



Chorus UFB Services Agreement
Bitstream Services: Service Description for
Bitstream 2 Accelerate

Reference Offer

June 2014

1 Interpretation

- 1.1 References to clauses or sections are references to clauses or sections in this Service Description unless expressly provided otherwise. The definitions set out in the General Terms and the Operations Manual apply to this Service Description unless expressly provided otherwise.
- 1.2 References to the Operations Manual are references to the operations manual for the Bitstream Services.

2 The Bitstream 2 Accelerate Service

- 2.1 The Bitstream 2 Accelerate Service is a multi-class bitstream service suitable for accessing a wide range of internet and bespoke applications and content delivered over a shared fibre access. Bitstream 2 Accelerate is part of the UFB family of bitstream services:

Bitstream 2	Based on the TCF Mass Market service.
Bitstream 2 Accelerate	Based on the TCF Mass Market service with enhanced low priority options.
Bitstream 3	Based on the TCF Business service.
Bitstream 3 Accelerate	Based on the TCF Business service.
Bitstream 3P2P	Based on the TCF Business service.
Bitstream 3a	Based on the TCF Business service with Low Priority options.
Bitstream 3a Accelerate	Based on the TCF Business service with Low Priority options.
Bitstream 3aP2P	Based on the TCF Business service with Low Priority options.
Bitstream 4	Based on the TCF Business Premium service.
UFB Handover Connection	Based on the TCF E-NNI specification.
Multicast	Based on the TCF Ethernet Multicast Access (EMA) service.
ATA Voice	An analogue telephone access service.
UNI Voice (128/128)	Low speed Bitstream service for telephony access service.

- 2.2 A diagram of the configuration for the Bitstream 2 Accelerate Service is set out in Appendix A. The Bitstream 2 Accelerate Service provides one or more E-AVPLs from the UNI at the End User Premises, Service Provider Premises or NBAP (as applicable) to the UFB Handover Connection Service located at the POI that enables a Service Provider to access and interconnect with the LFC Network.
- 2.3 The Bitstream 2 Accelerate Service is an input service which a Service Provider can combine with other LFC services (or with the Service Provider's own network or wholesale services provided by other service providers) to provide fibre based telecommunications services to End Users.
- 2.4 The Bitstream 2 Accelerate Service has the following key characteristics:
- 2.4.1 The Bitstream 2 Accelerate Service includes one or more Ethernet E-AVPL bitstream services delivered in conjunction with Baseband over GPON. In particular:

- (a) each Ethernet E-AVPL bitstream service provides a single VLAN between the UNI and the E-NNI; and
- (b) the Baseband service supports up to two instances of the ATA Voice Service.

2.4.2 Support for two classes of traffic, High Priority and Low Priority:

Traffic Class	CIR	EIR
Low Priority	≥ 0	≥ 0
High Priority	≥ 0	= 0

2.4.3 A range of Service Template packages are offered. Clause 3.7.5 provides an overview of the Service Templates that are initially offered, each consisting of a single Ethernet bitstream and one or two ATA Voice Service packages with the option to create modified or new Service Templates using 'core building blocks' and the Product Development Process.

2.4.4 Supports tagged or untagged frames at the UNI.

2.4.5 Optionally inserts Circuit ID information in DHCP (Version 4) and PPPoE traffic.

2.4.6 Complies with the Mass Market service specified in the *TCF Ethernet Access Service Description v24, 19 January 2011*.

3 Bitstream 2 Accelerate Service and implementation activities

Installation Services

3.1 The Bitstream 2 Accelerate Service includes a Standard Install¹ as set out in the Operations Manual. The LFC will provide Non-Standard Installs as an ancillary service.

Termination Point

3.2 The Bitstream 2 Accelerate Layer 1 and Layer 2 termination points are set out in the Operations Manual.

Testing

3.3 The LFC will test the Fibre Lead-in from the termination point at the Premises, as referred to in the Operations Manual, to the Central Office where the access node is located to ensure the fibre is within the technical specification for fibre set out in Appendix B.

3.4 The LFC will perform a functional test of the Bitstream 2 Accelerate Service at the Layer 2 termination point at the Premises referred to in the Operations Manual.

Additional Services

3.5 If the Service Provider requires additional services such as:

- (a) a Non-Standard Install which includes (where required):
 - (i) the installation of the Fibre Lead-in where there is no existing fibre cabling and the installation is outside the parameters set out in the Operations Manual; or
 - (ii) installation of specialised termination equipment in an NBAP; or
 - (iii) installation of Fibre-Lead-in diversity at an End User Premises, Service Provider Premises or NBAP (as applicable) (from the FAP to the ETP or OFDF as applicable);

¹ Standard Install parameters may differ between LFCs

- (b) provision of diversity to End User Premises, Service Provider Premises or NBAP (as applicable) (when the second or subsequent instance of a Primary Bitstream 2 Accelerate Service is purchased);
- (c) any Premises wiring services; or
- (d) installation and testing of Service Provider equipment and services,

then the LFC may be able to provide items (c) and (d) on request subject to terms to be agreed between the LFC and the Service Provider. Items (a) and (b) are available on terms as set out in this Agreement.

Core Bitstream 2 Accelerate Service

3.6 The core bitstream services provided as part of the Bitstream 2 Accelerate Service are as follows:

3.6.1 One or more E-AVPLs, each consisting of:

- (a) A single 802.1q VLAN on a designated UNI on the ONT at the End User Premises or Service Provider Premises or NBAP (as applicable).
- (b) A single 802.1ad VLAN (Service VLAN ID/ Customer VLAN ID) on the E-NNI at the POI.
- (c) A QOS bandwidth profile that describes how traffic is carried between these points.

3.6.2 Bandwidth overhead for Low Priority to compensate for higher protocol encapsulation overheads. The size of the overhead is calculated as follows:

- (a) 10% overhead in Low Priority downstream for bandwidths <200 Mbps, e.g. 33 Mbps for a 30 Mbps headline bandwidth;
- (b) 8.5% overhead in Low Priority downstream for bandwidths ≥ 200 Mbps e.g. 217 Mbps for a 200 Mbps headline bandwidth;
- (c) 10% overhead in Low Priority upstream for bandwidths < 50 Mbps, e.g. 44 Mbps for a 40 Mbps headline bandwidth; and
- (d) 15% overhead in Low Priority upstream for bandwidths ≥ 50 Mbps, e.g. 57.5 Mbps for a 50 Mbps headline bandwidth;

This bandwidth overhead does not guarantee End Users will experience the headline speed as their experience is dependent on a number of external factors including, but not limited to, End User applications and local network, the Service Provider network and location of the content they are accessing.

3.7 The Bitstream 2 Accelerate Service includes the options, exercised by Service Request, to:

3.7.1 Set the UNI as a tagged or untagged interface.

3.7.2 Enable Circuit ID, as specified in Broadband Forum TR-101/TR-156, per tail. If this feature is requested TR-101 information will be embedded in DHCP or PPPoE traffic.

3.7.3 If the UNI is set to untagged:

- (a) Untagged frames sent from the End User are 802.1q tagged and marked as Low Priority;
- (b) Tagged frames sent from the End User are treated as set out in 3.7.4 below; and
- (c) 802.1q tags will be removed from downstream frames and presented as 802.3 Ethernet frames at the UNI.

3.7.4 If the UNI is set to tagged:

- (a) Frames sent from the End User that do not have 802.1q tags will be tagged and marked as Low Priority;
- (b) Tagged traffic sent from the End User or Service Provider are treated as follows:
 - (i) Frames tagged with PCP = 5 will be treated as High Priority.
 - (ii) Frames tagged with PCP = 0 will be treated as Low Priority.
 - (iii) Frames tagged with PCP = 1, 2, 3, 4, 6 or 7 will be remarked as PCP 0 and treated as Low Priority.
 - (iv) Frames will be treated as follows:

Type	Ingress	Transport
Low Priority	CIR \geq 0 EIR \geq 0 Policed at ingress based on CBS/EBS	Queued and weighted fairly under congestion conditions Frames classified as EIR dropped first
High Priority	CIR \geq 0 EIR = 0 Policed at ingress based on CBS	Strictly prioritised

- (v) Downstream traffic class is determined using the s-tag PCP setting although it is recommended that both the s-tag and c-tag is set to the same value.

3.7.5 The following initial Service Templates are available consisting of a Baseband Service with one or two instances of the ATA Voice Service and one Ethernet E-AVPL Bitstream service as follows:

Template	ATA ¹ ports	Headline ²				Low Priority PIR ⁹ (Mbps)		Low Priority Downstream				Low Priority Upstream				High Priority Downstream				High Priority Upstream			
		Low Priority (Mbps)		High Priority (Mbps)		Down	Up	EIR	EBS	CIR	CBS	EIR	EBS	CIR	CBS	EIR	EBS	CIR	CBS	EIR	EBS	CIR	CBS
		Down	Up	Down	Up																		
Evolve 30-10-2.5-2.5 ³	1	30	10	2.5	2.5	33	11	30.5	110	2.5	32	8.5	90	2.5	32	0	0	2.5	32	0	0	2.5	32
Education 30-30-10-10 ⁵	1	30	30	10	10	33	33	30.5	110	2.5	32	30.5	110	2.5	32	0	0	10	32	0	0	10	32
Education 50-50-10-10 ⁵	1	50	50	10	10	55	57.5	52.5	140	2.5	32	55	130	2.5	32	0	0	10	32	0	0	10	32
Evolve 200-50-2.5-2.5 ⁸	1	200	50	2.5	2.5	217	57.5	214.5	250	2.5	32	55	130	2.5	32	0	0	2.5	32	0	0	2.5	32
Evolve 128-128 ⁴ ⁶	0	0	0	0.128	0.128	0	0	0	0	0	0	0	0	0	0	0	0	0.128	32	0	0	0.128	32
Evolve 100-20-2.5-2.5 ³	1	100	20	2.5	2.5	110	22	107.5	180	2.5	32	19.5	100	2.5	32	0	0	2.5	32	0	0	2.5	32
Evolve 100-50-2.5-2.5 ³	1	100	50	2.5	2.5	110	57.5	107.5	180	2.5	32	55	130	2.5	32	0	0	2.5	32	0	0	2.5	32
Evolve 100-100-2.5-2.5 ³	1	100	100	2.5	2.5	110	115	107.5	180	2.5	32	112.5	180	2.5	32	0	0	2.5	32	0	0	2.5	32
Evolve 200-20-2.5-2.5 ⁴	1	200	20	2.5	2.5	217	22	214.5	250	2.5	32	19.5	100	2.5	32	0	0	2.5	32	0	0	2.5	32
Evolve 200-100-2.5-2.5 ⁴	1	200	100	2.5	2.5	217	115	214.5	250	2.5	32	112.5	180	2.5	32	0	0	2.5	32	0	0	2.5	32
Evolve 200-200-2.5-2.5 ⁴	1	200	200	2.5	2.5	217	230	214.5	250	2.5	32	227.5	180	2.5	32	0	0	2.5	32	0	0	2.5	32
Evolve ATA ⁴ ⁷	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] The ATA service is as described in the ATA Voice Service Description except that the High Priority frames are tagged with PCP 5.

[2] The headline rate is the Layer 2 bandwidth prior to the addition of the overhead described in section 3.6.2.

[3] Available for residential connections only.

[4] Available for residential or business connections with the appropriate connection Charge and SLAs applying

[5] Only available to an approved list of Education Priority Users agreed between Chorus and MBIE, provided on Chorus website and at <http://www.educationcounts.govt.nz/directories/list-of-nz-schools>

[6] Only to be used to provide telephony access services in greenfield areas. Not currently available, subject to Service Provider demand and subsequent CFH approval.

[7] This Service Template only contain ATA Voice services (Voice-AVPLs). Only available in greenfield areas.

[8] Trial, to be withdrawn.

[9] Low Priority 'Peak Information Rate', which is the headline rate plus the bandwidth overhead described in clause 3.6.2, is the sum of Low Priority CIR and Low Priority EIR.

Further Service Templates may be developed in future to facilitate the availability of other bandwidth profiles built from separate building blocks which are detailed in clause 3.8 below. However building blocks are not intended to enable the Bitstream 2 Accelerate upstream bandwidth to extend beyond a total of 50Mbps CIR (High Priority CIR plus Low Priority CIR), or downstream bandwidth to extend beyond a total of 100Mbps CIR (High Priority CIR plus Low Priority CIR).

3.7.6 The Bitstream 2 Accelerate Service has similar characteristics to the other services within the UFB family of Bitstream services as identified below:

Attribute	Bitstream 2 Bitstream 2 Accelerate	Bitstream 3 Bitstream 3 Accelerate	Bitstream 3a Bitstream 3a Accelerate	Bitstream 4
Bitstream	E-AVPL	E-APL	E-APL	E-APL
High Priority	Yes	Yes	Yes	Yes
Low Priority	Yes	No	Yes	No
Service Bandwidths (reference offer)*	Low Priority from 30/10 Mbps up to 100/50 Mbps Low Priority + High Priority up to 110/52.5 Mbps	From 2.5/2.5 Mbps to 100/100 Mbps	High Priority from 2.5/2.5 Mbps to 90/90 Mbps Low Priority + High Priority = 100/100 Mbps	From 1Mbps up to 10 GigE
Service Bandwidths (Accelerate)*	Low Priority from 30/10 Mbps up to 100/50 Mbps Low Priority + High Priority CIR up to 100/50 Mbps	From 2.5/2.5 Mbps to 100/100 Mbps	Low Priority from 100/100 Mbps up to 1000/1000 Mbps with High Priority from 2.5/2.5 Mbps up to 100/100 Mbps	N/A
MTU	2000 Bytes	2000 Bytes	2000 Bytes	9100
MAC addresses	16	64	64	Unlimited
Number of available UNIs	4 standard	4 standard	4 standard	1 with a second UNI available on request
L2CP support	No	No	No	Limited

Attribute	Bitstream 2 Bitstream 2 Accelerate	Bitstream 3 Bitstream 3 Accelerate	Bitstream 3a Bitstream 3a Accelerate	Bitstream 4
Diversity	On request with limited availability	On request with limited availability	On request with limited availability	Available to Priority Users in selected areas

* Bandwidth options for each Bitstream Service are detailed in each Bitstream Service Description and further options can be developed using the Product Development Process.

UNI – NNI characteristics

- 3.7.7 All Bitstream 2 Accelerate Services (E-AVPLs) on a UNI must belong to the same Service Provider and must connect to an E-NNI belonging to that Service Provider. However each Bitstream 2 Accelerate Service can connect to a different E-NNI at the same or different POI within a Coverage Area.
- 3.7.8 The sum of High and Low Priority traffic profiles of all services delivered at a UFB Handover Connection Service can exceed the UFB Handover Connection Service line rate. If there is insufficient line rate to deliver the traffic then frames will be randomly discarded, based on their Class of Service precedence, and Service Levels for that Class of Service do not apply. It is therefore the Service Provider's responsibility to shape and queue traffic appropriately.

New Service Template Options

- 3.8 A Service Provider may request that the LFC creates additional Service Templates as follows:
- 3.8.1 Additional Service Templates can be created using combinations of one more of the following set of standard building blocks:
- (a) Point-to-Point single VLAN Ethernet Bitstream service (E-AVPL) service using High Priority and Low Priority combinations as set out in the Service Description for the Bitstream 2 Service or the Bitstream 2 Accelerate Service. Multiple E-AVPLs can be configured on the same or on different UNIs;
 - (b) Point to Point VLAN (E-APL) service using High Priority combinations as set out in the Service Description for the Bitstream 3 Service or the Bitstream 3 Accelerate Service noting that E-APL and E-AVPL VLANS must be on separate UNIs;
 - (c) Point to Point VLAN (E-APL) service using High Priority and Low Priority combinations as set out in the Service Description for the Bitstream 3a Service or the Bitstream 3a Accelerate Service noting that E-APL and E-AVPL VLANS must be on separate UNIs;
 - (d) Multicast VLAN Ethernet Bitstream service (EMA) using High Priority (CIR) only as set out in the Service Description for the Multicast Service;
 - (e) ATA Voice port as set out in the Service Description for ATA Voice;
 - (f) UNI (100/1000 Base-T) port;

- (g) WiFi; and
 - (h) Other services or attributes requested by the Service Provider and agreed by the LFC.
- 3.8.2 Ethernet bitstream services consisting of High Priority and Low Priority bandwidth combinations can be created using the following standard building blocks:
 - (a) High Priority CIR in increments of 2.5 Mbps upstream and/or downstream;
 - (b) Low Priority CIR in increments of 2.5 Mbps upstream and/or downstream; and
 - (c) Low Priority EIR in increments of 10 Mbps upstream and/or downstream.
- 3.9 Service Templates can be added as primary or secondary Service Templates and have the following characteristics:
 - 3.9.1 Primary Service Templates must include Baseband. A primary Service Template does not require the End User connection to consume any other Service Templates in order for the services to be provided.
 - 3.9.2 Secondary Service Templates can be added as an additional service to an End User who is already consuming one or more Service Templates.
 - 3.9.3 Baseband is a required service for all End User connections. If the primary Service Template is removed from an End User connection and one or more secondary Service Templates remain, then either a secondary Service Template needs to be changed to a primary Service Template, or all of the secondary Service Templates will be removed by the LFC.
- 3.10 Requests for additional Service Templates will be implemented and delivered through the Product Development Process. The Product Development Process includes determination of pricing, development, testing and implementation.
- 3.11 The LFC will comply with the Service Provider's request under clause 3.8 in a timely manner. In the event that demand for new Service Templates exceeds the LFC's capacity to deliver the new Service Templates then the LFC may prioritise the Service Template requests in accordance with the Operations Manual.

Operations, Administration and Maintenance
- 3.12 The Bitstream 2 Accelerate Service will support Service Provider remote access to the ONT via a service management gateway for appropriate management. A Service Provider may request particular management attributes via the Product Development Process.
- 3.13 The Bitstream 2 Accelerate Service will support Ethernet Service Operations and Maintenance (OAM) for service integrity testing, fault diagnostics and performance measurement using ITU Y.1731. OAM capability will be phased in as the functionality is developed and deployed in scale and may be updated or amended by the LFC from time to time.

Service Requirements
- 3.14 To use the Bitstream 2 Accelerate Service the Service Provider must have the capability to access and interconnect with it, by one of the following:
 - 3.14.1 co-locating Service Provider equipment at the POI using the UFB Handover Connection Service and Central Office and POI Co-location Service;

- 3.14.2 connecting to third party co-location space at the POI using the UFB Handover Connection Service, and with the third party taking the Central Office and POI Co-location Service;
- 3.14.3 connecting to a backhaul service at the POI; or
- 3.14.4 by using the Direct Fibre Access Service to connect to Service Provider equipment at a remote location within the Central Office area.

The location of the POIs is detailed in the Operations Manual appendices.

Additional Service Characteristics

- 3.15 The technical specification of the Bitstream 2 Accelerate Service is set out in Appendix B.
- 3.16 The LFC will provide certain support and other assistance as part of the Bitstream 2 Accelerate Service including:
 - 3.16.1 an automated facility for Service Requests;
 - 3.16.2 an automated facility for fault notifications; and
 - 3.16.3 a tool to assist the Service Provider in determining the location and availability of the Bitstream 2 Accelerate Service (pre-qualification), each as more particularly set out in the Operations Manual.
- 3.17 The Bitstream 2 Accelerate Service specifically excludes:
 - 3.17.1 the UFB Handover Connection Service;
 - 3.17.2 provision or maintenance of any cabling or connection or active device:
 - (a) beyond the Service Demarcation Points described in clauses 4.1 and clause 5.1; and
 - (b) between the jack terminating the LFC provided Fibre Lead-in and the ONT where that cabling or connection is not provided by the LFC and the LFC has not agreed to take responsibility for that cabling or connection;
 - 3.17.3 configuration, monitoring, operation, on-going support or maintenance of Service Providers' or End User's applications, equipment or networks; and
 - 3.17.4 supply of AC mains & UPS power, accommodation space, heating, ventilating, and air conditioning and facilities at the POI or End User Premises or Service Provider Premises or NBAP (as applicable).

4 Service Demarcation Point at End User Premises or Service Provider Premises or NBAP (as applicable)

- 4.1 The Service Demarcation Point at the End User Premises or Service Provider Premises or NBAP (as applicable) is the 100/1000Base-T UNI on the ONT.

- 4.2 The Bitstream 2 Accelerate Service excludes the End User Premises or Service Provider Premises or NBAP (as applicable) wiring. If a fault reported by the Service Provider is found to be caused by the End User Premises or Service Provider Premises or NBAP (as applicable) equipment (CPE) or the wiring at the End User Premises or Service Provider Premises or NBAP (as applicable) beyond the Service Demarcation Point, then the Service Provider may be charged the “No fault found” Ancillary Charge in the Price List. Note the wiring should comply with the industry standard Premises wiring requirements which are available at www.tcf.org.nz.

5 Service Demarcation Point at POI

- 5.1 The Bitstream 2 Accelerate Service is delivered as a single VLAN (the logical Service Demarcation Point) per E-AVPL on the UFB Handover Connection located at the POI.
- 5.2 The physical Service Demarcation Point is the MOFDF in the POI, which is part of the UFB Handover Connection Service.
- 5.3 The UFB Handover Connection Service is a separate service and is a prerequisite to the supply of the Bitstream 2 Accelerate Service i.e. Service Provider’s must first purchase and then continue to maintain a UFB Handover Connection Service at all times while taking the Bitstream 2 Accelerate Service.

6 LFC and Service Provider Responsibilities

- 6.1 Other LFC and Service Provider responsibilities are detailed in the General Terms and the Operations Manual.

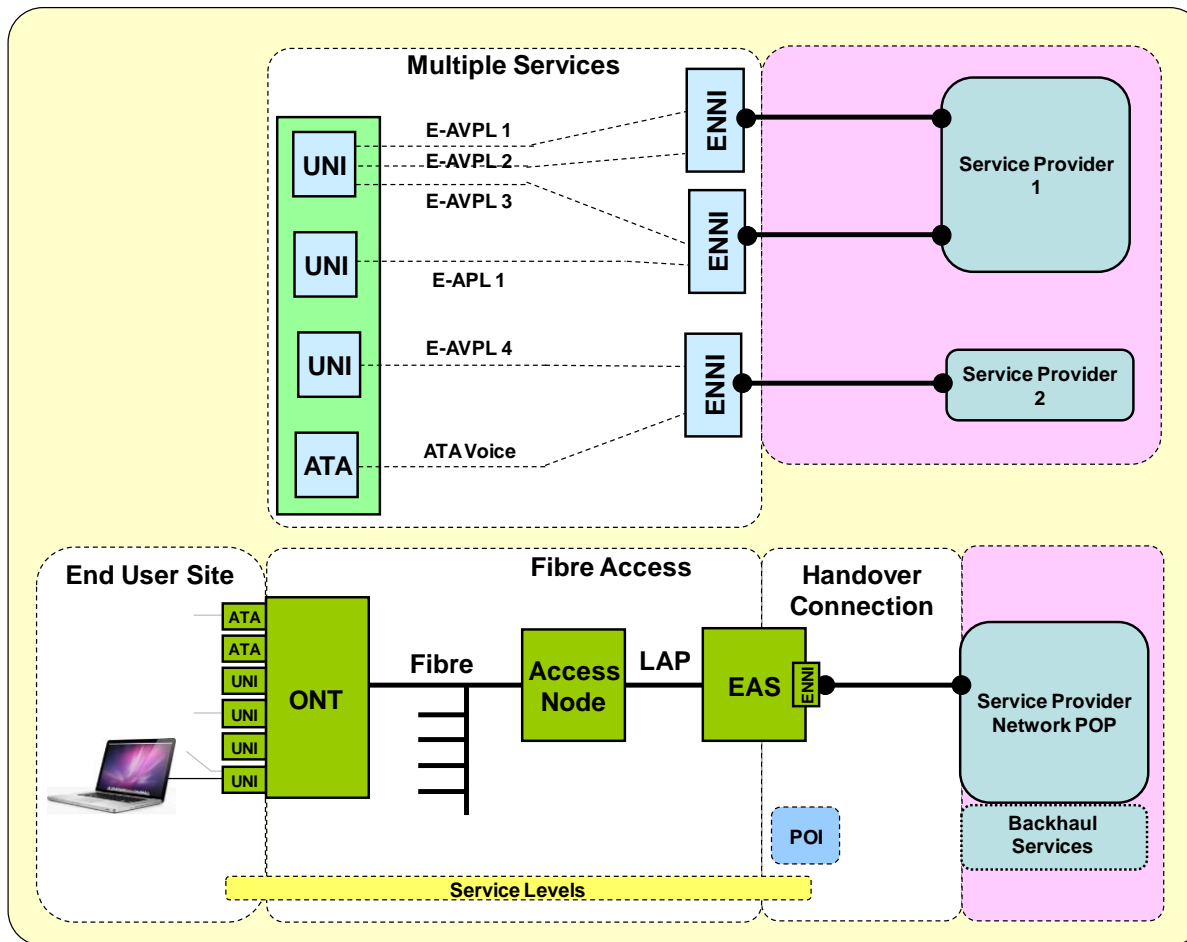
7 Fibre Diversity

- 7.1 The Bitstream 2 Accelerate Service provides a single fibre between the Central Office and the End User Premises, Service Providers Premises or NBAP (as applicable).
- 7.2 Diversity (a second or subsequent instance of the Bitstream 2 Accelerate Service between the Fibre Access Point and the Central Office) will be available as an option for some but not all Premises. Standard Installation Charges and Service Levels do not apply to the provision of the diverse products that involve diverse access to the End User Premises or Service Provider Premises or NBAP (as applicable) or access to a Central Office that is not the local Central Office. Each instance of the Bitstream 2 Accelerate Service, primary and diverse, will be treated as an individual line for the purpose of availability Service Levels.
- 7.3 Where available the diverse optical paths will be in separate fibre cable sheaths, and if requested in separate cable routes. The diverse cable routes will be a minimum of the width of a street apart, and should not share any manholes or access points. Separate entries into the Central Office will also be used where available.
- 7.4 Service Providers can also request diverse access to End User Premises or Service Provider Premises or NBAP (as applicable), or access to diverse Central Offices as part of a Non-Standard Install, however this will not be available in all cases.
- 7.5 There may be practical limitations to providing full physical diversity to some sites. The provision of a separate entry to an LFC Central Office will have unique site specific engineering considerations and may attract additional costs.

8 Bitstream 2 Accelerate Service Levels

8.1 Service Levels for both the Layer 1 and Layer 2 components of the Bitstream 2 Accelerate Service are set out in the Service Level Terms for the Bitstream Services.

Appendix A – Diagram



This is a generic diagram showing the standard configuration and Service Demarcation Points. It is not intended to represent every situation or detailed physical architecture. The following points should be noted:

- The Bitstream 2 Accelerate Service and pricing applies from the UNI to the E-NNI at the POI.

- Service Levels (availability, network performance) only apply to UNI to the E-NNI at the POI.
- Access node and aggregation interconnection may use redundant links to meet Service Level requirements.

The Bitstream services support simultaneous delivery of multiple Service Templates from the same or multiple Service Providers as follows:

- Multiple E-AVPLs can be delivered to the same UNI.
- An E-APL service requires a dedicated UNI.
- An ATA Voice Service can be considered an E-AVPL with an ATA Voice port at the End User interface. The class and bandwidth characteristics of this E-AVPL are optimised for voice.
- All services delivered to a UNI must belong to the same Service Provider but can be mapped to the same or different E-NNIs.
- The initial Bitstream 2 Accelerate Service Templates contain a single E-AVPL and one or two ATA Voice Services.

Appendix B – Technical Specification

Technical Specification	
Ethernet	Ethernet II or 802.3 untagged interface; or 802.1q tagged interface with <ul style="list-style-type: none"> • VLAN id = As agreed with Service Provider • 802.1p = 0, 1, 2, 3, 4, 6, 7 (Low Priority) • 802.1p = 5 (High Priority)
UNI	ONT supports: <ul style="list-style-type: none"> • 4 x UNI • 2 x ATA Voice ports • Optional additional ports: <ul style="list-style-type: none"> ○ RF Overlay port ○ WiFi Per UNI: <ul style="list-style-type: none"> • 100/1000Base-T
UFB Handover Connection (E-NNI)	Ethernet: <ul style="list-style-type: none"> • 802.1ad VLAN (SVID, CVID); or

	<ul style="list-style-type: none"> • Double tagged QnQ.
VLAN	<p>Point-to-Point (E-AVPL) MTU 2000 Bytes Unicast Frame Delivery = passed within service CIR/EIR Multicast Frame Delivery = passed within service CIR/EIR Broadcast Frame Delivery = passed within service CIR/EIR Layer 2 Control Protocols Processing = Initially none (but may be amended by LFC from time to time)</p>
Fibre	<p>External fibre must comply with ITU-T specification G.652D or 657A. Internal building fibre cables must meet appropriate fire regulations i.e. be Flame-Retardant, Non Corrosive, Low Smoke, Zero Halogen (FRNC/LSZH). Fibre terminations must be SC/APC type connectors (complying with the IEC 61754-4 standard) or alternatively LC/APC also known as LCA type connectors (complying with the IEC 61754-20 standard) as appropriate. Laser types and path characteristics are expected to be designed to a minimum standard which are contained in either IEEE 802.3 Section 5 standard or ITU-T G.984 (GPON) standards. Testing for power loss will be at either 1310 or 1550 nm The wavelengths of 1625 nm and 1650nm are reserved for network maintenance testing purposes, compliant with ITU-T L.41.</p>