Product Technical Specification

nbn™ Enterprise Ethernet Product Module

Wholesale Broadband Agreement

This document forms part of NBN Co's Wholesale Broadband Agreement, which is a Standard Form of Access Agreement for the purposes of Part XIC of the Competition and Consumer Act 2010 and constitutes nbn's Latest Standard Offer.

Product Technical Specification

nbn™ Enterprise Ethernet Product Module

Wholesale Broadband Agreement

Version	Description	Effective Date
4.0	First issued version of WBA 4	1 December 2020
4.1	Amendments to support updates in the aggregation network	13 September 2021
4.x	Introduction of new 2-10Gbps **nbn**™ Enterprise Ethernet bandwidth profiles	30 June 2022

Roadmap

A roadmap describing the structure of this **nbn™** Enterprise Ethernet Product Technical Specification follows for the assistance of RSP.

1 Scope and purpose

1.1 Purpose

This **nbn™** Enterprise Ethernet Product Technical Specification sets out the technical specifications for the **nbn™** Enterprise Ethernet Product. It forms part of the **nbn™** Enterprise Ethernet Product Module.

1.2 Scope

Sections 2 to 7 of this **nbn™** Enterprise Ethernet Product Technical Specification describe the features of the **nbn™** Enterprise Ethernet Product, as offered by **nbn**.

1.3 Definitions

Capitalised terms used but not defined in this **nbn™** Enterprise Ethernet Product Technical Specification have the meaning given in the Dictionary.

If a capitalised term used in this document is not defined in the Dictionary, then that term has the ordinary meaning commonly accepted in the industry.

2 Introduction

2.1 Service Type Availability

This section provides a brief overview of the service types that RSP may choose to deploy using **nbn™** Enterprise Ethernet.

2.1.1 Access E-Line Services

nbn™ Enterprise Ethernet provides a MEF Carrier Ethernet 2.0 compliant symmetrical Access E-Line Service from an external NNI at a POI to a UNI-E at a Premises.

nbn™ Enterprise Ethernet uses OVCs to provide symmetrical Ethernet service bandwidths.

The OVC can support an Access Ethernet Virtual Private Line (Access EVPL) service or an Access Ethernet Private Line (Access EPL) service as defined by MEF 51 and MEF 33. These can be used by RSP to form either a VLAN-based or a port-based E-Line or E-LAN service.

2.2 Class of Service (CoS) Architecture

The Enterprise Ethernet Network implements a number of Classes of Service that are distinguished in capability and performance, designed to accommodate the widest variety of higher-layer applications. RSP may take advantage of these Classes of Service to provide more tailored performance and effective utilisation of the Enterprise Ethernet Network.

2.2.1 Classes of Service

Traffic is scheduled within the Enterprise Ethernet Network using strict priority, according to the Class of Service. The available Classes of Service are described in Table 1.

Class of Service	Example Applications	Specification
High	Voice over IP (VOIP) and interactive video, such as telepresence	CIR
Medium	Interactive video, Financial/trading, and Database synchronisation	CIR & EIR
Low	Web Browsing, File Transfer, E-Commerce and E-mail	EIR

Table 1: Available Classes of Service

RSP may use these Classes of Service to allocate service capacity in a manner that reflects the demands and operation of its end-to-end applications. The performance attributes of each respective Class of Service are described in section 6 .

Each OVC can be configured with one, two or all three of the Classes of Service shown below. An OVC cannot be configured with more than one of each Class of Service.

2.2.1.1 Class of Service - high (CoS-H) Description

CoS-H delivers traffic with a Committed Information Rate only. It is intended to support a mixture of traffic types, including bursty and non-bursty traffic, that demand low latency, jitter and loss tolerance.

2.2.1.2 Class of Service - medium (CoS-M) Description

CoS-M provides a combination of Committed Information Rate and Excess Information Rate traffic at a ratio of 1:3 (CIR:EIR). It is intended to support near real-time or critical applications that can be bursty yet sensitive to latency, jitter and loss. Within this Class of Service, traffic arriving at the NNI from RSP is treated explicitly as CIR or EIR based on the received marking (colour aware behaviour). At this interface, CoS-M is configured to allow unused CIR to be used by traffic arriving in excess of the configured EIR, through the MEF coupling flag (set = 1). In doing so the excess yellow (EIR) traffic will remain marked as yellow even when using the unused CIR. Similarly, unused EIR may be used by traffic arriving in excess of the configured CIR. However, in this case the excess green (CIR) traffic will be downgraded to yellow. The UNI-E is not colour aware, so at this interface any traffic marked as CoS-M will first be sent as CIR within the CoS-M performance metrics, until the subscribed CIR bandwidth is exceeded, at which point further traffic will be sent as EIR with best efforts performance.

2.2.1.3 Class of Service - low (CoS-L) Description

CoS-L delivers traffic as Excess Information Rate only and as such is “best efforts” only. It is intended to support non-critical applications that are typically bursty and have more tolerance for latency, jitter and loss.

2.2.2 Bandwidth Profile Parameter Considerations

This section describes the bandwidth profile parameters used within the Enterprise Ethernet Network.

2.2.2.1 Calculation of Information Rate

All Information Rate limitations, including as set out in this **nbn™** Enterprise Ethernet Product Technical Specification, are enforced at both the UNI-E and NNI interfaces between the RSP and the Enterprise Ethernet Network.

The effective payload rate of the Enterprise Ethernet Network will degrade slightly for lowest-sized Ethernet service frames. This is the expected behaviour for Ethernet-based services for which the bandwidth profile is based on the service frame definitions in the relevant Network Interface Specification. It is the responsibility of RSP to accommodate any payload rate degradation as a result of Layer 2 Frame Sizes.

2.2.2.2 Committed Information Rate

Committed Information Rate (CIR) traffic will be carried through the Enterprise Ethernet Network within specified performance guarantees that define the performance attributes for the ordered Class of Service.

2.2.2.3 Committed Burst Size

The Committed Burst Size (CBS) is set by **nbn** for each CIR specification, and cannot be modified. The CBS may differ between Classes of Service and may be specified differently for the UNI-E and NNI.

The CBS is used by the policing functions of the Enterprise Ethernet Network at ingress to the Enterprise Ethernet Network to determine whether a stream of ingress data complies with the subscribed CIR. RSP is responsible for ensuring that all ingress traffic is shaped to comply with the CIR/CBS as specified for the required Class of Service and interface, before presentation to the UNI-E or NNI as relevant. CBS values are set out in the Network Interface Specification – OVC.

2.2.2.4 Excess Information Rate

Excess Information Rate (EIR) is the additional information rate that RSP can utilize and for which traffic can pass through the OVC without any performance objectives. EIR is subject to the limitations described in sections 3.2.3.2 and 4.1.2 of this **nbn™** Enterprise Ethernet Product Technical Specification and sections 3 and 10 of the **nbn™** Enterprise Ethernet Product Description.

2.2.2.5 Excess Burst Size

The Excess Burst Size (EBS) defines the length of a burst of Layer 2 traffic (either in bytes or milliseconds as set out in the Network Interface Specification - OVC) that may be received at ingress to the Enterprise Ethernet Network for a burst of traffic that pushes the average information rate above the configured bandwidth profile for an EIR Class of Service. Traffic in excess of the EBS will be discarded by the Enterprise Ethernet Network. The EBS is set by **nbn** for each EIR specification and cannot be modified.

The EBS is used by the policing functions of the Enterprise Ethernet Network at ingress to the Enterprise Ethernet Network to determine whether a stream of ingress data complies with the subscribed EIR. RSP is responsible for ensuring that all ingress traffic is shaped to comply with the EIR/EBS as specified for the required Class of Service and interface, before presentation to the UNI-E or NNI as relevant. EBS values are set out in the Network Interface Specification – OVC.

3 User Network Interface (UNI)

3.1 Overview

The UNI is the physical demarcation point between the responsibility of RSP and the responsibility of **nbn**. Each UNI will be assigned to a single RSP and RSP may deliver multiple services over that UNI.

The **nbn™** Enterprise Ethernet UNI Product Component has one variant:

- UNI-E: Ethernet UNI port for the purposes of data carriage

Each UNI-E is logically connected to an NNI via an OVC.

3.2 UNI-E

The UNI-E is an Ethernet interface in compliance with IEEE 802.3 standards. Each UNI-E is regarded as a fully independent interface, operating in total isolation from any other UNI-E residing on the same B-NTD, except that the aggregate of all UNI-E Information Rates on a B-NTD cannot exceed the relevant B-NTD throughput limit set out in section 10.2 of the **nbn™** Enterprise Ethernet Product Description and in Section 7.2 of the Network Interface Specification – PND.

Detailed specifications are set out in the Network Interface Specification – UNI-E.

3.2.1 Addressing Mode

The UNI-E supports a number of interface tagging and prioritisation addressing modes and Class of Service mapping modes as described in the Network Interface Specification - OVC.

3.2.2 Physical Interface

The following interface modes are available via the UNI-E:

- 10/100/1000Base-T (Copper)
- 1000Base-SX (Multi-Mode Fibre)
- 1000Base-LX (Single-Mode Fibre)
- 10GBase SR (Multi-Mode Fibre)
- 10GBase LR (Single-Mode Fibre)

The UNI-E must be associated with at least one active OVC at all times.

3.2.3 UNI-E Scalability Factors

The UNI-E is scalable in terms of capacity and services. Each UNI-E has two capacity metrics that define its ability to carry RSP Products and Downstream Products.

3.2.3.1 Line Rate

The UNI-E supports the following Ethernet Line Rates:

- 10Mbps
- 100Mbps
- 1000Mbps
- 10,000Mbps

The Line Rate sets the maximum bound on the information-carrying capacity of the link. RSP must 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 capacity allocation.

The UNI-E will be configured to auto-negotiate the Line Rate with the End User Equipment attached to the UNI-E.

RSP is responsible for ensuring that the UNI-E is operating with a Line Rate that is sufficient to carry the requested OVC capacity, using auto-negotiation.

The UNI-E will be configured in Full Duplex mode.

3.2.3.2 Information Rate

As above, the Layer 2 Information Rate, if converted to a Layer 1 rate is bounded by the Line Rate of the UNI. The Information Rate is also subject to the limitations described in sections 3 and 10 of the **nbn™** Enterprise Ethernet Product Description.

Note that once provisioned, OVC capacity will not be automatically re-adjusted as a result of changing Line Rates through auto-negotiation. Should a UNI-E auto-negotiate to a Line Rate less than the requested OVC rate, the End User may experience degraded performance in excess of the targets for each Class of Service on the provisioned OVC as set out in section 6.1 of this **nbn**™ Enterprise Ethernet Product Technical Specification.

3.2.4 OVC Support

For **nbn™** Enterprise Ethernet, each UNI-E functionally supports up to 8 OVCs, with each OVC able to be terminated at a different NNI.

3.2.5 Resiliency

The UNI-E is an unprotected physical interface. If an unprotected UNI-E suffers a failure, all services being delivered across that UNI-E will be disrupted.

3.2.6 B-NTD Supply

RSP cannot directly order a B-NTD. The provision and operation of the B-NTD is the responsibility of **nbn**.

In all Premises at which **nbn** will supply **nbn™** Enterprise Ethernet, an internal B-NTD will be provided, as described in section 7 of the Network Interface Specification - PND. Where there is more than one B-NTD specified in the section 7 of the Network Interface Specification – PND, **nbn** will select the appropriate B-NTD to be installed.

B-NTDs are designed to operate within certain environmental conditions, which may be set out in the Network Interface Specification – PND. If a B-NTD is subjected to environmental conditions outside those expressly permitted, **nbn**™ Enterprise Ethernet Ordered Products supplied using the B-NTD may not perform in accordance with the **nbn**™ Enterprise Ethernet Product Description or this **nbn**™ Enterprise Ethernet Product Technical Specification.

4 Operator Virtual Connection (OVC)

4.1.1 Overview

The OVC supports delivery of unicast, multicast, and/or broadcast frames from the UNI-E to the NNI, as further described in the Network Interface Specification – OVC. RSP may deliver multiple End User applications using a single OVC and CoS to manage the capacity between applications.

The **nbn™** Enterprise Ethernet OVC Product Component has two Access E-Line Service variants:

- Access EPL
- Access EVPL

The Access E-Line Service variants are as per MEF51 and MEF33 definition with the following configuration options:

Configuration	Access EPL	Access EVPL
Number of OVCs per UNI	1	≥ 1 and ≤ 8
Bundling	All-to-One	One-to-one Many-to-One
Service Frame Delivery	Delivered Unconditionally for unicast, multicast and/or broadcast service frames	
CE-VLAN ID Preservation	Yes	Yes
CE-VLAN CoS Preservation	Yes	Yes

OVCs are logically isolated from each other and are designed to be individually dimensioned by RSP from a set of selectable parameters according to the service needs of the End User.

An OVC is designed to be scaled in capacity (through its bandwidth profile), within the bounds of the product constructs and the physical limits of the Enterprise Ethernet Network.

4.1.2 OVC Bandwidth Profile Availability

An OVC comprises of one or a combination of the available Classes of Service (CoS-H/CoS-M/CoS-L) as described in section 3.1 of the **nbn™** Enterprise Ethernet Product Description.

The orderable bandwidth (information rate) of each Class of Service may be selected from the options below. Subject to Appendix A.1 , these bandwidths reference information rate at the UNI-E. Additional bandwidth is required at the NNI to account for the additional S-TAG at this interface.

Bandwidth Profiles	
10Mbps-100Mbps	10Mbps Increments
100Mbps-500Mbps	50Mbps Increments
500Mbps-1000Mbps	100Mbps Increments
1000Mbps-10,000 Mbps	1000Mbps Increments

A valid OVC bandwidth profile comprises a combination of available bandwidth profiles for each Class of Service within the limitations below. These limitations will be presented in the ordering process and then enforced at ingress to the Enterprise Ethernet Network.

The ordering process will enforce the following:

At the UNI-E, the OVC bandwidth profile must be selected as follows:

- Total combination of CIR and EIR on OVC must be greater than 0 (where at least one Class of Service on the OVC has a non-zero bandwidth profile)
- Total CIR on UNI-E must not exceed the maximum information rate specified in Appendix A.1 [1] (where total CIR is calculated including all CIR bandwidth across all OVCs on the UNI-E)
- Total CIR on B-NTD must not exceed the maximum information rate specified in Appendix A.1 [2] (where total CIR is calculated including all CIR bandwidth of all OVCs across all UNI-Es on the B-NTD)
- **nbn** will manage CIR allocation across a B-NTD given the B-NTD may potentially serve multiple RSPs on different UNI-Es[3]

At the NNI, OVC bandwidth profiles must be selected as follows:

- Total CIR on NNI must not exceed available NNI capacity[4]

The corresponding ingress information rate limitations enforced by the Enterprise Ethernet Network at the NNI and UNI-E, are further detailed in Appendix A.1 and A.2 respectively.

4.2 Route Type

nbn™ Enterprise Ethernet will offer RSP the ability to terminate an OVC at a State Aggregation POI nominated by **nbn** instead of the Local POI. Section 4.2 of this **nbn™** Enterprise Ethernet Product

[1] This limit will be applied for all orders, except a single order of 1000Mbps CoS-H (in respect of 1Gbps B-NTD) or a single order of 10,000Mbps CoS-H (in respect of 10Gbps B-NTD). In this case, the order will be accepted and RSP must be aware of the specific limits of the service as outlined in Appendix A.

[2] This limit will be applied for all orders, except a single order of 1000Mbps CoS-H (in respect of 1Gbps B-NTD) or a single order of 10,000Mbps CoS-H (in respect of 10Gbps B-NTD). In this case, the order will be accepted and RSP must be aware of the specific limits of the service as outlined in Appendix A.

[3] Any EIR traffic will be carried subject to available bandwidth after prioritising CIR traffic across the B-NTD, and will not be subject to any performance criteria. It is at RSP's discretion as to how much EIR bandwidth is assigned to a UNI-E (taking into account available ordering options).

[4] NNI capacity is consumed by the allocation of both **nbn™** Ethernet CVC bandwidth and Enterprise Ethernet OVC CIR bandwidths to the NNI. It is at RSP's discretion as to how much bandwidth is left for OVC EIR assigned to the NNI.

Technical Specification does not apply to an order where a bandwidth profile of more than 1000Mbps is ordered. The route selected will be termed the Route Type of the service.
Given the increase in distance to backhaul the service across Enterprise Ethernet Network boundaries, Route Type will be one of the factors used to determine the performance of the specific OVC and as further described in section 6.2 of this **nbn™** Enterprise Ethernet Product Technical Specification.

4.2.1 Route Type Scalability

The POIs nominated by **nbn** for use as a State Aggregation POI are as follows (unless otherwise notified by **nbn**):

State in which Local POI is present	State Aggregation POI
VIC TAS	3MEB
NSW ACT	2SYB
QLD	4BNB
SA	5ADB
WA	6PEA
NT	N/A[5]

RSP may use Route Type to aggregate up to 1Gbps of **nbn**™ Enterprise Ethernet Ordered Products per Local POI. Specifically, this means total combined CIR and EIR allocated by RSP for all aggregated **nbn**™ Enterprise Ethernet Ordered Products between the Local POI and a State Aggregation POI cannot exceed 1Gbps.

[5] As the Northern territory is served by a single POI, the state aggregation option is the same as the Local POI option. As a result, **nbn** will NOT offer a State Aggregation POI for services located within the NT.

5 Network-Network Interface (NNI)

Section 1 of the **nbn™** Enterprise Ethernet Product Description describes the NNI Product Component and the NNI Group and NNI Bearer entities and their interrelationships. This section provides further product-level specification of the NNI Group, NNI Bearers, Redundancy Mode, NNI Link, V-NNI and the OVC support characteristics of the NNI Product Component.

Detailed network-level specifications are set out in the Network Interface Specification – NNI.

5.1 NNI Group and NNI Bearers

For 1Gbps and 10Gbps NNI Bearers, an NNI Group can support up to 8 NNI Bearers.

For 100Gbps NNI Bearers an NNI Group can support up to 2 NNI Bearers in Single Chassis mode or up to 4 NNI Bearers in Diverse Chassis mode.[6]

All NNI Bearers within an NNI Group must be consistent with the group interface rate for that NNI Group[7] (i.e. 1Gbps, 10Gbps or 100Gbps).

5.2 Redundancy Mode

The NNI Group must be configured in one of the following redundancy modes:

- **Single Chassis** (where all NNI Bearers are connected to the same chassis)
- **Diverse Chassis** (where NNI Bearers are connected across a pair of chassis)

5.2.1 Single Chassis

When an NNI Group is configured in Single Chassis mode, all NNI Bearers of the NNI Group will be provisioned on the same chassis.

These NNI Bearers will operate in an N:1 protection mode, meaning that if any NNI Bearer within the NNI Group fails, the NNI Group will continue to operate at an aggregate capacity that is reduced by the capacity of the failed NNI Bearer.

5.2.2 Diverse Chassis

When an NNI Group is configured in Diverse Chassis mode, half of the NNI Bearers of the NNI Group will be provisioned on one (working) chassis, and the other half will be provisioned on a second (protect) chassis.

The NNI Group will operate in a 1:1 protection mode, meaning that if any NNI Bearer on the working chassis fails, traffic will be re-directed to the NNI Bearers on the protect chassis.

---

[6] Note that the addition of NNI Bearers to an NNI Group may result in the degradation of aggregate NNI Group link efficiency, as a result of IEEE802.3ad frame distribution.

[7] Optical characteristics may vary, providing the interface rate is consistent.

5.3 NNI Link

An NNI Link allows the reservation of an S-TAG pool and bandwidth profile from the NNI Group that the Linked NNI is configured to, enabling RSP to assign this S-TAG pool and bandwidth profile to a V-NNI RSP. An NNI can support the maximum assignment of 4,000 NNI Links.

RSP is not permitted to over-book S-TAGs or contend bandwidth within an NNI Group. Each S-TAG pool must be unique to an NNI Link, CVC or OVC, and the total bandwidth of all NNI Links linked to an NNI cannot exceed the bandwidth of the available NNI capacity.

5.4 V-NNI

Where RSP orders a V-NNI, the V-NNI will adopt the following characteristics:

- The V-NNI supports the association of a single NNI Link.
- Subject to **nbn** incorporating this functionality, the V-NNI will have visibility of the NNI Link operational Status.
- The V-NNI will obtain its S-TAG pool and bandwidth profile from the associated NNI Link.
- The V-NNI will inherit the redundancy mode of the NNI Group from which the NNI Link was created.
- The V-NNI does not support the use of NNI Group of NNI Bearers.

5.5 OVC Support

An NNI Group can support up to 500 OVCs in aggregate, including any mix of OVC variants and Route Types.

An NNI Group may support both OVCs in respect of **nbn**™ Enterprise Ethernet and CVCs in respect of **nbn**™ Ethernet simultaneously. In this case the capacity within the NNI Group will be shared between these two Products. RSP is not permitted to over-book CIR on this shared OVC and CVC capacity within an NNI Group.

The S-TAG pool available on an NNI Group will be shared between **nbn**™ Ethernet and **nbn**™ Enterprise Ethernet. For this reason, any new **nbn**™ Ethernet Product or **nbn**™ Enterprise Ethernet Product configured on an NNI Group will need to have an S-TAG that is unique on that NNI Group.

5.6 Service Support

RSP must not exceed the maximum number of Product Components, in aggregate, supported in an NNI Group set out in this section (in this section 5.6 the **Bearer Limit**). The Bearer Limit operates in addition to the limitation set out in section 5.5 .

For the purpose of this section 5.6 , the Bearer Limit includes the total number of Unicast 1:1 AVCs, OVCs, Unicast N:1 CVCs and Multicast Domains associated with an NNI Group.

5.6.1 100Gbps NNI Bearers

The Bearer Limit for an NNI Group of 1 x 100Gbps NNI Bearer in Single Chassis mode is 31,000.

The Bearer Limit for an NNI Group of 2 x 100Gbps NNI Bearers in Single Chassis mode is 62,000.

The Bearer Limit for an NNI Group of 2 x 100Gbps NNI Bearers in Diverse Chassis mode is 31,000.

The Bearer Limit for an NNI Group of 4 x 100Gbps NNI Bearers in Diverse Chassis mode is 62,000.

5.7 Class of Service Support

The NNI Group will transparently support the Class of Service and priority encoding/decoding model set out in section 2.2 of this **nbn**™ Enterprise Ethernet Product Technical Specification and detailed in the Network Interface Specification – NNI.

For NNI Groups configured as Single Chassis, the failure of one or more NNI Bearers may result in the discard of traffic due to insufficient NNI Group aggregate capacity to carry the provisioned OVC capacity. In such cases, traffic is designed to be discarded according to the priority as indicated at the OVC level.

6 Class of Service Performance

6.1 Class of Service Performance

nbn will aim to achieve the following standards (on an individual Class of Service basis) for each Class of Service and Route Type application:

OVCs Terminated at a Local POI

	Performance (Reference distance: 200km)		
Class of Service	CoS-H	CoS-M	CoS-L
Frame Delay (ms)[8]	≤ 5.25	Not Specified	Not Applicable
Inter Frame Delay Variation (ms)	≤ 1	Not Specified	Not Applicable
Frame Loss Ratio (%)[9]	≤ 0.01	≤ 0.01	Not Applicable

OVCs Terminated at a State Aggregation POI

[8] Frame Delay will be calculated by halving the round-trip delay. The performance metric will therefore only apply to measurements taken using this methodology.

[9] Frame Loss Ratio will be calculated by halving the sum of the Forward and Reverse Frame Loss Ratios. The performance metric will therefore only apply to measurements taken using this methodology.

	Performance (Reference distance: 1500km)		
Class of Service	CoS-H	CoS-M	CoS-L
Frame Delay (ms)[10]	≤ 15	Not Specified	Not Applicable
Inter Frame Delay Variation (ms)	≤ 1	Not Specified	Not Applicable
Frame Loss Ratio (%)[11]	≤ 0.01	≤ 0.01	Not Applicable

Note: Performance targets tabled above for CoS-H and CoS-M refer only to CIR components of each service and are averages over a period of 48 hours using MEF35 synthetic performance measurements.

6.2 Limitations on the Standards for Class of Service Operations Performance

The performance of Class of Service operations as specified in section 6.1 of this **nbn**™ Enterprise Ethernet Product Technical Specification will only apply under the following conditions:

Class of Service	Layer 2 Frame Size at UNI (Bytes)[12]
CoS-H	1,522
CoS-M	1,522
CoS-L	Not Applicable

Frame Delay guidance is provided between UNI-E and NNI distances noted in section 6.1 . In the case of UNI to NNI distance > 100km, an extra allowance of 1.4msec latency per additional 200km air path (as the crow flies) distance (or part thereof) is required.

The Class of Service operations performance does not apply to **nbn™** Enterprise Ethernet Ordered Products, where the Line Rate is not capable of supporting the provision of all CoS-H and CoS-M bandwidth profiles ordered by RSP in respect of that Ordered Product (see section 3.2.3 and Appendix A of this **nbn**™ Enterprise Ethernet Product Technical Specification).

The Layer 2 Frame Size values must result in a data stream which is less than or equal to the subscribed Class of Service CIR or any other circumstance in which the speed, performance or stability of an Ordered Product is affected by any matters set out in sections 3 or 10 of the **nbn™** Enterprise Ethernet Product Description, and the limitations outlined in Appendix A of this **nbn**™ Enterprise Ethernet Product Technical Specification.

[10] See footnote 8.

[11] See footnote 9.

[12] Service frames are accepted up to the maximum Frame Size as described in section 3.5 of the Network Interface Specification – UNI-E.

Performance of each Class of Service must be validated in the presence of no other traffic from other Classes of Service within the OVC.

7 Orderable Attributes

7.1 Access Components

Access Components, for the purposes of this **nbn™** Enterprise Ethernet Product Technical Specification, only comprise each instance of the UNI-E and OVC Product Components supplied by **nbn** to RSP to use as an input to an RSP Product or Downstream Product.

Available Product Components are tabled below:

	UNI Type	Access E-Line Service type
Enterprise Ethernet	UNI-E	Access EPL Access EVPL

7.1.1 B-NTD Attributes

The following service attributes must be specified where a new B-NTD is required:

Component	Service Attribute	Specification (Provided by RSP)
1Gbps B-NTD	B-NTD Mounting	Rack
		Wall
	Power Supply 1	DC (-48V) Note: this is not available with wall mount
		AC (240V)
	Power Supply 2	Not Required
		Required
		(Type will be same type as Power Supply 1)
10Gbps B-NTD	B-NTD Mounting	Rack
		Wall
	Power Supply 1	AC (240V)
	Power Supply 2	Not Required
		Required
		AC (240V) DC (-48V) Note: this needs to be ordered separately (if required).

Table 2: Service Attributes for B-NTD

7.1.2 UNI-E Service Attributes

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

Component	Service Attribute	Specification (Provided by RSP)
UNI-E	Interface Bandwidth	1Gbps
		10Gbps
	Physical Interface	Copper (Auto-negotiate)
		Optical (Single Mode)
		Optical (Multi Mode)
	OVC Type	Access EPL
		Access EVPL
	TPID (EtherType)	0x8100
		0x88a8
		0x9100
	UNI Term	12 months (Default)
		24 months
		36 months
	Service Restoration SLA	Premium-12 (24/7) (Default)
		Premium-8 (24/7)
		Premium-6 (24/7)
		Premium-4 (24/7)

Table 3: Service Attributes for UNI-E

7.1.3 OVC Service Attributes - Access EPL

The following service attributes must be specified at time of order for each unicast 1:1 OVC:

Component	Service Attribute	Specification (Provided by RSP)
OVC	OVC ID	Assigned by **nbn**
	Route Type	Local
		State Aggregation
	NNI Group ID	NNI Group identification (Existing)
	S-VLAN ID	• 0: Assigned by **nbn** (default) • 1 - 4,000: Request Specific S-TAG Note: This will be used to identify the OVC at the NNI
	OVC Maximum Frame Size	Jumbo (9000 Bytes)
	CoS-H Bandwidth	BW: selected from set options/increments - CIR

Component	Service Attribute	Specification (Provided by RSP)
	CoS-M Bandwidth	BW: selected from set options/increments - fixed to 1:3 ratio (CIR:EIR)
	CoS-L Bandwidth	BW: selected from set options/increments - EIR
	CoS Mapping Mode	DSCP
		PCP Note: the CoS Mapping Mode refers to the CoS mapping at the UNI-E only

Table 4: Service Attributes for Access EPL

7.1.4 OVC Service Attributes – Access EVPL

The following service attributes must be specified at time of order for each unicast 1:1 OVC:

Component	Service Attribute	Specification (Provided by RSP)
OVC	OVC ID	Assigned by **nbn**
	Route Type	Local
		State Aggregation
	NNI Group ID	NNI Group identification (Existing)
	S-VLAN ID	• 0: Assigned by **nbn** (default) • 1 - 4,000: Request Specific S-TAG Note: This will be used to identify the OVC at the NNI
	UNI-VLAN-IDs (CE-VLAN-IDs)	• 1 - 4,094, with ranges and single values accepted. Maximum VLAN range values supported per UNI: 8. Maximum VLAN values (either VLAN ID or a VLAN range value) per OVC: 32.
	OVC Maximum Frame Size	Jumbo (9000 Bytes)
	CoS-H Bandwidth	BW: selected from set options/increments - CIR
	CoS-M Bandwidth	BW: selected from set options/increments - fixed to 1:3 ratio (CIR:EIR)
	CoS-L Bandwidth	BW: selected from set options/increments - EIR
	CoS Mapping Mode	DSCP
		PCP Note: the CoS Mapping Mode refers to the CoS mapping at the UNI-E only

Table 5: Service Attributes for Access EVPL

7.2 NNI Service Attributes

7.2.1 NNI Group

The NNI Group has the following attributes:

- Location
- Interface Rate
- Redundancy Mode
- Set of NNI Bearers
- Layer 2 Functional Characteristics

7.2.1.1 NNI Group Location

The location of the NNI Group must be specified at time of NNI Group creation.

In order to change the location of an NNI Group (i.e. re-locate NNI Bearers to a different location), it is necessary to purchase a new NNI Group in the intended location, and transition existing OVCs, AVCs and CVCs (as relevant) from the previous NNI Group. Once completed, the previous NNI Group may be cancelled.

7.2.1.2 NNI Group Interface Rate

A new NNI Group will be configured with a group interface rate that determines the interface rate of each NNI Bearer within the NNI Group. The following group interface rates are available:

- 1Gbps
- 10Gbps
- 100Gbps

The group interface rate is set through the selection of the first NNI Bearer (Single Chassis mode), or pair of NNI Bearers (Diverse Chassis mode) at the time the NNI Group is created (each mode is described in section 5).

The group interface rate is fixed per NNI Group and will restrict the type of NNI Bearer that can be added to the NNI Group. For example, if the NNI Group is created with an initial NNI Bearer operating at 1Gbps, then any further NNI Bearers added to this group must also have an interface rate of 1Gbps.

In order to change the group interface rate of an NNI Group (for example, change all 1Gbps NNI Bearers to either 10Gbps or 100Gbps), it is necessary to purchase a new NNI Group in the intended group interface rate and associated NNI Bearers, and transition existing OVCs, AVCs and CVCs (as relevant) from the previous NNI Group. Once completed, the previous NNI Group may be cancelled by RSP.

7.2.1.3 NNI Group Redundancy Mode

The NNI Group must be configured in one of the following redundancy modes:

- **Single Chassis** (where all NNI Bearers are connected to the same chassis)
- **Diverse Chassis** (where NNI Bearers are connected across a pair of chassis)

In order to change the redundancy mode of an NNI Group, RSP must purchase a new NNI Group in the intended redundancy mode and transition existing OVCs, AVCs and CVCs (as relevant) from the previous NNI Group. Once completed, the previous NNI Group may be cancelled.

7.2.1.4 NNI Group Orderable Attributes Summary

A summary of attributes that must be specified for each NNI Group order is shown in Table 6.

Component	Attributes	Attribute Description	Selectable Options
Service details	Physical Location	Physical location of NNI	POI Site
NNI Group Attributes	TPID	Ability to specify the S-TAG TPID used for service frames across the NNI	0x88A8 (default)
			0x8100
	Redundancy Mode	Physical interface type	Single Chassis (default)
			Diverse Chassis

Table 6: NNI Group Orderable Attributes

Each successful NNI Group order is intended to yield an **nbn**-supplied NNI Group identification.

7.2.2 NNI Bearer

7.2.2.1 NNI Bearer Ordering

NNI Bearers are ordered through an NNI Group (refer to section 5).

A feasibility check will be required upon addition of any NNI Bearer to an NNI Group, to determine whether the number of allowable NNI Bearers within the NNI Group has been exceeded.

nbn initially provisions each completed NNI Bearer order to RSP in an administratively "down" state. **nbn** will change this to an "up" state in co-ordination with RSP.

The following activities may be performed on an NNI Group, with respect to the set of NNI Bearers:

- establish a new NNI Group through ordering at least one NNI Bearer (Single Chassis mode) or at least one pair of NNI Bearers (Diverse Chassis mode)
- modify an existing NNI Group through adding/removing NNI Bearer(s)
- cancel an existing NNI Group – all underlying NNI Bearers and NNI Links will be automatically cancelled

For NNI Groups configured as Single Chassis, NNI Bearers may be ordered as single interfaces.

For NNI Groups configured as Diverse Chassis, NNI Bearers must be ordered in pairs, with each NNI Bearer of each pair provisioned on different chassis.

For NNI Groups comprising 1Gbps Ethernet interfaces, **nbn** intends to use reasonable endeavours to provide the ability to seamlessly scale an NNI Group up to four NNI Bearers. Beyond four NNI Bearers, **nbn** intends to schedule an Outage with RSP unless **nbn** notifies RSP that an Outage is not necessary.

For NNI Groups comprising 10Gbps or 100Gbps Ethernet interfaces, **nbn** intends to schedule an Outage with RSP in order to augment the NNI Group with additional NNI Bearers unless **nbn** notifies RSP that an Outage is not necessary.

7.2.2.2 NNI Bearer Orderable Attributes

Each NNI Bearer order must specify each of the service attributes listed in Table 7.

Component	Attributes	Attribute Description	Selectable Options
Service details	NNI Group	The NNI Group to which the NNI Bearer is intended to be associated	NNI Group identification
NNI Bearer	Type	Physical interface type	1000BaseLX
			1000BaseEX
			10GBaseLR
			10GBaseER
			100GBaseLR4
			100GBaseER4

Table 7: NNI Bearer Service Attributes

Each successful NNI Bearer order will yield an **nbn**-supplied NNI Bearer identification, which will indicate a physical port on the **nbn**™ ODF to which the NNI Bearer has been cabled.

RSP must separately acquire the necessary facilities access rights to connect the NNI Bearer to RSP's backhaul transmission cables or RSP Active Equipment.

7.2.3 NNI Link

7.2.3.1 NNI Link Ordering

The following activities may be performed on an NNI Group with respect to NNI Links:

- Establish a new NNI Link by specifying the range of S-TAGs, bandwidth and the V-NNI RSP.

- Modify an existing NNI Link by updating of the S-TAG pool and bandwidth (subject to there being sufficient spare capacity on the associated Downstream V-NNI to accommodate the Modification). Updating the V-NNI RSP is only possible if the NNI Link is not linked to a Downstream V-NNI.
- Cancel an existing NNI Link.

The pool of S-TAGs will be validated to ensure that it is not currently assigned to an existing NNI Link, CVC or OVC.

The bandwidth of the NNI Link (refer to section B.1) will be validated to confirm it is unused and within the NNI Group capacity before the NNI Link order is accepted.

Cancelling of an existing NNI Link is permitted only when not used by a Downstream V-NNI.

7.2.3.2 NNI Link Orderable Attributes

A summary of attributes that must be specified for each NNI Link order is shown in Table 8.

Component	Attributes	Attribute Description	Selectable Options
Service details	NNI Group	The NNI Group to which the NNI Link is intended to be associated	NNI Group identification
NNI Link Attributes	S-TAG pool	Range of S-TAG values associated with the NNI Link	Start of pool, greater than or equal to 1
			End of pool, less than or equal to 4,000
	Bandwidth	NNI Link Bandwidth	Refer to section B.1
	V-NNI RSP	RSP name belonging to the V-NNI RSP	RSP name

Table 8: NNI Link Service Attributes

Each successful NNI Link order will be assigned an **nbn**-designated NNI Link identification number.

7.2.4 V-NNI

7.2.4.1 V-NNI Ordering

The following activities may be performed by RSP for a V-NNI:

- Create a new V-NNI by selecting from a list of possible NNI Links.
- Cancel an existing V-NNI.

A V-NNI can be associated with one Upstream NNI Link. The Upstream NNI Link attributes (S-TAG pool and bandwidth) will be displayed during the V-NNI ordering process.

Cancelling of an existing V-NNI is permitted after any associated CVCs and OVCs have been cancelled.

7.2.4.2 V-NNI Orderable Attributes

A summary of attributes that must be specified for each V-NNI order is shown in Table 9.

Component	Attributes	Attribute Description	Selectable Options
V-NNI Attributes	NNI Link ID	The NNI Link which will be associated to the V-NNI	NNI Link ID

Table 9: V-NNI Service Attributes

Each successful V-NNI order will be assigned an **nbn**-designated V-NNI identification number.

Appendix A

A.1 Ingress Information Rates

The OVC bandwidth profiles selectable in the ordering system refer to bandwidth at the UNI-E. As a result, the NNI Information Rate must be allocated to allow for an additional S-TAG (over and above what is all allocated at the UNI-E). This has been specified as requiring an additional 2.5% bandwidth at the NNI, as per Table 10 below.

nbn policers will be set to the Information Rates shown below, which increase with bandwidth ordered up to the physical limits of the Enterprise Ethernet Network. These limitations apply to both bandwidth ordered as a single service over a UNI-E and bandwidth ordered as multiple services over a UNI-E/B-NTD.

RSP must be aware that if traffic is to ingress over and above these limits, it will be discarded.

Ordered OVC Bandwidth (Mbps)	Layer 2 Information Rate at ingress to UNI-E (Mbps)		Layer 2 Information Rate at ingress to NNI (Mbps)	
	1GE UNI-E	10GE UNI-E	1GE UNI-E	10GE UNI-E
10	10	10	10.25	10.25
20	20	20	20.50	20.50
30	30	30	30.75	30.75
40	40	40	41.00	41.00
50	50	50	51.25	51.25
60	60	60	61.50	61.50
70	70	70	71.75	71.75
80	80	80	82.00	82.00
90	90	90	92.25	92.25
100	100	100	102.50	102.50
150	150	150	153.75	153.75
200	200	200	205.00	205.00
250	250	250	256.25	256.25
300	300	300	307.50	307.50
350	350	350	358.75	358.75

Ordered OVC Bandwidth (Mbps)	Layer 2 Information Rate at ingress to UNI-E (Mbps)		Layer 2 Information Rate at ingress to NNI (Mbps)	
	1GE UNI-E	10GE UNI-E	1GE UNI-E	10GE UNI-E
400	400	400	410.00	410.00
450	450	450	461.25	461.25
500	500	500	512.50	512.50
600	600	600	615.00	615.00
700	700	700	717.50	717.50
800	800	800	820.00	820.00
900	900	900	922.50	922.50
1000	952	1000	975.80	1025
2000	952	2000	975.80	2050
3000	952	3000	975.80	3075
4000	952	4000	975.80	4100
5000	952	5000	975.80	5125
6000	952	6000	975.80	6150
7000	952	7000	975.80	7175
8000	952	8000	975.80	8200
9000	952	9000	975.80	9225
10000	952	9520	975.80	9758

Table 10: Bandwidth and Ingress Information Rate Mapping

A.2 Frame Size impact on Information Rate

As per section 3.2.3.1 of this **nbn™** Enterprise Ethernet Product Technical Specification, the Line Rate sets the maximum bound on the information-carrying capacity of the link, onto which the inherent limitations of Ethernet in relation to framing overhead must be taken into account.

Table 11 below maps this by providing the maximum achievable Layer 2 Information Rate against the UNI-E interface speed (both physical and negotiated options) and Frame Size. As Table 11 shows, with a 1G UNI-E interface speed, the physical limitations of the Enterprise Ethernet Network become more apparent, over the limitations of the UNI-E interface itself.

Interface (UNI-E)	Service Frame Size[13] (Bytes)							
	64	128	256	512	1024	**1522**	**2000**	**9000**
~~10M~~10Mbps	7.62	8.65	9.28	9.62	9.81	9.87	9.90	9.98
~~100M~~100Mbps	76.2	86.5	92.8	96.2	98.1	98.7	99	99.8
~~1G~~1,000Mbps	703	814	884	924	945	952	952	952
10,000Mbps	7230	8393	9113	9520	9520	9520	9520	9520

Table 11: Achievable Information Rate ~~(Mbps)~~ per UNI and Frame-size

This limitation applies to both bandwidth ordered as a single Ordered Product over a UNI-E and bandwidth ordered as multiple Ordered Products over a UNI-E/B-NTD.

A.3 Traffic Mix and Flows

Any Information Rates in this document are determined using a standard Internet Mix Traffic (IMIX) of packets and multiple Layer 2 flows per OVC.

[13] Service Frame Size includes Ethernet Header and FCS

Appendix B

B.1 NNI Link Bandwidth Profiles

The bandwidth profile for an NNI Link may be constructed by selecting the NNI Link capacity from the following table.

Profile Number	NNI Link (Mbps)
1	100
2	200
3	300
4	400
5	500
6	600
7	700
8	800
9	900
10	1000
11	1100
12	1200
13	1300
14	1400
15	1500
16	1600
17	1700
18	1800
19	1900
20	2000
21	2100
22	2200
23	2300
24	2400
25	2500
26	2600
27	2700
28	2800
29	2900
30	3000
31	3100
32	3200

Profile Number	NNI Link (Mbps)
33	3300
34	3400
35	3500
36	3600
37	3700
38	3800
39	3900
40	4000
41	4100
42	4200
43	4300
44	4400
45	4500
46	4600
47	4700
48	4800
49	4900
50	5000
51	5100
52	5200
53	5300
54	5400
55	5500
56	5600
57	5700
58	5800
59	5900
60	6000
61	6100
62	6200
63	6300
64	6400
65	6500
66	6600
67	6700
68	6800
69	6900
70	7000

Profile Number	NNI Link (Mbps)
71	7100
72	7200
73	7300
74	7400
75	7500
76	7600
77	7700
78	7800
79	7900
80	8000
81	8100
82	8200
83	8300
84	8400
85	8500
86	8600
87	8700
88	8800
89	8900
90	9000
91	9100
92	9200
93	9300
94	9400
95	9500
96	9600
97	9700
98	9800
99	9900
100	10000
101	11000
102	12000
103	13000
104	14000
105	15000
106	16000
107	17000
108	18000

Profile Number	NNI Link (Mbps)
109	19000
110	20000
111	21000
112	22000
113	23000
114	24000
115	25000
116	26000
117	27000
118	28000
119	29000
120	30000
121	31000
122	32000
123	33000
124	34000
125	35000
126	36000
127	37000
128	38000
129	39000
130	40000
131	41000
132	42000
133	43000
134	44000
135	45000
136	46000
137	47000
138	48000
139	49000
140	50000
141	51000
142	52000
143	53000
144	54000
145	55000
146	56000

Profile Number	NNI Link (Mbps)
147	57000
148	58000
149	59000
150	60000
151	61000
152	62000
153	63000
154	64000
155	65000
156	66000
157	67000
158	68000
159	69000
160	70000
161	71000
162	72000
163	73000
164	74000
165	75000
166	76000
167	77000
168	78000
169	79000
170	80000

Table 12: NNI Link Bandwidth Profile Capacities