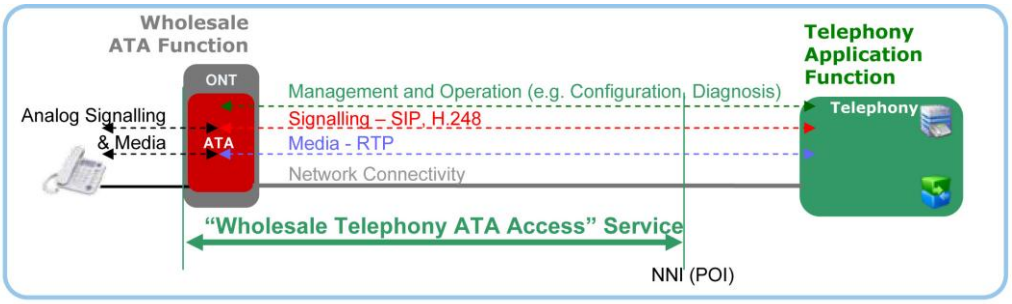
4.3.4 Figure 5 shows the logical interactions between the ONT ATA function and the Telephony Application Function. This includes:

(a) Signalling (e.g. SIP and/or H.248);

(b) Media (RTP);

(c) Management and Operations (e.g. for provisioning, diagnostics); and

(d) IP Connectivity to ATA.



Communications Alliance – NBN Wholesale Service Description Framework – Telephony Access Service – Release 1 – Aug 2010

FIGURE 5

ATA to Telephony Provider interactions

4.3.5 Figure 6 shows four basic industry options for a retail TSP delivering telephony services using the Wholesale Telephony Access Service:

(a) IMS based: MMTel or PSTN Emulation Server with IMS core.

(b) SIP based: SIP Application Server on a SIP Core.

(c) H.248 based: Use a Softswitch.

(d) H.248 based: Use PSTN switch via a V5.2 Gateway.

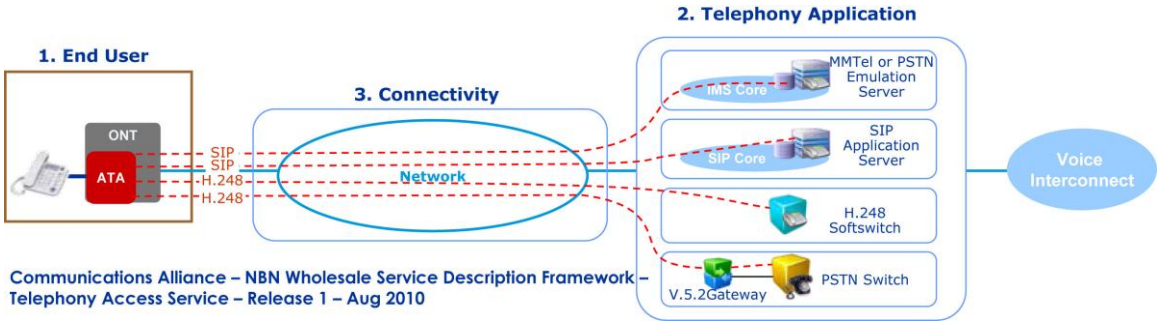


Figure 6

Architecture options for Telephony Application using the Wholesale Telephony Access Service

4.3.6 The ATA will need to support SIP and where technically or commercially feasible should support H.248 to support the different Telephony Application solutions in clause 4.3.5 and Figure 6 by the retail TSPs. While SIP is the preferred technology option in the longer term, H.248 should also be supported to enable a smooth transition from the current telephony solution (e.g. H.248 is in use today to support POTS over FTTP access in some greenfield sites).

NOTES:

In terms of telephony features:

1. Many features are implemented in the Application Server only, and do not require standardisation, nor support in an ATA.

2. Various supplementary service features have been standardised (e.g. in IMS MMTel, TISPAN PSTN Emulation Service and H.248) to ensure operability between an ATA and an Application Server. In general, an ATA needs to support certain features if the RSP is to deliver these standardised supplementary services.

3. Some features have been standardised by H.248, but are still either being developed under TISPAN PSTN Emulation, or not currently defined by TISPAN PSTN Emulation (e.g. Payphones). Consequently, SIP/IMS support for certain PSTN features is considered at an early stage of maturity in the industry.

4. If the wholesale TSP implements enhancements to the SIP and H.248 protocols then they shall be supported in accordance with industry standards (e.g. as developed by 3GPP, ITU-T, IETF).

4.4 Service Scope

4.4.1 Figures 7, 8, and 9 show the boundaries for the Wholesale Telephony Access Service. The retail TSP purchases:

(a) Access to the ONT ATA facility; and

(b) Connectivity services between the ONT and the NNI at the Point of Interconnect.

4.4.2 Three potential connectivity options are shown in Figures 8, 9 and 10. These options are described in more detail in section 6.3.

NOTES:

1. The WTAS provider will need to identify options that the RSP can purchase (e.g. QoS, POI bandwidth).

2. Refer to the Notes to section 6.3 for more information on the connectivity options.

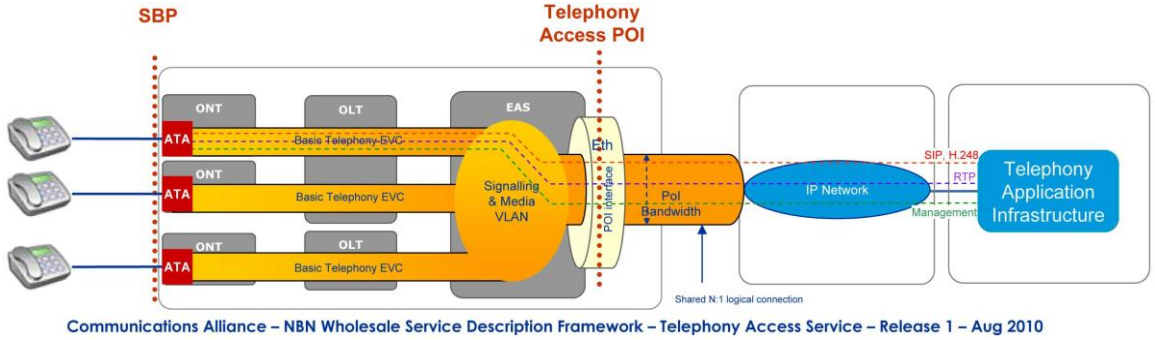


Figure 7

Wholesale Telephony Access Service (N:1 VLAN per POI Model)

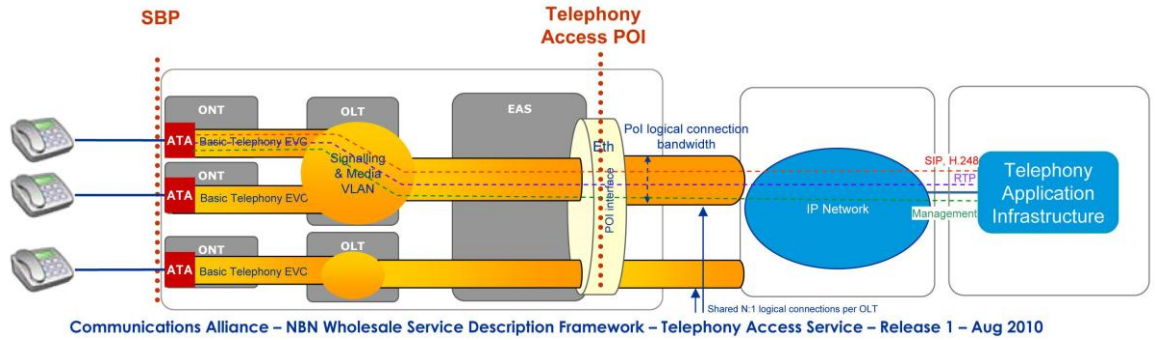


Figure 8

Wholesale Telephony Access Service (N:1 VLAN per Access Node Model)

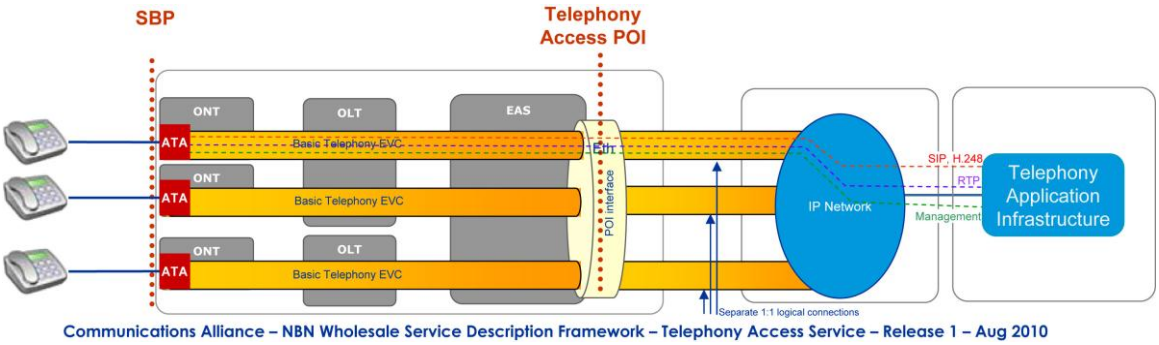


Figure 9

Wholesale Telephony Access Service (1:1 VLAN Model)

NOTES:

1. To deliver a 'carrier grade' telephony service using the ATA function in the ONT, a retail TSP also needs telephony application infrastructure which delivers many of the telephony service features. However, certain capability also needs to be supported in the ATA in the ONT to deliver certain end-to-end services (e.g. fax, modem, 3 way conferencing, call on hold, etc.).

2. Refer to Section 5 for more detail on the capability to be supported in the ATA in the ONT.

5 ATA FUNCTIONAL CHARACTERISTICS

5.1 Introduction

5.1.1 To enable retail TSPs to deliver 'carrier grade' telephony services over NBN FTTP access using an ATA, the ATA will require a range of capabilities.

5.1.2 The full technical requirements for an ATA will depend on the telephony features to be provided by retail TSPs. What telephony features retail TSPs will provide will be determined by a combination of individual RSP's commercial decisions, government policy and regulatory requirements.

5.1.3 This section lists high level key technical requirements by reference to existing POTS features. These will be necessary to the extent that the retail TSPs desire or are required to provide these features. Note that the following features are high level requirements only, not full technical specifications for an ATA.

NOTE: Some features have been marked as desirable. Such features may be difficult to support today given the maturity of industry implementations.

5.2 Signalling Protocol support

5.2.1 The Wholesale Telephony Access Service shall support SIP. The following protocols shall be supported in an ATA:

(a) Session Initiation Protocol (SIP) – refer to IETF RFC 3261 – and related protocols;

(b) User Equipment basic signalling requirements as specified in 3GPP IMS Release 8 (or later) (refer to 3GPP 24.229) and TISPAN IMS (refer to ETSI ES 283 003).

5.2.2 Where technically and commercially feasible, the Wholesale Telephony Access Service should also support H.248, as per ITU-T Recommendation H.248.1 and related recommendations.

NOTES:

1. While SIP is the agreed long term direction, there are currently different views on whether or not an ATA should support H.248.

One view is that H.248 should be supported by the ATAs because:

- *it is used today to deliver voice services over FTTP;*
- *H.248 is more mature in terms of support of existing POTS features (today);*
- *There is better feature transparency with POTS services (today); and*

- *It will minimize customer impacts and migration issues during the transition.*

Another view is that H.248 should not be supported by the ATAs because:

- *support for H.248 by ONT vendors is declining; and*
- *some existing vendors have it is as a candidate for removal.*

2. What telephony features retail TSPs will provide will be determined by a combination of individual RSPs' commercial decisions, Government policy and regulatory requirements.

3. H.248.1 was also known as IETF RFC 3015 Media Gateway Control (or MEGACO).

4. 3GPP IMS MMTel and TISPAN PSTN Emulation are also known as IMS based SIP.

5.2.3 The Wholesale Telephony Access Service Provider may have the capability to configure each ATA port to use one of the above signaling protocols.

5.3 Telephony Feature support

5.3.1 Some supplementary services are network based and have no specific requirements in the ATA (therefore out of scope for this document). The Wholesale Telephony Access Service ATA should not preclude delivery of these services by the retail TSP.

5.3.2 The Wholesale Telephony Access Service shall support the following basic telephony services in order to facilitate delivery of a RTS that complies with regulatory and Industry Code requirements:

(a) Calling Line Identification Presentation (CLIP);

(b) Calling Line Identification Restriction (CLIR);

(c) Calling Number Display (inbound and outbound);

(d) National Relay Service and TTY; and

(e) Ring Cadences and Dial Tones.

5.3.3 Where it is technically and commercially feasible the Wholesale Telephony Access Service should support basic telephony supplementary services as defined in IETF RFCs, 3GPP MMTel (3GPP Release 8) and TISPAN PSTN Emulation (in the ATA) including:

(a) 3 Party Call;

(b) Call Waiting (CW);

(c) Call Hold/Enquiry;

(d) Message Wait Indication (MWI) (including stutter tone);

(e) Advice of Charge (desired)

(f) Explicit Communication Transfer (ECT);

(g) Dual-tone multi-frequency (DTMF); and

(h) Dial Plan.

NOTES:

1. The ATA shall support industry standard options for both in-band and out-of-band signalling. A telephony service may implement either, or both, in-band or out-of-band signalling. Suggested methods for the transport of DTMF tones include RFC2833/RFC4733 for out-of-band and G.711 for in-band signaling. Refer to sections 6.6 and 6.7 for more information on support of DTMF.

2. If the above features are not supported on the ATA, then customers will not be able to use these features on the WTAS.

3. Advice of Charge is required for Payphones and Private Metering. While standards have been developed, industry support might be immature.

5.3.4 Where it is technically and commercially feasible the Wholesale Telephony Access Service should support the following features to support legacy PSTN services (in an ATA/IAD):

(a) Fax service (e.g. via T.38, V.152 protocol);

(b) Modem service (e.g. via V.150.1, V.152 protocols) (for EFTPOS, security diallers, etc.);

(c) SMS on Fixed (dial-up modem support); and

(d) Hotline.

NOTES:

If the above features are not supported on the ATA, then customers will not be able to use these features on the WTAS.

Options to support voiceband data network devices through voiceband data (e.g. V.152) include:

- *Use of clear channel G.711 with echo cancellation turned off; and*
- *Negotiation to use Fax over IP (e.g. T.38) or Modem over IP.*

The choice of implementation method to support voiceband data network devices is a decision for the Service Provider and is not addressed in this document.

5.3.5 The following legacy PSTN service features are considered desirable for support by the Wholesale Telephony Access Service (in an ATA/IAD)

(a) ISDN Basic Rate (Q.931 on customer side, ISDN Emulation);

(b) Payphones (refer to H.248.26 and/or H.248.34, TS 183 043) Advice of Charge, Analogue Pulse Metering/Line Reversal);

(c) Line specific features such as Line Reversal, Flash Hook and Distinctive Ringing;

(d) Other services that operate over the current POTS (e.g. personal emergency response services).

NOTES:

1. If ISDN services are to be migrated to the NBN, then the ability for ISDN Basic Rate to be provided "over the top" of an NBN service is required. This could be achieved using commonly available external ISDN Emulation TAs (if the WTAS does not support ISDN).

2. TISPAN PSTN/ISDN Emulation defines how ISDN Basic Rate could be supported. While standards exist, industry support may be immature.

3. Similarly, while PSTN Emulation standards define support for other features, industry support may be limited.

5.4 Codecs

5.4.1 The Wholesale Telephony Access Service shall support the ITU-T G.711 A-law audio media format (i.e. codec).

NOTES:

1. Support of G.711 A-law facilitates interworking with existing telephony services on the PSTN and the ISDN.

2. Support of G.711 A-law facilitates support of fax and modem tones.

3. In Australia the use of G.711 A-law is more widespread than G.711 μ-law and this is assumed to continue for the foreseeable future.

5.4.2 The following codecs are desirable for Wholesale Telephony Access support, to enable transcoder free operation with other networks:

(a) ITU-T G.711 μ-law;

(b) ITU-T G.722;

(c) ITU-T G.729 (G.729A is also acceptable) and associated VAD/DTX annexes;

(d) 3GPP AMR (refer to 3GPP TS 26.071, also known as AMR-NB); and

(e) 3GPP AMR-WB (refer to 3GPP TS 26.171 and to ITU-T G.722.2).

NOTES

1. Support of ITU-T G.711 μ-law encoding facilitates interworking with North American equipment operating in its default state.

2. Support of ITU-T G.722 and AMR-WB encoding facilitates interworking with other endpoints that support wideband coding. The current industry support for analogue wideband voice user equipment is limited however increased demand for G.722 and G.722.2/AMR-WB may emerge in future.

3. Support of ITU-T G.729 encoding facilitates interworking with existing low bit rate telephony services. The predominant use of FTTP for access and associated bandwidth availability suggests use of ITU-T G.729 may decline over time.

4. Support of AMR-NB facilitates interworking with mobile telephony, to allow transcoder free operation with some types of mobile devices.

5. This list does not preclude the use of other codecs.

6. For more information on VoIP parameters (e.g. frame sizes, jitter buffers, echo cancellation) refer to Communications Alliance guidelines G632 and G634.

5.5 Numbers of basic telephony ports

5.5.1 An ATA should support multiple telephony ports.

5.5.2 An ATA should support multiple customer lines when using different ATA ports from the same retail TSP, or different retail TSPs.

NOTE: Support for more than one telephony provider per NTU will involve additional technical and operational complexity for service providers and end users.

5.6 ATA Port

Layer 1 Physical Interface Options

The ATA shall support existing handset physical connector types. Refer to section 4.11 of the National Broadband Network End-User Premises Handbook for more information on connector types.

5.7 ATA Configuration Methods

5.7.1 The IP addressing for the ATA is the responsibility of Retail Service Providers.

NOTE: IP address assignment to the ATA and the configuration of the ATA should be done securely, ensuring the confidentiality and integrity of configuration data.

5.7.2 The ATA shall support both the:

(a) IPv4 protocol (IETF RFC 791 and related specifications); and

(b) IPv6 protocol (IETF RFC 2460 and related specifications).

NOTES:

1. From an industry perspective, public IPv4 address space is running out. IPv6 is the accepted industry direction.

2. It is a Retail Service Provider's decision as to whether it continues to use IPv4 addressing (either public or private) or IPv6 addressing. The Retail Service Provider view is that IPv6 needs to be supported on the ATA to facilitate evolution to IPv6 in the future.

5.7.3 The ATA shall support dynamic IP address assignment to simplify operations by the retail TSP.

5.7.4 There are two options for how the ATA will support address assignment capabilities:

(a) Dynamic Host Configuration Protocol (DHCP): Where IP address (and other parameters) are assigned via the Retail Service Provider, independent of the Wholesale Telephony Access Provider's management system. DHCP is a standard industry practice for IP address assignment. DHCP specific support shall include:

(i) DHCP (refer to RFC 2131);

(ii) relevant DHCP options;

(iii) Dynamic Host Configuration Protocol for IPv6 (DHCPv6) (refer to RFC 3315); and

(iv) relevant DHCPv6 options (refer to RFC 3319).

(b) ONT Management and Control Interface (OMCI): IP address (and other ATA parameters) are assigned via the WTAS Provider's management system. The RSP needs to interact with the WTAS Provider's management.

NOTES:

1. There are alternate views on methods of IP address assignment to be supported (i.e. option (a) and/or (b) above).

Those in support of option (a) highlight that DHCP is a standard industry practice for IP address assignment. It would provide a consistent approach with the delivery of telephony services via other means. It would also simplify operational aspects, including adds/moves/changes. This is more consistent with the current RSP approach for address assignment, and is simpler for the RSP.

Those in support of option (b) highlight that a retail TSP will need to implement an interface to the WTAS provider's B2B management system (via OMCI) for the purpose of configuring the ATA settings that are not related to network connectivity. For example, B2B will be used to provision SIP parameters, ring tones, dial plans, impedances, etc. (Note: If ITU-T G.984.4 options for file configuration or TR-069 support are implemented, the RSP could use this mechanism for dynamic configuration of many ATA parameters).

In other words, the B2B management interface needs to be completed for other configuration tasks and so a neater solution is to use the Management Interface for all configuration tasks, including network connectivity.

Vendor support among GPON ONT vendors is inconsistent for DHCP (both IPv4 and IPv6) and this may necessitate the use of the management interface.

2. See Section 6.5 on Line Identity for information on Option 82 and DHCPV6.

5.7.5 The WTAS should support different methods for ATA configuration as per ITU-T G.984.4.

NOTES:

1. Similar to IP Address assignment options, standards have defined that other ATA SIP parameters can be configured in the ONT either via a management system or dynamically.

2. ITU-T G.984.4 identifies 4 options for VoIP service configuration:

- *OMCI (i.e. use a management system).*
- *File retrieval.*
- *DSL Forum TR-069 (also known as Broadband Forum TR-069).*
- *IETF SIPPING config framework.*

2. The option used for service configuration should consider appropriate security measures including, but not limited to, the encryption of SIP credentials.

5.8 Ancillary capability – Security

5.8.1 If the Wholesale Telephony Access Service supports DHCP, then the Wholesale Telephony Access Service Provider shall support Line ID insertion into DHCP (Option 82) (to support one form of registration security).

5.8.2 Where a Wholesale Telephony Access Service supports a N:1 connectivity model, then the wholesale TSP shall implement MAC spoofing protection (e.g. at the OLT).

5.8.3 The ATA shall support security requirements including:

(a) authentication of signalling;

(b) integrity of signalling; and

(c) confidentiality of signalling.

5.8.4 Where technically and commercially feasible the ATA should support signalling and media security requirements as defined in 3GPP (refer to 3GPP 33.203) and TISPAN (refer to ETSI TS 187 003) IMS specifications, including:

(a) Authentication of signalling;

(b) Integrity of signalling; and

(c) Confidentiality of signalling.

NOTE: There are alternate views on the applicability of IMS security requirements to the legacy Wholesale Telephony Access Service provided on the ATA port.

There is a view that development of rich media type IMS features and supplementary services will be primarily directed at services utilizing the data ports on the ONT.

The analogue nature of the WTAS ATA port, legacy WTAS feature set, and uncertain technical maturity do not warrant the mandatory application of these specifications to the WTAS.

The other view is that standards have defined security specifications to mitigate various threats. Retail TSPs may be implementing security for multimedia calling services (to native SIP endpoints), and would benefit from having a consistent security approach across all products.

5.9 Ancillary capability – power supply

Refer to section 4.9 of the *National Broadband Network End-User Premises Handbook* for information on a power backup source including the option for the end user to have battery backup to allow the telephony service to operate when local power fails.

6 CONNECTIVITY CHARACTERISTICS

6.1 Introduction

POI characteristics are to be based on the *National Broadband Network Wholesale Service Definition Framework – Ethernet* paper.

6.2 Interface specifications at the Point of Interconnect

The POI shall support Ethernet (i.e. IEEE 802.3) interfaces. For more information refer to the:

(a) *National Broadband Network End-User Premises Handbook*; and

(b) *National Broadband Network Wholesale Service Definition Framework – Ethernet* paper.

6.3 Logical connection from an ATA

6.3.1 The Points of Interconnect shall allow the option for different services (e.g. voice, broadband) to be combined on a single physical link, but kept logically separated.

6.3.2 The Wholesale Telephony Access Service shall provide redundancy options to improve fault tolerance and availability.

6.3.3 There are three potential options for how the Wholesale Telephony Access Service will support the logical connection from an ATA as shown in Figures 7, 8, and 9.

6.3.4 Where technically and commercially feasible, the Wholesale Telephony Access Service shall support both N:1 and 1:1 VLAN models.

NOTES:

There are three potential technical options for providing connectivity from the ATAs to the PoI, as summarised below.

In considering the requirements for connectivity to the ATA, it should be recognised that connectivity is only a component of the overall service. As such, the WTAS connectivity component should be optimised for supporting the end-to-end Telephony Access Service.

Each of the different options have different scaling, cost and operational implications for the WTAS provider and retail TSPs as summarised below.

Option 1: N:1 VLANs per PoI.

This model provides a single multipoint connection between a large number of ATAs and the PoI. Ethernet MAC learning/switching is used to forward traffic to individual ATAs. Characteristics of this model include:

- *A small number of multipoint layer 2 interfaces are required at the PoI. This means that general purpose switch/router platforms can be used by the RTSP at the PoI.*

- *The WTAS provider must implement MAC layer switching technology. This may have significant scalability and cost implications for the WTAS provider PoI switch.*

- *Simple provisioning of the RTSP PoI router since individual access services do not need to be provisioned there. In particular, per-service traffic management is not required because the traffic has effectively already been shaped by the voice codec to the appropriate rate.*

- *PoI redundancy is simpler to implement (compared to the 1:1 model used for data services) due to the inherent multipoint capability of the N:1 model. Standard redundancy protocols such as VRRP (refer to RFC 3768 for IPv4, or RFC 5798 for Ipv4 and Ipv6) can be used by the RTSP to provide redundant connectivity at the PoI in a manner transparent to the WTAS provider (i.e. failover from an active to a standby PoI is under the control of the RTSP without requiring specific protocol support within the WTAS provider network and without requiring signalling between the RTSP and the WTAS provider networks.*

Option 2: N:1 VLANs per Access Node.

This model is very similar to option 1 except that the scope of the N:1 VLAN is restricted to a single Access Node. This means that the requirement to support MAC layer switching is distributed across a number of Access Nodes thereby limiting the scalability impact for the WTAS provider. For the RTSP on the other hand, this model has only minor additional scaling requirements at the PoI compared to option 1. In addition, this model facilitates per Access Node traffic management.

Option 3: 1:1 VLANs per ATA.

The 1:1 VLAN model provides a point-to-point layer 2 connection from each ATA to the Point of Interconnect (PoI). The characteristics of this model include:

- *Each PoI will potentially be required to support tens of thousands of individual voice VLAN connections in addition to the individual VLAN connections required for Data services. This may have significant scalability and cost implications for the RTSP.*

- *As each individual Wholesale Telephony Access Service is activated, an additional VLAN interface must be provisioned on the RTSP PoI switch/router.*

- *Redundancy can be implemented using standard approaches such as IEEE 802.1AX Link Aggregation (previously referred to as IEEE 802.3ad) which requires signalling*

interaction between the WTAS Provider and RTSP to effect failover.

- *A more consistent approach with the Wholesale Service Definition Framework – Ethernet paper, which specifies 1:1 VLAN delivery.*

6.4 Bandwidth and QoS

6.4.1 The wholesale TSP shall provide the option to mark signalling and media traffic at Layer 2 (i.e. Ethernet) or Layer 3 (i.e. IP DiffServ – refer to IETF RFCs 2475 and 4594) at the POI (in the upstream direction) with marking as specified by the retail TSP.

NOTE: Another relevant reference paper for marking traffic at Layer 2 is the NBN Co 'Fibre Access Service – Traffic class performance discussion paper'.

6.4.2 Where the retail TSP has marked traffic for the WTAS in accordance with agreed processes (e.g. Communications Alliance guidelines G632 and G634) then the wholesale TSP shall not modify the marking of signalling and media traffic at Layer 2 (i.e. Ethernet) or Layer 3 (i.e. IP DiffServ – refer to RFC 2475 and RFC 4594).

6.5 Line Identity

6.5.1 If DHCP is supported, then IPv4 DHCP relay agent capability including Option 82 shall be supported, to allow the retail TSP to obtain line identity information for the Telephony Service.

6.5.2 If DHCPv6 is supported, then the Wholesale Telephony Access Provider shall support a Lightweight DHCPv6 Relay Agent (LDRA) to encode access loop identification in the Interface-Id Option (option 18) and use the "Relay Agent Remote-Id" Option (option 37).

NOTES:

1. Option 82 provides Line identity information.

2. Line identity may be used for different purposes (e.g. registration authentication, security, location)

3. The NBN Wholesale Service Definition Framework – Ethernet paper describes the ability for Line Identity using DHCP Relay.

4. The Wholesale Telephony Access Service Provider and retail TSP must share a common understanding on the format of the Line ID, whether specified by the WTAS provider or RTSP.

5. Broadband Forum (BBF) TR-101 details line identity details relevant to IPv4 while the requirements for IPv6 are still being established through BBF activities WT-187 IPV6 for PPP and WT-177 Migration to IPv6 in the context of TR-101. The requirements

predominantly apply to DHCP relay functions within the Access Node and BNG.

6.6 Support for Dual Tone Multifrequency (DTMF) signaling

6.6.1 The support for DTMF signaling in IP networking reflects the need to continue to support services and associated Customer Equipment (CE) designed for use with traditional (i.e. not IP based) Public Switched Telephony Networks.

6.6.2 Notwithstanding this, it is important to recognize that IP networks are being built and optimised for use with IP based applications and IP CE. Such applications and CE are being developed in accordance with various international standards that specifically allow and exploit the use of many varied device and network based codecs.

6.6.3 As a consequence of IP networks being able to support many varied codecs, and a desire to have IP and non-IP CE maintain a similar user interface (e.g. keypad operation), international standards such as RFC 2833 (now superseded) and subsequently RFC 4733 have been specifically developed. These international standards define the methods of transporting DTMF signaling generated by the CE or by any form of analogue tone generator attached to or using the CE, that is recognized as a valid DTMF tone through an IP based network.

6.6.4 The methods for the transport of DTMF signaling can be summarised as DTMF tones:

(a) sent as in-band tones or tone sequences (Method 1); and

(b) signaled as out-of-band telephony events (Method 2).

6.6.5 Note that utilisation of these methods will deliver in specific circumstances a different outcome depending on the method and the Analogue Terminal Adaptor (ATA) used to interface with the IP network. For example:

(a) Method 1 can only deliver a consistent outcome if used with a codec that encodes with sufficient bandwidth for accurate tone detection, such as G.711; and

(b) Method 2 relies on the quality of the ATA implementation for detecting the generation of a DTMF tone.

6.6.6 In future, as larger volumes of IP based CE become available and are able to exploit different user interfaces and as fixed and mobile CE converge, method 2, out-of-band telephony events, is expected to become the majority implementation in IP based networks because Method 2 supports both DTMF tone detection and other user interface options.

6.6.7 Where there is an integrated ATA within the ONT (referred to in the NBN Co ONT as the UNI-V port), the ATA must be capable of

supporting both methods of DTMF operation whether or not it operates exclusively with the G.711 codec.

6.6.8 However, as noted above, either method 1 or 2 will, in specific circumstances, deliver a different level of outcome. The following section recognises the exclusive use by an NBN Access Network Provider of the G.711 codec and defines an accepted industry process that is to be applied to the NBN service (e.g. that offered via the UNI-V port on a NBN Co ONT), to deal with the case where DTMF tones are not being signaled clearly to the RSP.

6.6.9 Steps in the flow of DTMF tone based information from origin CE to destination CE include:

(a) Generation at the originating CE – refer to ITU-T Recommendation Q.23 and standard AS/CA S002 for more information.

(b) Detection, Conversion – If DTMF tones are generated correctly then CE should detect the tone events correctly in accordance with AS/CA S003.

NOTE: End-to-end network losses may result in valid DTMF tones that are lower than the minimum tone detection level in AS/CA S003.

(c) Transport / Transmission – out of band events should comply with RFC 2833 or RFC 4733. In band DTMF tones should not be modified.

(d) Interpretation – e.g. a machine receiving RFC 2833/4733 event information should interpret it correctly.

6.7 DTMF standards compliance

6.7.1 Refer to ITU–T Recommendation Q.23 for the definition of the sixteen pairs of frequencies that are DTMF signals.

NOTES:

1. Some telephone handsets may not implement all sixteen combinations of DTMF frequencies e.g. only twelve combinations are mandatory in AS/CA S002.

2. However there are a number of specifications for alarm panels that do use all sixteen combinations of DTMF tones.

3. RFC 2833 requires support of all sixteen combinations of DTMF tones (e.g. refer to clause 3.3 and Table 1 of RFC 2833).

4. RFC 4733 expects the support of all sixteen combinations of DTMF tones unless explicitly stated otherwise in an 'events' parameter (e.g. refer to clause 2.5.1 and Table 3 1of RFC 4733).

6.7.2 Refer to AS/CA S002 for the CE requirements for the generation of DTMF signals e.g. frequencies, levels, duration.

6.7.3 Refer to AS/CA S003 for the CE requirements for the detection of DTMF signals.

NOTE: End-to-end network losses may result in valid DTMF tones that are lower than the minimum tone detection level in AS/CA S003.

6.7.4 Access network equipment providing ATA functionality (such as the UNI-V port of the NBN Co NFAS service) and CE must pass the test cases of ETSI ES 202 718, section 6.2.20 (i.e. *Immunity to DTMF False Detection in Send Direction*).

6.7.5 Refer to RFC 2833 or RFC 4733 for the definition of out of band events for telephony, data modem and fax services.

6.8 Industry Process for detection of false DTMF signaling

6.8.1 Where Method 2 (i.e. DTMF tones signaled as out-of-band telephony events) is in operation the following process applies between CSPs and the Access Network Provider(s).

6.8.2 Process outline for detection of false DTMF signaling under Method 2 –for an individual subscriber with 3 or more false detections per 30 minutes of speech):

(a) RSP to revert to Method 1 for this subscriber on the NBN Access Provider's ATA, or the RSP may provide an external ATA and use the NBN Access Provider's data network.

(b) This case is not deemed a failure/fault of the NBN Access Provider's network, and will be treated as 'no fault found' events, if a fault has been raised against the NBN Access Provider.

6.8.3 Process outline for detection of false DTMF signaling under Method 2 – where it exceeds a 'number of subscriber' threshold:

(a) Threshold is where:
(i) 1% or more of a RSP's subscribers have reported detection of false DTMF signaling within any 1 month window; and
(ii) there are 3 or more false detections per 30 minutes of speech for one subscriber.

(b) The RSP must raise a fault with the Access Network Provider and provide evidence to the Access Network Provider that the threshold has been exceeded (e.g. customer fault report(s)).

(c) The RSP also gathers relevant supporting information (e.g. trace information; details of CE such as equipment type and port number). Where the information demonstrates a DTMF error then the RSP supplies this information to the Access Network Provider.

(d) The Access Network Provider will analyse the fault and determine whether the equipment is operating to specification and provide feedback on its analysis to the RSP.

(e) Where a network is not operating to specification then action by the access network provider should be taken to bring the network into compliance and this should be completed as early as practicable and within not more than six months.

(f) Where the network is operating to specification and still generating faults in excess of the threshold, the RSP may refer the matter to Communications Alliance for possible industry resolution e.g. development of an Australian test signal as an alternative to the test signal referenced in Annex B in ETSI ES 202 718.

(g) Where a new test signal is developed then access network equipment must be given a defined time period to comply with any subsequent change to the DTMF False Detection test.

7 PERFORMANCE, SERVICE LEVEL AGREEMENTS & REPORTING

7.1 Target Performance Values

The wholesale TSP shall achieve target performance values to allow retail TSPs to meet regulatory obligations (e.g. customer service guarantee, national reliability framework, priority assistance, etc.) applicable to the Wholesale Telephony Access Service.

> *NOTE: For more information on defining and testing Quality of Service for IP networks and for VoIP services refer to Communications Alliance industry guidelines G632, G633, G634 and G635.*

7.2 Performance Monitoring capability

7.2.1 Where commercially and technically feasible the Wholesale Telephony Access Service should support the capability for the Retail Service Provider to invoke performance measurements (between the ATA and POI, and for end-to-end service measurement).

7.2.2 The Wholesale Telephony Access Service Provider should support the following protocols:

(a) ITU-T Rec. Y.1731; and

(b) IETF RFC 3611.

> *NOTES:*
>
> *1. ITU-T Rec. Y.1731 recommends Operations Administration and Maintenance (OAM) functions and mechanisms for Ethernet based networks and is used for performance monitoring.*
>
> *2. IETF RFC 3611 specifies the RTP Control Protocol Extended Reports (RTCP XR).*

7.3 Performance Reporting

The Wholesale Telephony Access Service Provider should regularly provide performance reports to Retail Voice Service Providers.

8 CONFORMANCE TESTING

8.1 Support ATA specification feature and compliance statement

The Wholesale Telephony Access Service Provider shall supply standards and feature compliance statements of the ATA capability.

8.2 Interoperability testing with Voice Service Provider capability

The Wholesale Telephony Access Service Provider shall provide a facility to allow retail TSPs to undertake interoperability testing between the ATA in the ONT and the TSP's Network and Applications.

9 REFERENCES

Publication	Title
Australian Standards	
AS/CA S002:2010	Analogue interworking and non-interference requirements for Customer Equipment for connection to the PSTN http://commsalliance.com.au/Documents/all/Standards/s002
AS/CA S003:2010	Requirements for Customer Access Equipment for connection to a Telecommunications Network Part 1: General http://commsalliance.com.au/Documents/all/Standards/s003_1 Part 2: Analogue and TDM based technologies http://commsalliance.com.au/Documents/all/Standards/s003_2 Part 3: Packet and cell based technologies http://commsalliance.com.au/Documents/all/Standards/s003_3
3GPP Specifications	
3GPP TS 24.229	IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 Refer to: http://www.3gpp.org/ftp/Specs/html-info/24229.htm
3GPP TS 26.071	Mandatory speech CODEC speech processing functions; AMR speed Codec; General description Refer to: http://www.3gpp.org/ftp/Specs/html-info/26071.htm
3GPP TS 26.171	Speech codec speech processing functions; Adaptive Multi-Rate – Wideband (AMR-WB) speech codec; General description Refer to http://www.3gpp.org/ftp/Specs/html-info/26171.htm
3GPP TS 33.203	3G Security; Access security for IP-based services Refer to: http://www.3gpp.org/ftp/Specs/html-info/33203.htm

TISPAN PSTN simulation supplementary services	TISPAN Fixed network supplementary service specifications mapped to 3GPP IMS Refer to: http://www.3gpp.org/Fixed-network-core-IMS-mapping,195
Broadband Forum	
TR-069 Amendment 2	CPE WAN Management Protocol v1.1 Refer to http://www.broadband-forum.org/technical/trlist.php
TR-101	Migration to Ethernet Based DSL Aggregation Refer to http://www.broadband-forum.org/technical/trlist.php
ETSI Standards	
ETSI ES 202 718 V1.1.1 (2011-10)	Speech and multimedia Transmission Quality (STQ); Transmission Requirements for IP-based Narrowband and Wideband Home Gateways and Other Media Gateways from a QoS Perspective as Perceived by the User Refer to http://www.etsi.org/deliver/etsi_es/202700_202799/202718/01.01.01_60/es_202718v010101p.pdf
ETSI ES 282 002 V1.1.1 (2006-03)	Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation Sub-system (PES); Functional architecture Refer to http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=20622
ETSI ES 283 003 V2.6.1 (2008-08)	Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Call Control Protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP) Stage 3 [3GPP TS 24.229 [Release 7], modified] Refer to http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=28497
ETSI TS 183 043 V2.3.1 (2009-03)	Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation Stage 3 specification – PES Stage 3 Refer to http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=27300

ETSI TS 187 003 V2.1.1 (2009-02)	Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Security; Security Architecture Refer to http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=25916
IEEE Standards	
IEEE 802.1AX-2008	IEEE Standard for Local and Metropolitan Area Networks–Link Aggregation Refer to http://standards.ieee.org/getieee802/802.1.html
IEEE 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 Refer to http://standards.ieee.org/getieee802/802.3.html
IETF RFCs	
IETF RFC 791	Internet Protocol – DARPA Internet Program Protocol Specification Refer to: http://www.ietf.org/rfc/rfc791.txt
IETF RFC 2131	Dynamic Host Configuration Protocol (DHCP) Refer to: http://www.rfc-editor.org/rfc/rfc2131.txt
IETF RFC 2132	DHCP Options and BOOTP Vendor Extensions Refer to: http://www.rfc-editor.org/rfc/rfc2132.txt
IETF RFC 2460	Internet Protocol, Version 6 (IPv6) specification Refer to: http://www.ietf.org/rfc/rfc2460.txt
IETF RFC 2475	An Architecture for Differentiated Services Refer to: http://www.ietf.org/rfc/rfc2475.txt
IETF RFC 2833	RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals Refer to: http://www.ietf.org/rfc/rfc2833.txt
IETF RFC 3015	Megaco Protocol Version 1.0 Refer to: http://www.ietf.org/rfc/rfc3015.txt

IETF RFC 3261	Session Initiation Protocol Refer to: http://www.rfc-editor.org/rfc/rfc3261.txt
IETF RFC 3315	Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Refer to: http://www.ietf.org/rfc/rfc3315.txt
IETF RFC 3319	Dynamic Host Configuration Protocol (DHCPv6) Options for Session Initiation Protocol (SIP) Servers Refer to: http://www.ietf.org/rfc/rfc3319.txt
IETF RFC 3361	Dynamic Host Configuration Protocol (DHCP-for-IPv4) Option for Session Initiation Protocol (SIP) Servers Refer to: http://www.ietf.org/rfc/rfc3361.txt
IETF RFC 3611	RTP Control Protocol Extended Reports (RTCP XR) Refer to: http://www.ietf.org/rfc/rfc3611.txt
IETF RFC 3768	Virtual Router Redundancy Protocol Refer to http://www.ietf.org/rfc/rfc3768.txt
IETF RFC 4594	Configuration Guidelines for DiffServ Service Classes Refer to: http://www.ietf.org/rfc/rfc4594.txt
IETF RFC 4733	RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals Refer to: http://www.ietf.org/rfc/rfc4733.txt
IETF RFC 5798	Virtual Router Redundancy Protocol (VRRP) Version 3 for IPv4 and IPv6 Refer to http://tools.ietf.org/rfc/rfc5798.txt
ITU-T Recommendations	
G.711 (11/88)	Pulse code modulation (PCM) of voice frequencies Refer to: http://www.itu.int/rec/T-REC-G.711/en
G.722 (11/88)	7 kHz audio-coding within 64 kbit/s Refer to: http://www.itu.int/rec/T-REC-G.722/en
G.722.2 (07/03)	Wideband coding of speech at around 16 kbit/s using Adaptive Multi-Rate Wideband (AMR-WB) Refer to: http://www.itu.int/rec/T-REC-G.722.2/en

G.729 (01/07)	Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear prediction (CS-ACELP) Refer to: http://www.itu.int/rec/T-REC-G.729/en
G.984.4 (02/08)	Gigabit-capable passive optical networks (G-PON): ONT management and control interface specification Refer to: http://www.itu.int/rec/T-REC-G.984.4/en
H.248.1 (09/05)	Gateway control protocol: Version 3 Refer to: http://www.itu.int/rec/T-REC-H.248.1/en
H.248.2 (01/05)	Gateway control protocol: Facsimile, text conversation and call discrimination packages Refer to: http://www.itu.int/rec/T-REC-H.248.2/en
H.248.26 (01/05)	Gateway control protocol: Enhanced analog lines packages Refer to: http://www.itu.int/rec/T-REC-H.248.26/en
H.248.34 (01/05)	Gateway control protocol: Stimulus analogue lines package Refer to: http://www.itu.int/rec/T-REC-H.248.35/en
Q.23 (11/88)	Technical features of push-button telephone sets Refer to: http://www.itu.int/rec/T-REC-Q.23/en
Q.24 (11/88)	Multifrequency push-button signal reception Refer to: http://www.itu.int/rec/T-REC-Q.24/en
T.38 (04/07)	Procedures for real-time Group 3 facsimile communication over IP networks Refer to: http://www.itu.int/rec/T-REC-T.38/en
V.150.1 (01/03, plus 2003 amendments)	Modem-over-IP networks: Procedures for the end-to-end connection of V-series DCEs Refer to: http://www.itu.int/rec/T-REC-v.150.1/en
V.152 (01/05)	Procedures for supporting voice-band data over IP networks Refer to: http://www.itu.int/rec/T-REC-v.152/en
Y.1731 (02/08)	OAM functions and mechanisms for Ethernet based networks Refer to: http://www.itu.int/rec/T-REC-Y.1731/en

Y.2201 (09/09)	Requirements and capabilities for ITU-T NGN Refer to http://www.itu.int/rec/T-REC-Y.2201/en

Industry Guidelines

Communications Alliance National Broadband Network Reference Architecture – High Level Architecture Options for the NBN paper

Refer to: http://commsalliance.com.au/Activities/national-broadband-network

Communications Alliance National Broadband Network Wholesale Service Definition Framework - Ethernet paper

Refer to: http://commsalliance.com.au/Activities/national-broadband-network

Communications Alliance National Broadband Network End-User Premises Handbook

Refer to: http://commsalliance.com.au/Activities/national-broadband-network

G632:2007 Quality of Service parameters for networks using the Internet Protocol

Refer to: http://commsalliance.com.au/Documents/Interoperator-Arrangements-by-Topic/QoS

G633:2007 Testing Arrangements for Quality of Service Parameters for Internet Protocol Services

Refer to: http://commsalliance.com.au/Documents/Interoperator-Arrangements-by-Topic/QoS

G634:2007 Quality of Service parameters for Voice over Internet Protocol (VoIP) services

Refer to: http://commsalliance.com.au/Documents/Interoperator-Arrangements-by-Topic/QoS

G635:2007 Testing Arrangements for Quality of Service Parameters for Voice over Internet Protocol (VoIP) Services

Refer to: http://commsalliance.com.au/Documents/Interoperator-Arrangements-by-Topic/QoS

NBN Co Publication

NBN Co Fibre Access Service – Traffic class performance discussion paper

http://nbnco.com.au/assets/documents/traffic-performance-whitepaper-dec-2011.pdf

Legislation
Telecommunications Act 1997 *http://www.comlaw.gov.au/Series/C2004A05145*
Telecommunications (Consumer Protection and Service Standards) Act 1997 *http://www.comlaw.gov.au/Series/C2004A00441*

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

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

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

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

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