Broadbanding
Australia

NBN Co Fibre Access Service

PRODUCT TECHNICAL SPECIFICATION

28 JULY 2011

NBNCo
Limited

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NBN Co Limited

NBN Co Fibre Access Service Technical Specification

28/07/11

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Environment

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Contents

1 Scope and Purpose

This Technical Specification document describes the functional and high-level operational aspects of the NBN Co Fibre Access Service (**NFAS**).

It is intended for a technical audience, who are responsible for integrating the NFAS into their own service delivery architecture.

This Technical Specification document is specific to NFAS and may be updated by NBN Co from time to time in accordance with the Wholesale Broadband Agreement between NBN Co and each Customer.

Terms used in this Technical Specification document have the meaning given in the Dictionary to the Wholesale Broadband Agreement and the Glossary to the Operations Manual.

2 Supported Service Types

This section provides a brief overview of the service types that Customers may choose to deploy using NFAS.

2.1 Unicast Data Services

NFAS supports the flexible delivery of unicast data services. It uses logical, layer 2 circuits that may be used for a variety of higher-level data applications, including internet access.

These unicast services provide physical point-to-multipoint (aggregated) connectivity between one or more UNIs located at End User Premises, and a Customer's centrally-aggregated NNI.

2.2 IP-Based Telephony Services

A Customer may choose to use NFAS for the provision of IP-based telephony services to End Users via two means:

- An Analogue Telephony Adaptor (**ATA**) port (integrated into the Network Termination Device (**NTD**)), with integrated Session Initiation Protocol (**SIP**) capabilities for legacy telephony applications (**UNI-V**)
- Access to external, Access Seeker-supplied ATA devices using a UNI-D port (as a unicast data service)

A Customer who wishes to use NFAS for the delivery of IP-based telephony services is expected to provide and manage its own IP-based telephony network capabilities that interface to, and operate across, the NBN Co Network.

All IP-based protocols and functions that the Customer utilises to implement IP-based telephony services will pass transparently through the NNI, AVC, CVC and UNI-D NFAS Product Components. Where utilised, the UNI-V will terminate all IP-based telephony protocols and functions at the End User Premises.

NFAS supports the provision of voice-grade, IP-based telephony services through the use of specific traffic handling mechanisms that are tailored toward deterministic performance for real-time, conversational applications. The TC-1 traffic class is designed to accommodate the needs of IP-based telephony applications.

Capacity within this traffic class is available to the Customer via the UNI-D or UNI-V interfaces, ensuring a consistent telephony service experience regardless of the interface used.

2.2.1 Legacy Telephony Applications

Using the UNI-V, a Customer may access the NTD's in-built ATA port, with integrated SIP capabilities for legacy telephony applications. A range of configuration options enable a Customer to migrate an existing telephony service, with minimal impact to in-building wiring or equipment installed at the End User Premises.

IP-based telephony services deployed using the UNI-V are automatically provisioned with a specific TC-1 capacity allocation.

A Customer must interface its own IP-based telephony network with the IP-based telephony functions provided by the internal ATA of the UNI-V port. This will require integration testing between the Customer and NBN Co prior to service deployment in accordance with the Wholesale Broadband Agreement.

2.2.2 External ATA Device Support

A Customer may choose to deliver IP-based telephony services to an End User Premises using a dedicated, external ATA device using the NFAS UNI-D. The supply, powering and operation of this device is the responsibility of the Customer.

Such devices are readily available for consumer applications today, and will appear to NFAS as a regular data device, connected to a UNI-D port.

The Customer may choose to operate the AVC in a manner that recognises the relative priority of telephony traffic above other applications sharing the same AVC.

Under this deployment scenario, NFAS is agnostic[1] to the IP-based telephony protocols and data that the Customer utilises for the delivery of IP-based telephony services to an End User.

When delivering IP-based telephony services using an external ATA through a UNI-D, the Customer is able to utilise capacity from any of the two NFAS traffic classes (TC-1 or TC-4).

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[1] Note that specific Class of Service (**CoS**) handling may be configured for voice packets (requires appropriate DSCP marking).

3 Service Addressing

This section details the options for NFAS addressing, including IEEE802.1ad S-TAG/C-TAG structure, the allocation of S/C-VID values, and the addressing options available at the UNI-D. It describes the structure of the service frame with regard to fields used for individual service identification.

NFAS supports a common NNI addressing scheme for CVCs, using an IEEE802.1ad S-TAG to identify individual CVC services.

NFAS supports two different NNI service addressing modes for AVCs, capable of being selected at a CVC-level. These service addressing modes define how each individual AVC service within a CVC will be addressed by a Customer through the NNI.

3.1 VLAN Tag Structure

When required for CVC/AVC service addressing (as described below), each S-TAG and C-TAG is required to contain the following fields:[2]

- S/C-TPID – Tag Protocol Identifier, used to identify the tag type
- S/C-VID – VLAN Identifier, used for service identification
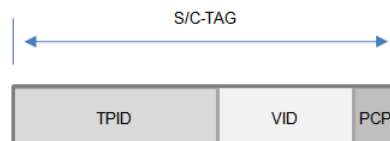- S/C-PCP – Priority Code Point Identifier, used for priority marking

Figure 1 S/C-TAG Structure (4 Bytes)

These fields will be validated for all service frames at ingress to the NBN Co Network. Note that an ingress service frame must contain the same PCP value for both the S-TAG and C-TAG.

3.2 CVC Addressing

CVCs are identified at the NNI using an outer IEEE802.1ad S-TAG, contained within each service frame. Each CVC within an NNI may be addressed and operated independently, allowing adjacent CVCs to be configured differently.

It is the responsibility of the Customer to ensure that each supplied S-TAG VID field conforms to the agreed service configuration. NFAS will discard any service frames received at the NNI with an S-VID that does not map to an agreed identifier for an active CVC service.

At egress from the NBN Co Network at the NNI, the NFAS will insert the S-TAG with the agreed S-VID for identification of the CVC to the Customer.

Within a CVC, a number of AVCs may be present. The mechanism used to address these individual AVCs depends upon the service being operated through the CVC.

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[2] Refer IEEE802.1ad for explanation of S/C- TAG fields

The following service addressing modes are used at the NNI to access individual AVC services operating through a CVC.

3.3 Service Addressing Mode A

Service Addressing Mode A uses a two-level VLAN addressing scheme at the NNI, which is compliant with IEEE802.1ad (Provider Bridges) to identify individual 1:1 AVC and CVC services.

This mode is available for unicast data services between the NNI and UNI-D ports.

Figure 2 describes the frame structure for service frames presented at ingress to the NNI using Service Addressing Mode A, highlighting the S-TAG and C-TAG provided by the Customer, required to associate the service frame with an individual CVC/AVC.
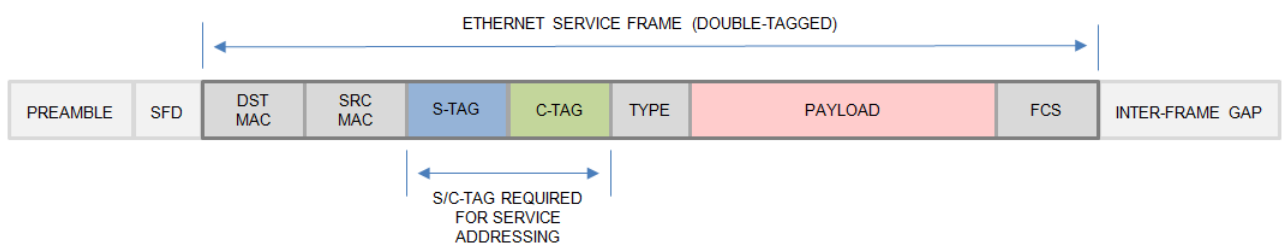

Figure 2 Service Addressing Mode A Frame Format[3]

Services using this addressing mode use the inner IEEE802.1ad C-TAG VID field to address each individual AVC within a CVC. This C-TAG is visible at the NNI, and is stripped before passing across the UNI boundary.

The C-VID can be used to address up to 4000 individual AVCs through a single S-TAG. Note that the same C-VID may appear through different S-TAGs on a given NNI, even where both S-TAGs are directed to the same Connectivity Serving Area. In such cases, the C-VIDs must always address different NTD UNI-D ports.

The S/C-PCP field is used to communicate priority information both across the UNI/NNI boundaries, and within the NBN Co Network.

Service Addressing Mode A requires that traffic flowing in the downstream direction (from the Customer's network into the NNI) must be tagged with the appropriate S/C-VID settings. Traffic flowing in the upstream direction, upon ingress to the UNI, may utilise one of two addressing options (refer to Section 5.1.1.3). It is the responsibility of the Customer to ensure that all ingress traffic at the NNI is compliant with the assigned VID settings for each respective service.

3.4 Service Addressing Mode C

Service Addressing Mode C implements N:1 addressing for IP-based telephony applications using the UNI-V. These services require the frame format shown in Figure 3 at the NNI:

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[3] Refer IEEE802.3 for explanation of service frame fields

ETHERNET SERVICE FRAME (N:1 SERVICE)

| PREAMBLE | SFD | DST MAC | SRC MAC | S-TAG | TYPE | PAYLOAD | FCS | INTER-FRAME GAP |

DEST MAC ADDRESS REQUIRED FOR AVC ADDRESSING
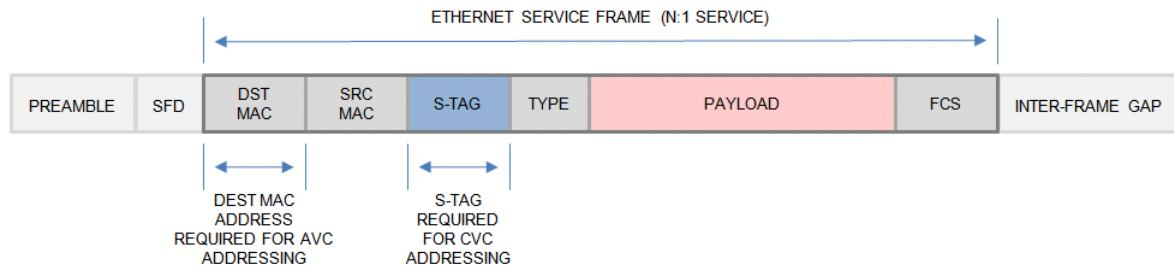
S-TAG REQUIRED FOR CVC ADDRESSING

Figure 3 Service Addressing Mode C Service Frame Format

Figure 3 describes the frame structure for service frames presented at ingress to the NNI for this type of service, highlighting the S-TAG provided by the Customer, required to associate the service frame with an individual N:1 CVC, and the Destination MAC field which identifies the individual destination UNI-V.

Note that under this addressing mode, there are no restrictions imposed by C-TAG VID range limitations on the number of AVCs that can be addressed through an S-TAG.

3.5 S/C-VID Allocation

The allocation of S/C-VID values must be co-ordinated between the Customer and NBN Co.

When requested by the Customer during the ordering process, NBN Co will allocate each new CVC/AVC an internally-generated S/C-VID. This S/C-VID value will be returned to the Customer, and must be used for accessing the requested service at the NNI.

Customers may optionally elect to nominate the S/C-VID used to address each CVC/AVC service instance through the NNI, for further alignment to their own backhaul network addressing schemes. Note that Customers are encouraged to use NBN Co's S/C-TAG default VID allocations, which will be unique to the Customer's service. This will avoid any potential for S/C-VID mismatch between the Customer and NBN Co.

For service addressing modes at the NNI that rely on MAC addressing for forwarding within the access network, the allocation of a C-VID is not required.

3.6 Tag Protocol Identifier (TPID) Formats

Table 1 describes the required TPID values for service frames at ingress to the NBN Co Network. Any received service frames that do not comply with these values will be discarded at ingress.

Table 1 TPID Requirements

Interface	Mode	S-TPID	C-TPID	Comment
NNI	Addressing Mode A	0x88A8 or 0x8100	0x8100	C-TPID value indicated is applicable to inner C-TAG. S-TPID value applicable to outer S-TAG.
	Addressing Mode C		N/A	Addressing Mode C utilises MAC forwarding for the AVC, and do not require a C-TPID.

UNI-D	Default-Mapped	N/A[4]	N/A[5]	For Default-Mapped and DSCP-Mapped UNI-D, the C-TPID is supplied by the NFAS at ingress.
	DSCP-Mapped			

Any tagged service frames with TPID settings outside of these values will be discarded at ingress.

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[4] S-TPID appended by NBN Co Network and not visible at UNI-D.

[5] Untagged interfaces do not require a C-TAG.

4 Class of Service (CoS)

NFAS implements two traffic classes that are distinguished in capability and performance, designed to accommodate the widest variety of higher-layer applications. Customers may take advantage of these traffic classes to provide more tailored performance and effective utilisation of the NBN Co Network.

4.1 NFAS Traffic Classes

NFAS traffic classes are described in Table 2.

Table 2 NFAS Traffic Classes

Traffic Class	Example Applications	Specification[6]
TC-1	Voice	CIR
TC-4	Best-effort data	PIR (AVC) CIR (CVC)

Customers may use these classes to allocate service capacity in a manner that reflects the demands and operation of their end-to-end applications.

4.1.1 TC-1 Description

The TC-1 traffic class is targeted towards real-time, interactive multimedia applications, with the following characteristics:

- Low bit-rate
- Low frame delay, frame delay variation, frame loss
- Highest levels of availability

The attributes of this class are aligned to the characteristics of the DSCP Expedited Forwarding (EF) per-hop behaviour described in RFC4594.

TC-1 provides a committed level of premium capacity with no ability to burst above its CIR, suitable for applications that require deterministic performance and are likely to be sensitive to packet loss.

4.1.2 TC-4 Description

The TC-4 traffic class is targeted towards "best effort" applications, as characterised by the DSCP Default Forwarding (DF) per-hop behaviour, described in RFC4594.

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[6] CIR means Committed Information Rate. PIR means Peak Information Rate.

4.2 Traffic Class Scheduling

Traffic is scheduled within the NBN Co Network using strict priority, according to the traffic class.

4.3 Bandwidth Profile Parameter Definitions

This section provides clarification of the bandwidth profile parameters (**Bandwidth Profiles**) used within the NBN Co Fibre Network.

4.3.1 Calculation of Information Rate

All Information Rates are calculated on Access Seeker layer 2 Ethernet service frames, over the series of bytes from the first bit of the Destination MAC Address through the last bit of the Frame Check Sequence. Note that IEEE802.3 physical-layer fields such as the Preamble, Start of Frame Delimiter and Inter-Frame Gap are not included in the Bandwidth Profile.

Note that the effective layer 2 payload rate of the NBN Co Fibre Network will degrade slightly for lowest-sized Ethernet service frames, where the AVC PIR/CIR approaches the Interface Rate of the UNI. This is the expected behaviour for Ethernet-Based services for which the Bandwidth Profile is based on the Service Frame definition as per Figure 2. It is the responsibility of the Customer to accommodate any payload rate degradation as a result of layer 2 frame sizes.

4.3.2 Committed Information Rate

Committed Information Rate (CIR) defines a level of data throughput for which service frames are delivered according to the performance objectives of the respective traffic class.

4.3.3 Peak Information Rate

Peak Information Rate (PIR) is defined as the maximum data throughput that may be delivered by the service. Note that traffic capacity in excess of the CIR and within the PIR will be carried through the NBN Co Network without any performance objectives. Traffic that exceeds the PIR will be discarded at ingress to the NBN Co Network.

4.4 Bandwidth Specification Model – AVC

The Customer is required to select the desired amount of capacity for each traffic class required for the AVC at time of order.

The AVC Bandwidth Profile components for NFAS Traffic Classes are shown in Table 3.

Table 3 Bandwidth Profile Components – AVC

Traffic Class	Component	Units	Description
TC-1	CIR	Mbps	CIR requirement for TC-1
TC-4	PIR	Mbps	PIR requirement for TC-4

Refer to Section 5.3.2.5 for supported AVC Bandwidth Profiles.

4.5 Bandwidth Specification Model – CVC

The Customer is required to nominate the capacity for each required traffic class within the CVC at time of service order. The CVC Bandwidth Profile components for NFAS Traffic Classes are shown in Table 4.

Table 4 Bandwidth Profile Components – CVC

Traffic Class	Component	Units	Description
TC-1	CIR	Mbps	CIR requirement for TC-1.
TC-4	CIR	Mbps	CIR requirement for TC-4

Note that capacity specified within a CVC bandwidth profile is inclusive of the S/C-TAGs, as per the service frame definition in Figure 2.

Refer to Section 5.4.6 for supported CVC Bandwidth Profiles.

4.6 Traffic Contention and Congestion Management

Customers are free to control their own End User experience, through contention applied through dimensioning of capacity between the AVC and CVC.

Contention may be applied at the traffic class level, allowing Customers to independently control the economics and operation of each class. This is controlled by careful dimensioning of AVC and CVC capacity, on a Traffic Class basis, to ensure a level of contention appropriate for each respective higher-layer application.

Customers must be aware of the implications of further contending NFAS, as this will effectively degrade the performance of a Customer's services.

4.7 Priority Identification

A Customer may use a number of methods to indicate relative priority of individual service frames depending on the NBN Co Network interface. The available methods differ for the UNI and NNI, as shown in Table 5.

Table 5 NFAS Priority Marking Options

Marking Scheme	UNI-D	NNI
PCP field (IEEE802.1p)	N	Y

DSCP (RFC2474)	Y	N
Un-marked	Y	N

4.8 Priority Code Point Encoding

A Customer must conform to the IEEE802.1P and DSCP settings indicated in Table 6 to map traffic into NFAS traffic classes at the UNI and NNI.

These ingress assignments are valid for ordered NFAS traffic classes only. Ingress traffic at the NNI which has a PCP assignment that cannot be mapped to an ordered NFAS traffic class will be discarded. For UNI-D configured as DSCP-Mapped, ingress traffic which cannot be mapped to an ordered NFAS traffic class will be discarded. For UNI-D configured as Default-Mapped, ingress traffic will be mapped to the TC-4 traffic class, irrespective of DSCP markings.

Customers will be required to identify and validate all required UNI-D DSCP and NNI PCP assignments during the on-boarding phase.

Table 6 NFAS Class of Service Encoding

Traffic Class	PCP/DSCP Assignment (Ingress)		
	CoS (UNI-D/NNI)	DSCP[7] (UNI-D)	
		DSCP	DSCP (Decimal)
TC-1	5	CS5, EF	40 – 47
TC-4	0	CS1, AF 11 – 13 CS0, Default	8 – 15, 0 – 7

4.9 Priority Code Point Decoding

Egress CoS decoding is indicated in Table 7.

Table 7 NFAS Class of Service Decoding

Traffic Class	PCP/DSCP Assignment (Egress)
	CoS (NNI)
TC-1	5
TC-4	0

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[7] DSCP-mapping available at UNI-D only.

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4.10 Default (Best Effort) Traffic Handling

For UNI-D configured as Default-Mapped, all ingress traffic will be mapped into TC-4. For UNI-D configured as DSCP-Mapped, any ingress traffic that does not map to a provisioned AVC traffic class will be discarded at ingress. For all NNI configurations, any ingress traffic that does not map to a provisioned CVC traffic class will be discarded at ingress.

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5 Product Component Attributes

5.1 User Network Interface (UNI)

The supported UNI types are as follows:

- Data UNI (Ethernet port) – referred to as "UNI-D"
- Voice/Telephony UNI (Analogue POTS port) – referred to as "UNI-V"

Each UNI is logically connected to an NNI via an AVC and CVC, and supports a single AVC.

5.1.1 UNI-D

Each UNI-D is regarded as a fully independent interface, operating in total isolation from any other UNI residing on the same NTD.

5.1.1.1 UNI-D Interface Attributes

The following interfaces are supported for UNI-D ports:

- 10/100/1000BASET/TX (Electrical, auto-negotiated speed and full/half-duplex)
- 100BASE-T (Electrical, auto-negotiated full/half-duplex)

5.1.1.2 UNI-D Scalability Factors

Each UNI-D has two capacity metrics that define its ability to carry End User services.

5.1.1.2.1 Line Rate

The Line Rate defines the rate at which the physical interface will transfer data. The UNI-D supports the following Ethernet Line Rates:

- 10Mbps
- 100Mbps
- 1000Mbps

The **Line Rate** sets the maximum bound on the information-carrying capacity of the link. Customers are advised that they should be familiar with the inherent limitations of Ethernet in relation to the impact of framing overhead and asynchronous operation on bandwidth efficiency, and accommodate this within any NFAS capacity allocation.

By default, the UNI-D will be configured to auto-negotiate the Line Rate with the equipment at the End User Premises attached to the NTD. An active UNI-D may be configured by NBN Co as a 100Mbps interface if required.

5.1.1.2.2 Information Rate

The **Information Rate** defines the amount of logical capacity assigned to the UNI. This is calculated using the AVC Bandwidth Profile active on the UNI-D.

The UNI-D is capable of supporting an Information Rate up to the active Line Rate. For example,[8] a UNI-D that has an auto-negotiated Line Rate of 100Mbps is capable of supporting an AVC with a PIR of 100Mbps.

Note that once provisioned, AVC capacity will not be automatically re-adjusted as a result of changing Line Rates through auto-negotiation. Should a UNI-D auto-negotiate to a lower Line Rate than required, the End User may experience increased discard on a provisioned AVC.

5.1.1.3   UNI-D Interfacing

There are two options for addressing services at the UNI-D, shown in Table 8.

Table 8 AVC Addressing Modes at the UNI-D

UNI-D Mode	Maximum Number of AVCs Supported at UNI-D	Comments
Default-Mapped	1	Untagged service frames that carry no layer 2 priority information, as per IEEE802.3
DSCP-Mapped	1	Untagged service frames that carry no layer 2 priority information, as per IEEE802.3, where priority information is encoded into the DSCP field, as per RFC2474

The addressing mode must be specified at time of solution definition, and determines how the Customer interfaces to the AVC and UNI-D. These modes have no impact of the operation or allocation of AVC C-TAGs at the NNI.

5.1.1.4   UNI-D Functional Attributes

5.1.1.4.1   Frame Forwarding

The UNI-D implements forwarding of service frames as per IEEE802.1ad, section 8.6.

Table 9 UNI-D Frame Forwarding Details

Destination MAC Address	Application	Default Behaviour	Optional Configurable Behaviour
01-80-C2-00-00-00	Bridge Group Address	Discard	None
01-80-C2-00-00-01	IEEE Std 802.3 PAUSE	Discard	None
01-80-C2-00-00-02	LACP/LAMP	Discard	None
	Link OAM	Discard	None
01-80-C2-00-00-03	IEEE Std. 802.1X PAE address	Discard	None

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[8] Note that this is an illustrative example only, and does not take into account Ethernet protocol overhead.

01-80-C2-00-00-04 - 01-80-C2-00-00-0F	Reserved	Discard	None
01-80-C2-00-00-10	All LANs Bridge Management Group Address	Discard	None
01-80-C2-00-00-20	GMRP	Discard	None
01-80-C2-00-00-21	GVRP	Discard	None
01-80-C2-00-00-22 - 01-80-C2-00-00-2F	Reserved GARP Application addresses	Discard	None
01-80-C2-00-00-30 - 01-80-C2-00-00-3F	CFM	Tunnel	None

Note the following definitions:

- Discard – the service frame will be discarded at ingress to the NBN Co Network
- Tunnel – the service frame is passed to the AVC/CVC and carried through the NBN Co Network

5.1.1.4.2 Auto Negotiation

Each UNI-D port provided at the NTD individually supports auto-negotiation as per IEEE802.3ab.

5.1.1.4.3 MAC Address Limitations

Each UNI-D is capable of supporting up to eight simultaneous MAC source addresses. This imposes a limit on the number of layer 2 devices that a Customer can connect directly to a UNI-D. Any attempt to connect a number of devices directly to a UNI-D that exceeds this limit will result in traffic from the newly-attached devices being discarded.

The NBN Co Network will learn the first eight MAC source addresses detected at ingress to the UNI-D, based upon ingress service frames. A MAC address ageing function ensures that any obsolete MAC addresses are removed from the active list, after a period of 300 seconds.

Note that this limitation applies for the UNI-D irrespective of the service type and does not imply MAC address-based forwarding for unicast services based on 1:1 VLANs.

A Customer must use a layer 3 device to interconnect to the UNI-D. If the Customer does not do so, the customer accepts the consequences of any issues arising from MAC address restrictions.

5.1.1.4.4 Resiliency

By default, the UNI-D is an unprotected physical interface. If an unprotected UNI-D suffers a failure, all services being delivered across that UNI will be disrupted.

5.1.2   UNI-V

This section details the functional attributes of the UNI-V. Additional details and parameters will be provided during the on-boarding process.

5.1.2.1   UNI-V Supported Features

The UNI-V supports a limited set of IP-based telephony features, each delivered in compliance with AS/CA S002:2010 and AS/CA S003:2010. It is the responsibility of the Customer to interface to the UNI-V with a soft switch, located beyond the NNI, and complete the delivery of these features with complementary feature support within its own network.

The IP-based telephony features supported by the UNI-V are described in Table 10.

Table 10 UNI-V Supported Features

End-User Feature	Supporting NBN Co Feature
Call Waiting	Supported by Call Hold, Flash hook and Flash Recall
Calling Number Display	Supported by Calling Line Identification Presentation
Calling Number Display Blocking	Supported by Calling Line Identification Restriction
Message wait indicator: visual and audible	Supported by Message Wait Indicator (light on phone) and distinctive dial tone (stutter dial tone)
Hot Line	Supported by immediate Hot Line

Customers may choose to provide other end-user call handling features that are implemented in the Customer soft switch and/or CPE and do not require specific support by the UNI-V including call barring and call forwarding.

5.1.2.2   UNI-V Interface Attributes

Each UNI-V will exhibit the characteristics described in Table 11.

Table 11 UNI-V Physical Port Characteristics

Parameter	Specification
Maximum Loop Length	150 metres of 0.4mm, Cat 3 cable[9]
Loop Voltage	42 to 56VDC

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[9] Cabling must be wholly contained within the space defined by the internal face of all external walls and roof, and not extending beyond the lower surface of the floor.

Ring Voltages	≥50 Vrms
Ringer Equivalence	Up to 3 REN per UNI-V
Loop Current	≥18mA
Line voltage drop in event of NTU upgrade or power outage	Less than 1 minute

5.1.2.2.1   Physical Interface

The internal NTD UNI-V line connection supports a miniature, 6-position socket as specified in ANSI/TIA 968 A 2002. The external NTD provides screw-down connections for each of the UNI-V ports. See Section 5.3.2.1 details whether an internal or external NTD will be provided at an End User Premises.

5.1.2.3   UNI-V Functional Attributes

5.1.2.3.1   Voice CODEC

The UNI-V supports the CODEC configuration described in Table 18.

Table 18 UNI-V CODEC Description

Parameter	Value
CODEC	G.711 A-law[10]
Packetisation Rate	20msec
DTMF Tones	In-band
Voice Activity Detection (VAD) and Comfort Noise Generation (CNG)	Disabled
Echo Cancellation	Support for G.168 Section 7 CPE must conform to AS/CA S002:2010 Appendix A for echo canceller/suppressor disable tones.

5.1.2.3.2   Traffic Management and Identification

All traffic associated with the UNI-V is carried within the NBN Co Fibre Network using the TC-1 traffic class.

Upstream UNI-V traffic will be presented at egress from the NNI with S-PID = 5 (TC-1). Customers must ensure that UNI-V service traffic appears at ingress to the NNI with S-PID = 5 (TC-1).

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[10] As per ITU-T G.711

Furthermore, the NFAS will mark traffic generated by the UNI-V ATA in the upstream direction with the DSCP markings described in Table 12.

Table 12 UNI-V DSCP Markings (NNI Egress)

Traffic Type	DSCP Marking (Decimal)
SIP Signalling	40
RTP Media	41
Management and Operations	42

5.1.2.3.3   IPv6 Support

The NFAS UNI-V currently supports IPv4-based SIP services only. NBN Co currently intends to support IPv6-based SIP services in the future.

5.1.2.3.4   Layer 3 Connectivity

It is the responsibility of the Customer to manage allocation of IP addresses and associated network parameters to the SIP User Agent associated with each UNI-V. DHCP will be used as the mechanism to manage address distribution and transfers of configuration files.

Customers must provide DHCP server infrastructure and assign the following parameters:

- IP Address (IPv4)
- Subnet Mask (Option 1)
- Default Router Address (IPv4) (Option 3)
- DNS server (required if a hostname is used for proxy server SIP URI) (Option 6)
- FTP Server (Option 66)

Within the NBN Co Network, DHCP Option 82 fields will be populated with the identifier of the AVC attached to a given UNI-V.

5.1.2.3.5   Dial Plan

The *Telecommunications Numbering Plan 1997* is supported on the UNI-V including national, international, regional, emergency and free call numbers and short dial codes as used for IVR, preselect, override, etc.

5.1.2.3.6   Digit Tone Detection

The UNI-V ATA supports in-band DTMF transmission across an IP network.

5.1.2.3.7   Low speed data, fax and modem support

The G.711 codec will support transmission of low speed data including TTY, fax with rates up to 9.6 kbps and modems with rates up to 14.4 kbps. CPE must conform to AS/CA S002:2010 Appendix A for echo canceller/suppressor disable tones.

5.1.2.3.8   Ring Cadence

The ring cadence supported by each UNI-V is DR0.

5.1.2.3.9   Service Tone Characteristics

The service tones supported by each UNI-V are described below. For further detail, refer Communications Alliance Technical Specification AS/CA S002:2010 Appendix A.

Table 20 Service Tones

Service Tone	Description
Pre-Answer - Dial	A combination of three frequencies at 400, 425 and 450Hz, lasting for up to 30 seconds prior to pressing a digit on the keypad.
Pre-Answer – Stutter Dial	A combination of three frequencies at 400, 425 and 450Hz, with a repeated sequence of 100ms ON and 40ms OFF.
Pre-Answer - Ringing	A combination of three frequencies at 400, 425 and 450Hz, with a repeated sequence of 400ms ON, 200ms OFF, 400ms ON and 2000ms OFF.
Pre-Answer - Busy	A repeated 425Hz tone turned on and off every 375ms.
Pre-Answer - Congestion	A repeated 425Hz tone turned on and off every 375ms, but with alternating 10dB attenuation every second tone.

5.2 Access Virtual Circuit (AVC)

5.2.1   Overview

The AVC implements the C-VLAN component of an IEEE802.1ad Provider Bridge, as described in Section 3.

A Customer may deliver multiple End User applications (such as voice and video) using a single AVC (using Class of Service to manage the capacity between applications).

5.2.2   AVC Scalability

The maximum number of AVCs that can be supported on a single UNI port depends on the UNI type and operation.

AVCs are isolated from each other via the use of distinct S-TAG/C-TAG VIDs, and can be individually dimensioned according to the service needs of each End User. An AVC can be scaled in capacity (through its Bandwidth Profile), within the bounds of the product constructs and the physical limits of the underlying access network technology.

5.2.3   DHCP Option 82 Support

An AVC may be optionally configured to provide support for DHCP Option 82.

DHCP Option 82 allows for two fields to be set:

- Circuit-ID
- Remote-ID

NBN Co will insert DHCP Option 82 fields into upstream DHCP DISCOVER messages upon ingress to the AVC at the UNI-D. The fields will be set as follows:

Circuit-ID – The Circuit-ID will not be populated. If equipment at the End User Premises attached to the AVC populates the Circuit-ID field, the NBN Co Network will strip this field.

Remote-ID – The Remote-ID will be set to the following format: the first three bytes will signify the AVC product prefix and the next 12 bytes will be a unique string identifying the AVC. Concatenated together, these values will form the **AVC Service ID**. If equipment at the End User Premises attached to the AVC populates the Remote-ID field, the NBN Co infrastructure will replace it with the AVC Service ID. The format for the AVC Service ID is illustrated in Figure 4 below.
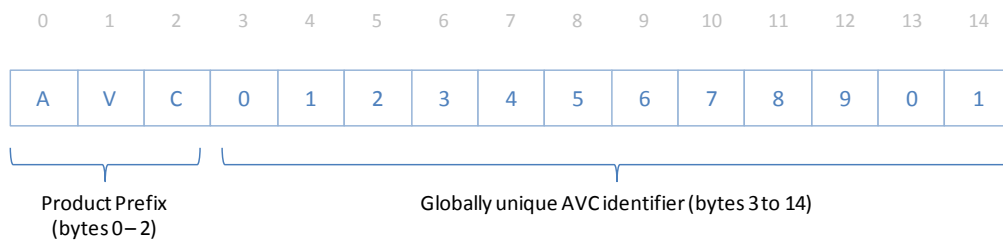
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	V	C	0	1	2	3	4	5	6	7	8	9	0	1

Product Prefix (bytes 0–2)   Globally unique AVC identifier (bytes 3 to 14)

Figure 4 – DHCP Option 82 Remote-ID Field Format

5.2.4   PPPoE Intermediate Agent Support

An AVC may be optionally configured for PPPoE Intermediate Agent support.

The PPPoE Intermediate Agent support configuration allows for two fields to be set:

- Circuit-ID
- Remote-ID

NBN Co will insert PPPoE Intermediate Agent Option 82 fields into upstream PPP PADI messages upon ingress to the AVC at the UNI-D. The fields will be set as follows:

Circuit-ID – The Circuit-ID will not be populated. If equipment at the End User Premises attached to an AVC populates the Circuit-ID field, the NBN Co Network will strip this field.

Remote-ID – The Remote-ID will be set to the following format: the first three bytes will signify the AVC product prefix and the next 12 bytes will be a unique string identifying the AVC. Concatenated together, these values will form the **AVC Service ID**. If equipment at the End User Premises attached to the AVC populates the Remote-ID field, the NBN Co Network will replace it with the AVC Service ID. The format for the AVC Service ID is illustrated in Figure 5 below.
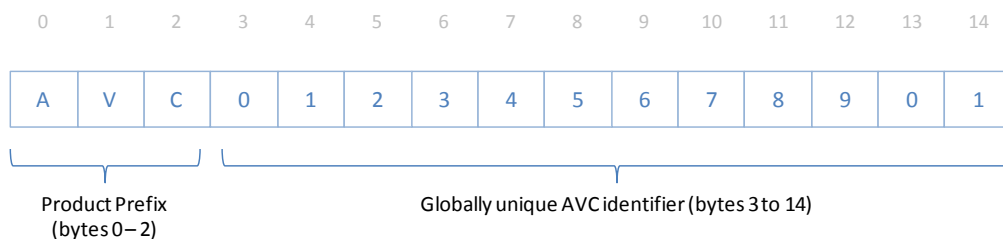
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	V	C	0	1	2	3	4	5	6	7	8	9	0	1

Product Prefix (bytes 0–2)   Globally unique AVC identifier (bytes 3 to 14)

Figure 5 – PPPoE Intermediate Agent Remote-ID Field Format

5.3 Access Components

Access Components comprise all UNI and AVC Product Components required to deliver a Customer's retail service to an End User.

This may involve a single UNI-D, or a UNI-D and UNI-V, each with separate associated AVCs.

Each Access Component is delivered using two sets of Product Features:

- **configuration attributes** – provided through Configuration Templates
- **service attributes** – provided through per-End User orders

This section will detail the Access Components in the context of configuration and service attributes.

5.3.1 Configuration Attributes

The following tables detail all AVC and UNI Product Features which must be specified within a Configuration Template, for the delivery of the Access Components. These Product Features are for Product Components available for NFAS only.

Each Customer may freely construct its end-to-end NFAS from a combination of these configuration attributes and service attributes provided with each Ordered Product.

Certain settings required to interface to the NBN Co Network must be decided at time of on-boarding during the solution definition phase, and captured in a Configuration Template. These details cannot be tailored between each specific Ordered Product. The Configuration Templates will be constructed through a joint consultation between NBN Co and the Customer during the solution definition phase, as part of the on-boarding process in accordance with the Wholesale Broadband Agreement.

Note that Configuration Templates apply to the Access Components only. They encompass UNI/AVC components that, when combined with per-Ordered Product service attributes provided at time of order, are required to fulfil an Ordered Product.

5.3.1.1   UNI Configuration Attributes

The following set of configuration attributes are supported by the UNI. These parameters are captured during the solution definition phase, as part of the on-boarding process.

Table 13 UNI Configuration Attributes (NFAS)

Component	Configuration Attribute	Configuration Attribute Options
UNI	UNI Type	UNI-D
		UNI-V
	VLAN Mode	Default-Mapped (UNI-D only)
		DSCP-Mapped
	Child AVC List	AVC ID (Single AVC only for NFAS)

5.3.1.2   AVC Configuration Attributes

The following set of configuration attributes are supported by the AVC. These parameters are captured during the solution definition phase, as part of the on-boarding process.

Table 14 AVC Configuration Attributes (NFAS)

Component	Configuration Attribute	Configuration Attribute Options
AVC	AVC Type	1:1 (UNI-D only)
		N:1 (UNI-V only)
	UNI Parent	UNI ID (Single UNI only)
	Supported Bandwidth Profiles	Refer Section 5.3.2.5
	Access Loop Identification Active	TRUE/FALSE

These templates define the AVC and UNI attributes that must be specified at time of the solution definition phase. A combination of UNI/AVC Product Components, each defined with these attributes, will constitute an order for Access Components.

5.3.2   Service Attributes

This section details the service attributes that are required to be supplied for each Access Component, at time of order. Note that the number and type of service components will be determined by the Configuration Template.

5.3.2.1   NTD Unit Type

Note that a Customer cannot directly order an NTD. The provision and operation of the NTD is the responsibility of NBN Co. By default, an internal NTD will be provided unless NBN Co determines that an external NTD is preferable in the circumstances or an End User indicates a preference for an external NTD during installation and agrees to any additional charges that may apply.

Customers are able to order individual UNIs on an NTD.

5.3.2.2   UNI-V Service Attributes

The following service attributes must be specified at time of order for each UNI-V:

Table 15 Service Attributes for UNI-V

Component	Service Attribute	Specification (Provided by Customer)
UNI-V	FTP Username	Username
	FTP Password	Password

	Configuration Filename	Filename

5.3.2.3   UNI-D Service Attributes

The following service attributes must be specified at time of order for the UNI-D:

Table 16 Service Attributes for UNI-D

Component	Service Attribute	Specification (Provided by Customer)
UNI-D	Physical Interface	AUTO (Speed)/AUTO (Duplex)
		100Mbps/AUTO (Duplex)

5.3.2.4   AVC Service Attributes

The following service attributes must be specified at time of order for each AVC:

Table 17 Service Attributes for AVC

Component	Service Attribute	Specification (Provided by Customer)
AVC	CVC ID	CVC ID
	C-VID at NNI (1:1 AVC only)	0 – 4000
	Bandwidth Profile (1:1 AVC only)	Specified from list of supported AVC Bandwidth Profiles in Table 18

5.3.2.5   Supported AVC Bandwidth Profiles

This table shows the valid combinations that may be used to populate the Bandwidth Profile (upstream and downstream) for an AVC. The Bandwidth Profile to be used for a specific order for an Access Component will be provided at time of order, and will be chosen as per the End User's service requirements.

Table 18 Supported AVC Bandwidth Profiles

Profile Number	AVC_TC-4 (DS) (Mbps)	AVC_TC-4 (US) (Mbps)	AVC_TC-1 (US/DS) (kbps)
1[11]	0	0	150

---

[11] This profile is the only one available on the UNI-V, and not available on UNI-D. It is automatically provisioned by NBN Co when the UNI-V is ordered.

2	12	1	0
3	12	1	150
4	25	5	0
5	25	5	150
6	25	10	0
7	25	10	150
8	50	20	0
9	50	20	150
10	100	40	0
11	100	40	150

Note the following:

- There are specific engineering rules enforcing the amount of TC-1 and TC-4 capacity that may be allocated to a Bandwidth Profile, which are not covered in this document.
- Certain AVCs will be restricted in what speed profiles they can support. For instance, a UNI-V is only allowed to support profile 1. This is enforced at the Configuration Template level.
- There are technical limitations which will restrict which Bandwidth Profiles can be deployed onto specific UNI/AVC types. These restrictions will be enforced at the solution definition phase of the on-boarding process, through the Configuration Template.

5.4 Connectivity Virtual Circuit (CVC)

This section details the technical interface and operational requirements of the CVC.

5.4.1 Overview

The CVC implements the S-VLAN component of an IEEE802.1ad Provider Bridge. This is an Ethernet Virtual Circuit that provides connectivity between an NNI and Connectivity Serving Area. It is dimensioned with a specific, configured amount of bandwidth capacity to deliver a higher-layer service (or number of services) to a range of AVCs within a particular Connectivity Serving Area.

The CVC may be configured as a 1:1 VLAN, for services delivered using the UNI-D interface, or as an N:1 VLAN, for services delivered using the UNI-V interface.

The NNI, and all CVCs delivered through it, are specific to a single Customer. It is possible that a Customer may have multiple CVCs delivered using a number of NNI at a given location.

A Customer may request to cancel a CVC. A CVC cancellation can only proceed once all member AVCs have been cancelled.

5.4.2 CVC Scalability

A single CVC can support up to 4000 1:1 AVCs, and is delivered to a single Connectivity Serving Area. Each of the 4000 1:1 AVCs is addressed using a single, unique C-TAG VID, locally significant to the CVC. The number of CVCs that a Customer may purchase to a given Connectivity Serving Area is limited only by the NNI resources that the Customer has purchased at the POI.

CVCs are isolated from each other on an NNI via the use of distinct S-TAG VIDs, and can each be individually dimensioned according to the service needs of each Connectivity Serving Area or UNI. CVCs using different service modes are able to co-exist on the same NNI.

Note that where a Customer requires access to more than 4000 AVCs on a given CVC, it is necessary to utilise additional CVCs.

Customers should consider scalability in conjunction with contention. Customers may control their own End User experience through contention applied by dimensioning of capacity between the AVC and CVC.

5.4.3 CVC Interfacing

The CVC is directly accessed by the Customer at the NNI. The VLAN tagging options for interfacing to the CVC at the NNI are described in Section 3.

The CVC S-VID will be validated at ingress to the NNI. Any traffic that does not comply with this tagging structure, or contains S-TAG VID settings that are not agreed values, will be discarded at ingress to the NNI.

5.4.4 CVC 802.1P Discard

Under congestion, any discard of service frames from a CVC will be in accordance with Section 4.

5.4.5 CVC Service Attributes

There is no Configuration Template required for a CVC. Each CVC order must specify each of the service attributes listed.

Table 19 CVC Service Attributes

Component	Attributes	Attribute Description	Selectable Options
End-Point Identification	NNI Group ID[12]	Identification of the NNI that the CVC is to be terminated on.	NNI Group ID (Existing)
	B-END CSA	Identification of the CSA that the CVC is terminated on.	CSA ID
S-TAG Mapping	S-TAG (NNI)	A Customer may choose a locally-significant S-TAG at the NNI.	Requested S-TAG (0 for NBN Co-Supplied

---

[12] Refer to Section 5.5 below.

			S-TAG)
		Optional parameter, if blank NBN Co will assign.	Default = 0
			S-TAG: (1 – 4000)
Bandwidth Profile	Bandwidth Profile (Upstream and Downstream)	CVC_TC-1_CIR	Refer Table 20
		CVC_ TC-4_CIR	Refer Table 21
Installation Options	CVC Type	Type of CVC.	1:1
			N:1

5.4.6 Supported CVC Bandwidth Profiles

The Bandwidth Profile for a CVC may be constructed by independently selecting the TC-1 and TC-4 capacities, from the following tables.

Table 20 CVC TC-1 Bandwidth Profile Capacities[13]

Profile Number	CVC_TC-1 (Mbps)
1	0
2	5

Table 21 CVC TC-4 Bandwidth Profile Capacities[14]

Profile Number	CVC_TC-4 (Mbps)
1	0
2	100
3	150
4	200

---

[13] Available for CVC services configured as N:1 only.

[14] Available for CVC services configured as 1:1 only.

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| 5 | 250 |
| 6 | 300 |

5.5 Network-Network Interface (NNI)

The NNI defines the interface at which the Customer interconnects its backhaul infrastructure to NBN Co's network.

Each physical interface (**NNI Bearer**) is configured as a member of a logical interface (**NNI Group**) using IEEE802.1ad Link Aggregation, which associates a number of NNI Bearers together into the NNI Group. Note that only one NNI Bearer is currently permitted per NNI Group.

5.5.1 NNI Interface Attributes

The two physical interface options for the NNI Bearer are described in Table 22.

Table 22 Optical Interface Parameters (NNI)

Parameter	1000BASE-LX	10GBASE-LR
Wavelength	1310nm	1310nm
Fibre Type	Single Mode (Separate TX/RX Fibre)	Single Mode (Separate TX/RX Fibre)
Connector Type	SC-APC	SC-APC
Launch Power (max) (dBm)	-3	0.5
Launch Power (min) (dBm)	-11.5	-8.2
Receiver Power (max) (dBm)	-3	0.5
Receiver Power (min) (dBm)	-19	-10.3 (-14.4)[15]

---

15 IEEE 802.3ae-2002 details two ways of measuring receiver power:

- OMA stressed eye sensitivity = -10.3dBm (degraded optical fibre link conditions as per IEEE stressed eye test)

- OMA Unstressed eye sensitivity = -14.4dBm. (Back to back, 0km fibre, un-degraded optical fibre conditions or penalties).

The Customer can determine which value is relevant for calculating link budgets. Refer Table 52-13, IEEE 802.3ae-2002.

5.5.2   NNI Scalability Factors

5.5.2.1   CVC Support

An NNI Group can support up to 4000 CVCs, including any mix of 1:1 and N:1 CVC types. Any limitation on CVC support is imposed by the S-TAG address space, and not NNI Group or Bearer capacity or capabilities.

A Customer is not permitted to over-book CVC capacity within an NNI Group.

5.5.3   NNI Functional Attributes

5.5.3.1   Frame Forwarding

The NNI implements forwarding of service frames as Table 23, providing all CVC VLAN tag conditions are met.

Table 23 NNI Frame Forwarding Details

Destination MAC Address	Application	Default Behaviour	Optional Configurable Behaviour
01-80-C2-00-00-00	Bridge Group Address	Discard	None
01-80-C2-00-00-01	IEEE Std 802.3 PAUSE	Discard	None
01-80-C2-00-00-02	LACP/LAMP	Peer	None
	Link OAM	Discard	None
01-80-C2-00-00-03	IEEE Std. 802.1X PAE address	Discard	None
01-80-C2-00-00-04 - 01-80-C2-00-00-0F	Reserved	Discard	None
01-80-C2-00-00-10	All LANs Bridge Management Group Address	Discard	None
01-80-C2-00-00-20	GMRP	Discard	None
01-80-C2-00-00-21	GVRP	Discard	None
01-80-C2-00-00-22 - 01-80-C2-00-00-2F	Reserved GARP Application addresses	Discard	None
01-80-C2-00-00-3X	CFM	Tunnel	None

Note the following definitions:

- Discard – service frame will be discarded at ingress to the NBN Co Network
- Peer – service frame will be terminated within the NBN Co Network
- Tunnel – service frame will be passed to the AVC/CVC and carried through the NBN Co Network

5.5.3.2   Class of Service

The NFAS traffic class model will operate transparently across an NNI.

5.5.4   Service Attributes Description

There is no Configuration Template required for an NNI. Each NNI order must specify each of the service attributes listed.

Table 24 NNI Service Attributes

Component	Attributes	Attribute Description	Selectable Options
Service details	Physical Location	Physical location of NNI	POI ID
NNI Type	Interface Type	Physical interface type.	1000BASE-LX
			10GBASE-LR

Each successful NNI order will yield an NBN Co-supplied NNI ID, which will indicate a physical port on the Optical Distribution Frame (ODF) located within the NBN Co POI, to which the interface has been cabled.

A Customer must separately acquire the necessary facilities access rights to connect the NNI to the Customer's rack or fibre service.

6 Network Attributes

This section details network level attributes and characteristics that are relevant to the delivery of end-to-end services by Customers.

6.1 Network Coverage

Footprint and coverage information will be provided by NBN Co to Customers from time to time.

6.2 Maximum Frame Size

The NBN Co Network supports a maximum layer 2 Ethernet frame size of 2000 bytes at the NNI, inclusive of the S-TAG and C-TAG. This maximum frame size limitation may be referred to as the layer 2 Maximum Transfer Unit (MTU) of the NBN Co Fibre Network.
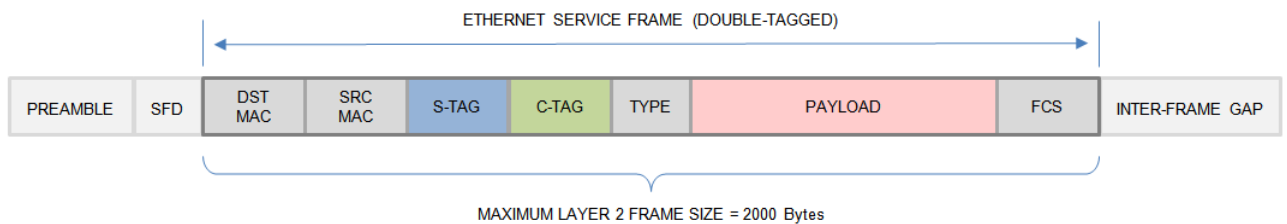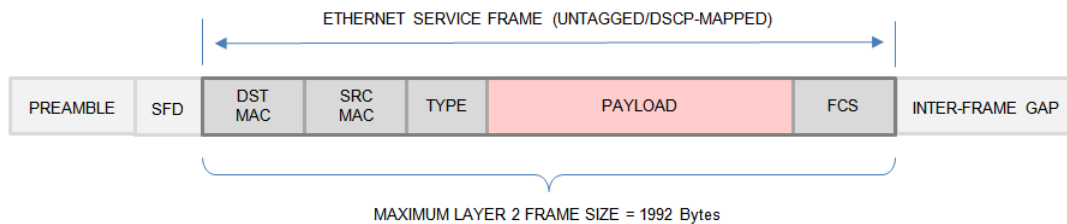

Figure 6 NNI Service Frame Definition

Figure 7 UNI-D Maximum Frame Size Definition (Default-Mapped/DSCP-Mapped Mode)

Any ingress service frame received at the UNI-D that exceeds this length will be discarded. Any ingress service frame received at the UNI-D that is less than 64 bytes (excluding any VLAN tag applied by the Customer) will also be discarded.

7 Deployment Guidelines

7.1 Delivery Options

NFAS supports GPON access technology for delivery of last-mile connectivity to the End User Premises.

7.2 Network Termination Device (NTD)

NFAS is delivered to an End User Premises using a physical NTD.

The NTD is intended for residential deployments, primarily for single-dwelling premises.[16] However, it may be used for other types of deployment subject to NBN Co's confirmation of suitability.

The internal and external NTD variants are functionally identical, in the number of ports and services that they can deliver.

7.2.1.1 Physical Interfaces

The NTD has the following UNI ports:

- Four electrical 10/100/1000BASE-T Ethernet UNI-D ports
- Two UNI-V[17]

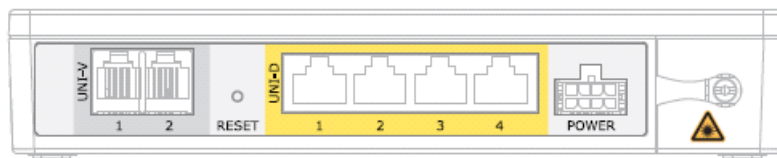Figure 8 shows the arrangement of UNI-D and UNI-V ports on the internal NTD.

Figure 8 Internal NTD

7.2.1.2 Power Supply

The NTD is supplied with an indoor power supply unit that must be connected to a dedicated, standard 240V, 10A Australian General Purpose Outlet (GPO). The NTD should be installed within 3 metres of the power supply unit.

NBN Co will deploy a battery backup solution with each NTD that provides battery backup power supply capability in respect of the UNI-V ports only in the event of mains power failure at that End User Premises.

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[16] NTD is also applicable for Multi-Dwelling Units where fibre access is deployed to each tenancy.

[17] NBN Co will only make available one UNI-V on each NTD unless notified otherwise by NBN Co