A Uniti Group Company

Product Technical Specification

Opticomm Ltd Ethernet Product Module

OPTICOMM Networks

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Change History

Version	Description	Effective date
1.0	First release	20 June 2022

Changes in the Revision

The detailed changes to this document, from Version 1.0 to Version ___ are outlined in the table below.

Section / Sub-section	Detailed Changes
N/A	N/A

Contents

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1 Forward

The product technical specifications outlined in this document apply across the Opticomm wholesale broadband network footprint. This includes the wholesale networks operated by Opticomm, which includes those networks formally owned by LBN Co, OPENetworks, Capital Fibre Networks and the Telstra South Brisbane exchange network and Velocity Estates network.

To determine the product features available on a specific premises, Residential Service Providers (RSPs) can determine this through a Service Qualification (SQ) look up of that premises, either on the RSP web portal or through the RSP SQ Application Programming Interface (API).

The RSP SQ provides the supported product features supported at each premises on the wholesale network and should be taken as the true source at the time of SQ. Over time with network capacity upgrades, equipment upgrades and operational process changes, the product feature availability per premises changes, so RSPs should perform SQ look ups routinely in their business processes.

2 Scope and Purpose

2.1 Purpose

This Product Technical Specification forms part of the ***Ethernet Product Specification Guide*** as it sets out the technical specifications for the Ethernet Bitstream Services and Metro Ethernet Access Services offered by Opticomm.

2.2 Scope

The features of the Product Technical Specification are described in Sections 2 to 11 of this document.

2.3 Supporting Documentation and Definitions

This document will reference the following Opticomm documents:

- Ethernet Product Specification Guide
- Operations Manual
- RSPMA
- Service Level Agreement
- Wholesale Price List

References will be in bold and italicized (for example, ***Wholesale Price List***), and refer to the most recently published version of each document by Opticomm. The most current versions of these documents are located at www.opticomm.com.au/legal.

Precedence: The ***RSPMA*** has precedence over the contents of this document, in the event of any discrepancies. Capitalised terms which are used but not defined in this document have the same meaning given to them in the ***RSPMA***, other definitions are as below. Where any definition is not included in either the ***RSPMA*** or below, that word is to be given its standard meaning.

Acronym	Definition
AVC	Access Virtual Circuit (also known as OAC)
CBS	Committed Burst Size
CIR	Committed Information Rate
CSA	Connectivity Servicing Area *(also known as OSA)*
CVC	Connectivity Virtual Circuit *(also known as OVC)*
ELINE Service	means Metro Ethernet Access Service
EPL	Ethernet Private Line
Ethernet Bitstream Service	has the meaning given in the ***Ethernet Product Specification Guide***
EVPL	Ethernet Virtual Private Line
Footprint	The addressable premises available within the Opticomm Network.
FTTBW	Fibre to the Basement Wholesale via the TPG Access Network

LEB	Local Ethernet Bitstream (being legacy Opticomm terminology for what is now known as AVC)
Metro Ethernet Access Service	has the meaning given in the ***Ethernet Product Specification Guide***
MTU	Maximum Transmission Unit
NNI	Network to Network Interface *(also known as ONI)*
NNI Bearer	Network to Network Interface Bearer (*also known as OBI*)
NTD	Network Termination Device *(also known as ONT or NTD)*
POI	Point of Interconnect
UNI	End-user Network interface *(also known as OUI)*
UNI-D	End-user Network Interface for data services *(also known as OUI-D)*
UNI-E	End-user Network interface for enterprise data services *(also known as OUI-E)*
QoS	Quality of Service
RSP	Residential Service Provider (also known as Customer under the ***RSPMA***)
RSPMA	Retail Service Provider Master Agreement
TPID	Tag Protocol Identifier

Table 1 - Acronym Definitions

The following table enables comparison between Opticomm API acronyms and nbn equivalents.

DESCRIPTION	FORMAT	EXAMPLE	EQUIVALENT NBN
Location/Property ID	OPC\d{12}	OPC000000000000	LOC000000000000
Product ID	OPI\d{12}	OPI000000000000	PRI000000000000
Product Order	OPO\d{12}	OPO000000000000	ORD000000000000
NNI	ONI\d{12}	ONI000000000000	NNI000000000000
NBI	OBI\d{12}	OBI000000000000	NBI000000000000
CVC	OVC\d{12}	OVC000000000000	CVC000000000000
Opticomm Access Circuit	OAC\d{12}	OAC000000000000	AVC000000000000
Customer Service Area	OSA\d{12}	OSA000000000000	CSA000000000000
NTD ID	OTD\d{12}	OTD000000000000	NTD000000000000
UNI PORT	OUI\d{12}	OUI000000000000	UNI000000000000
Appointment ID	OAT\d{12}	OAT000000000000	APT000000000000
Template ID	OPT\d{12}	OPT000000000000	TPL000000000000
Subscription ID	OCB\d{12}	OCB000000000000	CBK000000000000

Figure 1 - API Acronym Definitions

3 Introduction

3.1 Service Type Availability

This section provides a brief overview of the Service types that the RSP may choose to deploy for End-users using the Opticomm Ethernet Wholesale Network.

3.1.1 Ethernet Bitstream Services

Opticomm's Ethernet Bitstream Service has been designed to meet the needs of the Residential End-user and the growing demand for high-speed broadband services.

The Service supports the delivery of unicast data services through layer 2 circuits. These circuits provide transparency to network layer protocols such as IPv4 and IPv6 and protocols such as BFD.

3.1.2 ELINE Business Service

Opticomm's Metro Ethernet Access Services (generally referred to as "ELINE" services within this document) are a point-to-point business grade Service that is available throughout the Opticomm Network Footprint. ELINE offers predictable performance with symmetrical Committed Information Rates (CIR) to ensure low latency and a minimum of jitter.

Delivered over Opticomm's MPLS backbone network, the ELINE is a highly scalable Service available in bandwidths from 2Mbps to 100Mbps over GPON access links and up to 1000Mbps via dedicated fibre links. The type of access technology for ELINE services is site dependent.

ELINE Services are offered with business grade service level agreements (SLAs). Refer to the ***RSPMA*** and ***Service Level Agreement*** for further details.

3.2 Wholesale Network Product Topology

This section provides a brief overview of the available network topologies within the Opticomm Network. The topology supported on each premises in the Opticomm Network is found by the RSP performing an SQ on the premises.

3.2.1 N:1 VLAN Topology

Opticomm N:1 VLAN architecture provides the greatest level of scalability whilst reducing complexity for the RSP in the Opticomm Network.

Effectively it can be considered an ethernet bridge with multiple logical bridge ports.

These bridge ports are separated into two horizons:

- A Provider bridge port at the POI which faces the RSP; and
- End-user bridge ports which face the End-user.

User bridge ports are isolated from one another and can only communicate with a Provider port. The RSP can choose to configure IPoE or PPPoE authentication. See Section 8.8 below.

3.2.2 1:1 VLAN Topology

Opticomm 1:1 VLAN architecture consists of bundles of up to 4K End-user connections (AVCs) presented over a single logical connection to the RSP (CVC). User traffic is delivered double tagged where the outer tag is the CVC S-TAG and the inner tag is the End-user AVC C-TAG.

Every End-user connection (AVC) is logically isolated from each other via the use of distinct S/C-VLAN pairs and are designed to be individually dimensioned by the RSP from a set of selectable parameters according to the service needs of each End-user.

End-user ports are isolated from one another and can only communicate with the RSP.

3.3 Service Components

This section provides a brief definition of key components of Opticomm Services.

3.3.1 Network to Network Interface (NNI)

Network to Network Interface (NNI or ONI) is the physical interconnection between Opticomm core network and the RSP. RSP is required to have at least one NNI in each state (service area or OSA) in which they are planning on selling services. Opticomm provides state-based aggregation backhaul services to each of its communities, so as a minimum one NNI is required per state to purchase services in that state.

3.3.2 End-user to Network Interface (UNI)

End-user to Network Interface (UNI or OUI) is the physical interconnection between Opticomm NTD and the RSP's / End-user's premise equipment (e.g. a Residential Gateway (RG)).

3.3.3 Connectivity Virtual Circuit (CVC)

The Connectivity Virtual Circuit (CVC) connects the RSP's NNI to End-users' virtual circuits. At least one CVC needs to be ordered per NNI.

In an N:1 VLAN topology, a single CVC has access to all End-users in the state.

In a 1:1 VLAN Topology, a CVC is the S-TAG assigned to a CSA, and for ELINE likewise.

A dedicated CVC is required for each service type:

- CVC-D: is used for Ethernet Bitstream Services data.
- CVC-E: is used for ELINE Service data.

For ELINE Services and as defined by MEF33, there are two types of CVC Services that terminate on a UNI-E port at the End-user end and an NNI at the RSP's end.

- Ethernet Private Line (EPL) services. Port based at the UNI-E.
- Ethernet Virtual Private Line (EVPL) services. VLAN based at the UNI-E.

The RSP will need to build a CVC-E to support the ordering of the EPL and EVPL type CVCs for ELINE Services.

3.3.4 Access Virtual Circuit (AVC) / Local Ethernet Bitstream (LEB)

The Access Virtual Circuit (AVC) connects the End-users' UNI to an CVC. Also known in legacy Opticomm documentation as a Local Ethernet Bitstream (LEB). Access Virtual Circuit or AVC will be the terminology used going forward.

Each End-user can only have one AVC per UNI.

4 Network to Network Interface (NNI / OBI)

Further to the NNI Service Component in Section 3.3.1, the below section provides further product-level specification of the NNI Product Component. NNI is also known as a NNI Group (or redundancy groups). The OBI are the bearers inside the NNI Group.

A bearer (OBI) is a physical connection to a port, and bearers can be grouped together to form an NNI Group with a maximum of 8 bearers per NNI.

4.1 NNI Connection

RSP is required to connect to at least one NNI in each state in which they are planning on selling services.

End-users may choose to connect to Opticomm NNI via a Direct Link; as outlined in Sections 4.2.1 and 4.2.2; or via a VXC as outlined in Section 4.2.3.

Port allocation is determined at the time of cross-connect and therefore does not have a standard patching convention. This should be considered when connecting to the Opticomm Network.

4.1.1 NNI Limitations

Opticomm does not implement technical limitations on the NNI Bearer however limitations will need to be considered by RSP due to the RSP's set C&S Tag limitations.

4.2 NNI Location

Opticomm NNI's are available at the following POI locations*:

State	Site Code	Site Description	Address
VIC	DCM1 DCM2	Next DC M1 Next DC M2	Floor 1, 826 - 838 Lorimer Street, Port Melbourne, VIC 3207 Floor 1A, 75 Sharps Rd, Tullamarine VIC 3043
NSW	HAIS DCS2	Global Switch Next DC S2	Ground Floor, 390 - 422 Harris St, Ultimo, NSW 2007 Ground Floor, 6/8 Giffnock Ave, Macquarie Park, NSW 2113
QLD	WHRF DCB2	Next DC B1 Next DC B2	Ground Floor, 20 Wharf Street, Brisbane, QLD 4000

			Floor 3, 454 St Pauls Terrace, Fortitude Valley, QLD 4006
SA	BLIR CDC3	Your DC Colo City D3	Ground Floor, 60 Belair Rd, Hawthorn, SA 5062 Floor 1, 172 Morphett St, Adelaide, SA 5000
WA	MLRS DCP2	Next DC P1 Next DC P2	Ground Floor, 4 Millrose Dr, Malaga, WA 6090 Ground Floor, 12 Newcastle St, Perth, WA 6000

** note: locations subject to change from time to time, on notice from Opticomm*

Table 2 - POI Locations

4.2.1 Direct OBI Connection (as part of an NNI)

Direct NNI's are delivered on optical single mode fibre as the physical media type.

The following Port Speeds and Types are available as per the below table.

Port Speed	Transceiver	Max Distance[1]
1Gbps	1000Base-LX 1310nm	10 Km
	1000Base-ZX 1550nm	40 Km
	1000Base-BX 1270nm/1330nm	20 Km
10Gbps	10GBase-LR 1310nm	10 Km
	10GBase-ER 15510nm	40 Km
	10GBase-BXU 1270nm/1330nm	10 Km
40Gbps	40GBASE-LR4 1410nm	10 Km
100Gbps	100GBASE-LR4	10 Km
	100GBASE-ER4L	40 Km

Table 3 - Direct NNI Connection

[1] Thresholds of the hardware/device used may result in an upgrade/downgrade of module based on the distance and testing results

Opticomm does not use splitter or amplifiers between NNI ports.

To enable the delivery of 1Gbps AVC services, a 10Gbps NNI interface is required.

4.2.2 Direct NNI Redundancy Group

NNI Redundancy Groups can support up to the following:

Port Speed	NNI Interfaces
1Gbps	8
10Gbps	8
40Gbps[2]	1
100Gbps[2]	1

Table 4 - NNI Interfaces supported by NNI Redundancy Groups

All NNI Groups: 1Gbps, 10Gbps, 40Gbps or 100Gbps; can only support the same group interface rate. These cannot be interchanged.

For NNI redundancy, Opticomm implements Link Aggregation Control Protocol (LACP) as defined by IEEE 802.3ad.

The RSP can apply NNI redundancy at the same NNI Location (Single Chassis Redundancy) or at two different NNI Locations within the same state (Multi-Chassis Redundancy across dual POI's).

The following parameters can be decided by the RSP:

- Number of NNI interfaces in a LAG group
- In an MC-LAG topology, RSP can choose the minimum links that need to be active to keep the LAG group up
- The port priority from Opticomm side

Where a 10GE link fails on a LAG member, Opticomm will automatically switch the traffic to the side with the most active links.

4.2.3 VXC Connection

The Opticomm Network is connected to VXC at all NNI locations listed in Section 4.2. The Opticomm VXC interface is a public interface which can be searched and located using VXC marketplace.

[2] To enable the delivery of 40Gbps and 100Gbps NNI, a feasibility study will be conducted by Opticomm to confirm the availability at the NNI Location

End-users should know that each Service type will be delivered on a separate VXC.

The VXC needs to have a higher Gbps speed available than that of the speed being delivered. For instance, where 1Gbps VXC is being delivered, the RSP must have a minimum of 1.5Gbps available.

It is the RSP responsibility to submit a VXC order with VXC to connect to Opticomm VXC interface.

5 End-user Network Interface (UNI)

The ethernet UNI is supplied by Opticomm to the End-user premises. The UNI is an independent interface which operates in isolation from any other UNI residing on the same End-user equipment and in compliance with IEEE 803.2 standards.

5.1 Physical Interface

The below table outlines the interface modes available on the UNI.

Speed	Duplex	Negotiation	Type
10/100/1000	HALF/FULL	AUTO	Electrical

Table 5 - Interface mode available on UNI

RSP can determine the physical interface parameters for a specific premises through an SQ.

5.2 UNI Line Rates

The following ethernet line rates are supported by UNI (Line Rates):

- 10Mbps
- 100Mbps
- 1000Mbps

The upper bound on the information-carrying capacity of the link is set by the Line Rates.

It is the RSP's responsibility to understand the limitations of ethernet Services relating to the impact of framing overhead and asynchronous operation on bandwidth efficiency; and should be accommodated within the capacity allocation.

The Line Rate will be auto negotiated to the End-users UNI as per the default configuration settings.

It is the RSP's responsibility to ensure:

- the UNI operates with a Line Rate that is sufficient to carry the requested AVC capacity and can be achieved by using auto-negotiation or, where available, a fixed Line Rate setting requested by End-user; and
- the Duplex mode of the UNI.

5.3 UNI Redundancy

The UNI is an unprotected physical interface.

Should a physical failure occur on a UNI, all Services being delivered across that UNI will be disrupted.

5.4 End-user Equipment Supply

Opticomm is responsible for the provision and support of the NTD.

If a premises has an NTD already installed at the time of SQ, Services are provisioned on the NTD at the time of the RSP service order. If a premises doesn't have a NTD present, the RSP and/or the End-user can order an NTD through Opticomm, including installation by an Opticomm field technician, at the time of the RSP service order or before the RSP service order has been placed on the Opticomm OSS. The cost to install a premises with its first NTD is determined by the developer of the residential community and is found through the SQ. Replacement of failed or missing NTDs after the first install is the responsibility of Opticomm, however charges may apply where the NTD has failed due to third party interference.

Typically, Opticomm NTDs have 1 UNI physical interface. If multiple services are required at a premises, on demand Opticomm can replace a single port NTD with a multi-port NTD. The number of UNI interfaces available at a premises is determined through the SQ.

The Opticomm NTD is located in an End-user premises and remains the property of Opticomm.

The type of NTD used at the End-user premises is determined by the type of the wholesale access network in that Opticomm community. Opticomm will deliver the NTD based on the below:

	Supplied By	FTTP	HFC	FTTB	FTTBW	FTTR
GPON ONT	Opticomm	✓	×	×	Refer to FTTBW related installation requirements for Username, password and VLAN configurations	×
XGSPON	Opticomm	✓[3]	×	×		×
Cable Modem	RSP	×	✓	×		×
VDSL Residential Gateway	RSP	×	×	✓		×
VDSL Modem (where applicable)	RSP	×	×	✓[4]		×
No NTD required. Cat 5 / 6 wall plate is the wholesale network boundary point	End-user	×	×	×		✓

Table 6 - NTD End-user Premises Requirements

For specifications relating to the various NTD types, see the resource centre in the RSP Portal.

[3] On demand in the future when multi-gigbit products are introduced
[4] VDSL modems supported on nbn FTTB are supported on the Opticomm FTTB network

6 CVC

6.1 Overview

The CVC is a virtual point to multipoint ethernet Service delivered over Opticomm backbone network.

The Opticomm Ethernet CVC service component has the following variants:

- N:1 VLAN Ethernet Bitstream Service – One CVC to virtually connect NNI to residential End-users' AVC in the same state.
- 1:1 VLAN Ethernet Bitstream Service - each CVC to virtually connect NNI to residential End-users' AVC in the same state.
- 1:1 VLAN Ethernet ELINE Service – An CVC to virtually connect NNI to an End-user AVC.

6.2 CVC ID

Each CVC, existing or new, has a unique ID applied by Opticomm which follows the below format:

<3 letter service type><12-digit code>

E.g.: CVC123456123456

The CVC ID will remain for the lifetime of the CVC or until the CVC is permanently disconnected. Upon disconnection the CVC ID is retired and no longer available for use.

6.3 N:1 VLAN Architecture Scalability

There are no restrictions on the number of N:1 AVC's that can be associated with an CVC as the N:1 model does not use C-VLANs.

The S-VLAN ID on the CVC can be negotiated between Opticomm and the End-user.

6.4 1:1 VLAN Architecture Scalability

Each CVC is a separate logical construct; and has no inter-CVC traffic forwarding or inter-CVC impact. All traffic at the NNI includes an S-VLAN and C-VLAN.

Each AVC within a CVC is allocated a C-VLAN which must be unique within that CVC.

In the 1:1 model, each CVC can scale to a maximum of 4000 AVC's.

6.5 CVC Bandwidth Profile

Each CVC has an upstream and downstream bandwidth profile irrespective of traffic class. It is the RSP's responsibility to control the CVC:AVC contention.

The RSP is required to choose the defined allowance applied to an CVC, in turn this sets the inbound policer profile.

6.5.1 Bundled CVC

Opticomm provides a default of 1100Mbps included bandwidth per state per RSP.

A bundled entitlement is calculated daily at approximately 11pm by calculating the sum of the plan count x the plan entitlement count.

E.g.: if RSP has 10 x 25/5 bundle plans, RSP would be entitled to 12.5Mbps.

Refer to the ***Ethernet Product Specification Guide*** and ***Wholesale Price List*** for product and inclusion details and pricing.

6.5.2 Dimension Based CVC

The Dimension Based CVC policer is a defined bandwidth purchased by the End-user for a given CVC. The below table outlines the Aggregated Ethernet Bitstream Bundled for TC-4 options for Dimension Based CVC's:

Product Code	Product Name	Description
OPHLEB-12	Local Ethernet Bitstream Access - 12/1 Mbps	12/1 Mbps
OPHLEB-25	Local Ethernet Bitstream Access - 25/5 Mbps	25/5 Mbps
OPHLEB-50	Local Ethernet Bitstream Access - 50/20 Mbps	50/20 Mbps
OPHLEB-100-20	Local Ethernet Bitstream Access - 100/20 Mbps	100/20 Mbps
OPHLEB-99	Local Ethernet Bitstream Access - 100/40 Mbps	100/40 Mbps
OPHLEB-250-25	Local Ethernet Bitstream Access - 250/25 Mbps	250/25 Mbps[5]
OPHLEB-X2	Local Ethernet Bitstream Access - 250/100 Mbps	250/100 Mbps
OPHLEB-X5	Local Ethernet Bitstream Access - 500/200 Mbps	500/200 Mbps[5]
OPHLEB-1000-50	Local Ethernet Bitstream Access - 1000/50 Mbps	1000/50 Mbps[5]
OPHLEB-X9	Local Ethernet Bitstream Access - 1000/400 Mbps	1000/400 Mbps[5]

Table 7 - Dimension Based CVC's for Internet Services (No QoS)

CVC capacity: at the agreed capacity; of all provisioned CVCs on an NNI can exceed the NNI capacity. The Dimension Based CVC regime is being discontinued effective 30 June 2022, and from this date all RSP's will be required to be operating on the Bundled CVC regime as of 1 July 2022 (refer Section 6.5.1).

[5] May not be available in selected locations, refer to Service Qualification to confirm availability

6.6 CVC Traffic Classes

Traffic Classes offered by Opticomm are outline in the table below:

Traffic Class	Description
TC1	Voice traffic, *Expedited Forwarding* Class. Refer to ***Wholesale Price List*** for product inclusions
TC2	Future
TC4	Ethernet Bitstream, *Best Effort* Class. Default traffic class for Data/Internet traffic. Refer to ***Wholesale Price List*** for product inclusions

Table 8 - CVC Traffic Classes

Traffic that exceeds the bandwidth profile associated at the CVC levels will be discarded by the Layer 2 traffic policers.

6.7 CVC Service Type

6.7.1 Ethernet Bitstream CVC-D

Upon placement of a CVC-D, RSP must choose either a N:1 or 1:1 VLAN option.

The below table outlines the inclusion and exclusions for each.

CVC-D	N:1 VLAN	1:1 VLAN
NNI required per State	Yes	Yes
CVC-D required per state	Yes	Yes
Maximum number of AVCs	Unlimited[6]	4000
Single Tagging VLAN ID	Yes	NA
Double Tagging Outer Tag = CVC S-Tag Inner Tag = End-user AVC C-Tag	NA	Yes
Policer requirements	Refer to Section 7	

Table 9 - CVC-D inclusions and exclusions

6.7.2 1:1 Ethernet Eline CVC-E

For ELINE Services, the End-user needs to order a separate CVC-E with a VLAN ID. The VLAN-ID must be different to any existing CVC-D VLAN ID configured on the RSP NNI. Noting that if an RSP is connected via VXC, a separate VXC need to be ordered by the RSP.

[6] Limitations may need to be adhered to by the RSP's own standards/calculations

Multiple ELINE Services can be delivered using the same CVC-E VLAN ID, as long as the total services bandwidth does NOT exceed the NNI line rate or allocated bandwidth.

Ingress and Egress traffic on CVC-E has priority over other traffic types within the Opticomm Network. However, it is the RSP's responsibility to ensure sufficient bandwidth at the NNI where an CVC-D service is sharing the same NNI as other traffic types.

A Single EPL and Multiple EVPL CVCs are supported on a single UNI-E port.

Each CVC has the capability of being independently configurable to any one of the allowed bandwidth values.

RSPs are responsible to shape and/or police non-conforming CVC traffic.

A CVC provides complete transparency and unrestricted forwarding to Unicast, Multicast and Broadcast Ethernet frames. Where a multicast service is requested a feasibility test will occur to ensure the availability on the Opticomm Network.

7 Layer 2 Traffic Policing Implementation

Layer 2 traffic policing is applied at various points throughout the Opticomm Network and the AVC or CVC. The following outlines those applications.

- Where CBS is 100ms of the CIR of the AVC, the following applies:
  - AVC downstream – at the NTD
  - AVC upstream – at the NTD
- Where CBS is 100ms of the CIR of CVC, the following applies:
  - CVC downstream – at NNI Location
- Traffic is shaped to match the RSP's CVC Upstream rate
- Policer on the CVC is applied to the sub-interface (on the VLAN) to rate limit traffic
- Policer on the AVC at the NTD UNI for both upstream and downstream traffic, is based on the available bandwidth profiles as outlined in the table below:

Service Speed	Downstream PIR (Mbps)	Upstream PIR (Mbps)
12/1 Mbps	13.8	1
25/5 Mbps	28.75	5
50/20 Mbps	57.5	20
100/20 Mbps	115	20
100/40 Mbps	115	40
250/25 Mbps	287.5	25
250/100 Mbps	287.5	100
500/200 Mbps	575	200
1000/50 Mbps	1000	50
1000/400Mbps	1000	400

Table 10 - Policer on the AVC at the ONT UNI

All AVC traffic will be carried in relation to the CVC SLA and at the relevant CVC rate.

8 Access Virtual Circuit (AVC)

8.1 Overview

Access Virtual Circuit (AVC) (formally known as LEB) is a virtual circuit that connects and carries the traffic from NTD's UNI port.

Each UNI can terminate a maximum of one AVC circuit. Each circuit will have the ability to have multiple QOS marking. Within the AVC, different Traffic Classes will be applied.

8.2 AVC ID

Each AVC, existing or new, has a unique ID applied by Opticomm which follows the below format:

<3 letter service type><12-digit code>

E.g.: OAC123456123456

The AVC ID will remain for the lifetime of the AVC or until the AVC is disconnected.

Upon disconnection the AVC ID is retired and no longer available for use.

8.3 N:1 VLAN Architecture for Ethernet Bitstream Services

There are no restrictions on the number of N:1 AVC's that can be associated with an CVC as the N:1 model.

Traffic from AVC's will be presented at the CVC in the NNI as single tagged; as the CVC VLAN. Traffic between AVCs are separated and isolated from one another.

Only 0x8100 TPID is supported.

8.4 1:1 VLAN Architecture for Ethernet Bitstream Services

Addressing modes are as follows:

Mode	Summary	Description	Details
Default Mapped	Untagged Activation enabled QoS (selected at service activation)	Untagged packets received on the UNI are tagged with C-VLAN and S-VLAN and a fixed TC p-bit that is selected during service activation.	Untagged service frames that carry no Layer 2 priority information, as per 802.3. Default map will be TC-4
DSCP Mapped	Untagged DSCP enabled QoS	Untagged packets received on the UNI are tagged with C-VLAN and S-VLAN and	Untagged service frames that carry no Layer 2 priority information, as per 802.3, where priority information is

		TC p-bit based on IP DSCP value.	encoded into the DSCP field as per RFC2474.
Priority Tagged	Single tagged (null/unpopulated) 802.1p enabled QoS	Tagged packets received on the UNI are tagged with S-VLAN and TC p-bit that is selected during service activation.	Service frames that carry Layer 2 priority information in the VLAN tag, as per 802.1p, where priority information is encoded into the VLAN Priority-Code-Point (PCP) field
Tagged	Single tagged (End-user provided) 802.1p enabled QoS	Tagged packets received on the UNI are tagged with S-VLAN and TC p-bit mapped from C-VLAN p-bit value.	Service frames that carry Layer 2 priority information in the VLAN tag, as per 802.1p, where priority information is encoded into the VLAN Priority-Code-Point (PCP) field

Table 11 - 1:1 VLAN Addressing Modes

The table below outlines the Addressing Modes supported by each UNI type:

Type	Default Mapped	DSCP-Mapped	Priority-Tagged	Tagged
UNI-D	Yes	Yes	Yes	Yes
UNI-E	No	Yes	No	Yes
NNI	No	No	No	Yes

Table 12 - NNI Addressing Modes by UNI

8.5 1:1 VLAN Architecture for ELINE Services

AVC for an ELINE Service can be configured using one of the following VLAN operations:

Operation	Configuration	EPL	EVPL
Untagged	AVC is configured to receive untagged packets from End-user UNI and present the traffic as single tagged traffic at CVC NNI	No	Yes
Tagged	AVC is configured to received tagged packets with a specific VLAN ID from End-user UNI and present the traffic as single tagged traffic at CVC NNI	No	Yes

Transparent	AVC is configured to receive tagged and untagged packets from End-user NNI and insert and S-TAG on top of all received packets	Yes	No

Table 13 - VLAN Operation Configurations

The End-user MUST specify the type of VLAN operation at the time of ordering.

Only 0x8100 TPID is supported.

8.6 AVC Inclusions

Refer to ***Ethernet Product Specification Guide*** for product and inclusion details.

8.7 AVC Traffic Classes

Traffic Class combinations offered by Opticomm are outline in the table below.

Traffic Class/Combination	Option	PCP	DSCP	Bandwidth
TC-4 Only	UNI-D	0	0-63	As per selected Service
TC-4 plus TC-1	TC-1	5	40-46	Typically 150kbps
	TC-4	0	0-39 41-45 47-63	As per selected Service

Table 14 - AVC Traffic Classes

8.8 Authentication Methods

8.8.1 Ethernet Bitstream Service Authentication

The method of authentication for Ethernet Bitstream Services is by either PPPoE or IPoE.

PPPoE is typically authenticated using username/password combination or via populating the End-user Agent Circuit ID and Remote ID. PPPoE Agent remote ID is populated with AVC service ID.

The RSP MUST specify the authentication methods supported by their network during the onboarding process with Opticomm.

8.8.1.1 IPv4 and IPv6 support

For IPoE services, DHCPv4 Option 82 remote ID is populated with AVC service ID.

Service identification for DHCPv6 is supported on same Opticomm communities, confirmed through SQ, as per the RFC6221 standards, except for Option 37 (Remote ID) which must not be populated in the DHCPv6 Relay Forward message.

Option 20 must be used where the End-users Equipment attached to an AVC sends a DHCPv6 Relay Forward message; this includes transparently carrying any original DHCPv6 messages, i.e. Option 18 an Option 37).

Opticomm will populate the intermediate-agent information option in the upstream PADI packets against the AVC ID. The intermediate-agent information option is not visible downstream.

8.8.2 Ethernet Eline Service Authentication

The method of authentication for Ethernet Bitstream Services is by either PPPoE, IPoE or static IP.

8.8.3 MAC Address Limitation

Each AVC is restricted to a maximum of 8 MAC addresses.

MAC address learning is implemented with a 5-minute aging timer.

If the End-user exceeds the maximum MAC count, traffic from newly discovered devices at the UNI will be discarded.

8.8.4 MTU Size

The maximum supported AVC MTU size is 1526 bytes.

Frames greater than 1526 bytes may be discarded. This provides for a typical IP payload of 1500 bytes.

In case the End-user requires more than 1526 bytes MTU for an ELINE Service, a feasibility study will be required before offering a bigger MTU size.

8.9 Smartlink

Opticomm uses Smartlink on a local VLAN to service building services, i.e.: intercom, metering etc.

Smartlink does not impact the RSP services, backhaul utilisation or CVC traffic.

9 Network Performance

9.1 Traffic Classes

CVC's support the following traffic classes from NNI to UNI:

Traffic Class	Applications	Priority (802.1p/COS)	Supported Products
TC-1 (Voice)	Voice,	5	Ethernet Bitstream Services
TC-2 (Assured Forwarding) (Future)	Business Ethernet Services, Video, and Real Time Applications	4	Ethernet Bitstream Services ELINE Services
TC-4 (Best Effort)	Data	0	Ethernet Bitstream Services

Table 15 - Traffic Classes from NNI to UNI

All CVC-D are configured on TC-4 best effort traffic class.

CVC-E are configured on TC-2 assured forwarding traffic class.

9.1.1 Traffic Class Descriptor

It is a requirement for the RSP to support prioritisation of the Traffic Classes, TC-1, TC-2, and TC-4 as per the descriptions below.

9.1.1.1 TC-1 Description

The TC-1 traffic class is targeted voice applications that requires low-latency and expedited delivery, with the following characteristics:

- Low bitrate
- Low frame delay, frame delay variation, frame loss

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

TC-1 provides a committed level of premium capacity with limited ability to burst above its CIR.

9.1.1.2 TC-2 Description

The TC-2 traffic class is targeted towards real-time, interactive multimedia applications, with the following characteristics:

- High bitrates, and large ethernet frame sizes
- Low frame delay, frame delay variation, frame loss

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

TC-2 provides a committed level of premium capacity with limited ability to burst above its CIR.

9.1.1.3 TC-4 Description

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

9.1.1.4 Mapping of ingress traffic

The mapping of ingress traffic to Traffic Classes of the RSP’s network must comply with the following where applicable:

PCP	DSCP (only at DSCP mapped UNI)	Map To:
5	CS5, EF	TC-1
4	CS4, AF41-43	TC-2
0	All remaining markings	TC-4

Table 16 - Mapping of Ingress Traffic

The following rules apply:

1. NNI configuration
    - Any ingress traffic that does not map to a provisioned CVC traffic class will be discarded at ingress.
2. UNI-D configuration, DSCP-Mapped
    - Any ingress traffic (IPv4 or IPv6) that does not map to a provisioned AVC traffic classes are mapped to the TC-4 traffic class.
3. UNI-D configuration, Default-Mapped
    - All ingress traffic is mapped to the Default-Mapped traffic class, irrespective of DSCP marking.
4. UNI-D configuration, Priority-Tagged
    - Any ingress traffic with PCP marking that does not map to a traffic class provisioned in respect of the associated AVC will be discarded at ingress.
5. UNI-D configuration, Tagged
    - Any ingress traffic with PCP marking that is not mapped to a traffic class provisioned in respect of the associated AVC will be discarded at ingress

9.1.2 Priority Encoding (PCP)

Service frames carried by the Opticomm Network has priority encoding performed on egress towards the Opticomm Network at the NNI or towards the End-user premises at the UNI for Tagged and Priority Tagged service types.

Noting that where the Opticomm Network adds any VLAN tags, the appropriate PCP markings will be applied to all VLAN tags on egress.

The mapping of Traffic Class to PCP is shown below:

Traffic Class	Encodes PCP to:
TC-1	5
TC-2	4
TC-4	0

Table 17 - Mapping of Traffic Class to PCP

DSCP markings of IPv4 and IPv6 payloads must be carried transparently through the provider network for all service types.

9.2 CVC Bandwidth Profile

The below formula shows the Committed Burst Size (CBS) calculation for CVC Committed Information Rate (CIR):

$$CBS = \frac{0.1 \times CIR\ (bits)}{8}\ Bytes$$

9.3 ELINE Services Bandwidth Profile

The following table outlines the available ELINE Services offered by Opticomm.

Service Name	CIR (Mbps)
ELINE-1	1 Mbps
ELINE-2	2 Mbps
ELINE-5	5 Mbps
ELINE-10	10 Mbps
ELINE-20	20 Mbps
ELINE-50	50 Mbps
ELINE-100	100 Mbps
ELINE-200	200 Mbps
ELINE-300	300 Mbps
ELINE-400	400 Mbps

ELINE-500	500 Mbps
ELINE-1000	1000 Mbps

Table 18 - Ethernet Eline Service Bandwidth Profile

9.4 PON Optical Budget

Where the installed optical network is patched to an active Opticomm Headend the required testing is PON meter levels only at the NAP SC/APC connector.

The below are the expected and minimum acceptable levels. Also listed is the maximum acceptable variation in measurements taken between ports fed from the same FDH.

		OLT		OLT		OLT		1550 EDFA +21		1550 EDFA +18	
Equipment	Item	Spliced 1x64		Connect 1x64		Connect 1x32		Connect 1x64		Connect 1x32	
		dB	dBm	dB	dBm	dB	dBm	dB	dBm	dB	dBm
OLT/EDFA	Launch Pwr		3.00		3.00		4.50		21.00		18.00
	Connector	0.20	2.80	0.20	2.80	0.20	4.30	0.20	20.80	0.20	17.80
Patch Lead	Lead	0.10	2.70	0.10	2.70	0.10	4.20	0.10	20.70	0.10	17.70
WDM	Connector	0.20	2.50	0.20	2.50	0.20	4.00	0.20	20.50	0.20	17.50
	WDM	0.50	2.00	0.50	2.00	0.50	3.50	0.50	20.00	0.50	17.00
	1 x 2 Splitter	3.10	-1.10	3.10	-1.10		3.50	3.10	16.90		17.00
	Connector	0.20	-1.30	0.20	-1.30		3.50	0.20	16.70		17.00
Patch Lead	Lead	0.10	-1.40	0.10	-1.40	0.10	3.40	0.10	16.60	0.10	16.90
FOBOT	Connector	0.20	-1.60	0.20	-1.60	0.20	3.20	0.20	16.40	0.20	16.70
	Splice	0.05	-1.65	0.05	-1.65	0.05	3.15	0.05	16.35	0.05	16.65
Meterage	Cable	0.21	-1.86	0.21	-1.86	0.21	2.94	0.21	16.14	0.21	16.44
FJC	Splice	0.05	-1.91	0.05	-1.91	0.05	2.89	0.05	16.09	0.05	16.39
Meterage	Cable	0.21	-2.12	0.21	-2.12	0.21	2.68	0.21	15.88	0.21	16.18
FJC	Splice	0.05	-2.17	0.05	-2.17	0.05	2.63	0.05	15.83	0.05	16.13
Meterage	Cable	0.21	-2.38	0.21	-2.38	0.21	2.42	0.21	15.62	0.21	15.92
FDH	Splice	0.05	-2.43	0.05	-2.43	0.05	2.37	0.05	15.57	0.05	15.87
	1 x 8 Splitter	16.00	-18.43	9.70	-12.13	9.70	-7.33	9.70	5.87	9.70	6.17
	Connector	0.05	-18.48	0.20	-12.33	0.20	-7.53	0.20	5.67	0.20	5.97
Meterage	Cable	0.21	-18.69	0.21	-12.54	0.21	-7.74	0.21	5.46	0.21	5.76
NAP	Connector	0.10	-18.79	0.20	-12.74	0.20	-7.94	0.20	5.26	0.20	5.56
	1 x 4 Splitter		-18.79	6.90	-19.64	6.90	-14.84	6.90	-1.64	6.90	-1.34
	Connector	0.20	-18.99	0.20	-19.84	0.20	-15.04	0.20	-1.84	0.20	-1.54
LIA	Lead	0.10	-19.09	0.10	-19.94	0.10	-15.14	0.10	-1.94	0.10	-1.64
PCD	Connector	0.20	-19.29	0.20	-20.14	0.20	-15.34	0.20	-2.14	0.20	-1.84

Wall Outlet	Lead	0.10	-19.39	0.10	-20.24		-15.34		-2.14		-1.84
	Connector	0.20	-19.59	0.20	-20.44		-15.34		-2.14		-1.84
Patch Lead	Lead	0.10	-19.69	0.10	-20.54	0.10	-15.44	0.10	-2.24	0.10	-1.94
	Connector	0.20	-19.89	0.20	-20.74	0.20	-15.64	0.20	-2.44	0.20	-2.14
Link Loss Budget		22.89		23.74		20.14		23.44		20.14	
RX Level @ ONT			-19.89		-20.74		-15.64		-2.44		-2.14

Table 19 - PON Optical Budget