Interface Specifications for Verizon Wavelength Services

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Verizon Business Group

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Document History

Version	Date	Change	Verizon POC
.9	Aug 21, 2013	Initial draft	Will Russ
.91	Sept 5, 2013	Edit 40GbE & 100GbE Parameters	Will Russ
1.1	Nov 26, 2013	Add OTU2, OTU3, OTU4 Clarify demarcation Add network reference points	Will Russ
1.2	Dec 2, 2013	General edits	Will Russ
1.3		General edits	Will Russ
1.4		General edits	Will Russ
1.5	October 14, 2019	General edits	Will Russ

References

- ITU-T G.693 - Optical interfaces for intra-office systems

- ITU-T G.695 - Optical interfaces for coarse wavelength division applications (10/2010)

- ITU-T G.709 - Interfaces for the Optical Transport Network (02/2012)

- ITU-T G.959.1 - Optical Transport Network Physical Layer Interfaces (02/2012)

- ITU-T G.Sup43 - Transport of IEEE 10G Base-R in Optical Transport Networks (OTN)

- IEEE 802.3-2012

- IEE 802.3ba-2010 (40GbE and 100GbE)

- IEEE-802.3z (GbE)

- IEEE-802.3ae (10GbE)

- Telcordia GR-253-CORE, *Synchronous Optical Network (SONET) Transport Systems: Common Generic Criteria* (October 2009). Issue 5

Table of Contents

1 Purpose

This document provides the detailed interface specifications of the OC-3/12/48, STM-16/64, 1G, 10G, 40G and 100G interfaces (via Ethernet, OTN, SONET/SDH or Fibre Channel protocols) between Verizon and a customer (enterprise or carrier) in the transport of [Verizon Enterprise Services] *Wavelength Services*.

2 Scope

This document details the configuration of the customer's router or transport system or an Enterprise customer or 3rd Party Carrier's transport system for

- Ethernet layer 2 MAC transport behaviors

- OTN transport behaviors

- Fault propagation settings

- Signal Degrade and Signal Fail Thresholds

- Physical layer specifications for each service interface

- Demarcation references

Detailed configuration of other equipment is beyond the scope as well as network management architecture or maintenance parameters. The audience is Enterprise and Wholesale customers, network planning, Detail Engineering, project management, network implementation, provisioning, capacity management, systems integration and testing, IT, operations, service acceptance testing and project management at both Verizon and at third party carriers.

3 Service Overview Purpose

Verizon's Wavelength Services provides ultra-high speed dedicated point-to-point circuits between Customer Sites on the Verizon Network. Services are provided and are available in Metro, National and International configurations, subject to availability. Wavelength Services are available from 155 Mb/s to 100 Gb/s speeds. The services can be configured as Transparent Synchronous Frame (supports either SONET OCn or SDH STM handoffs), Ethernet, OTN interfaces (OTU2 or OTU4) or SAN protocols (FC 1/2/4/10G or FICON 1/2/4).

Wavelength Services are not be available in all countries/regions, at all bandwidths and/or with all features, service configurations or protection types.

Verizon may potentially order unprotected Wavelength Services from the Enterprise customer or Third Party Carrier as off-net access.

4   Network Reference Points Service Overview Purpose

These reference points are used for purposes of description in this document.

Both enterprise and wholesale customers will interface the Verizon network via a single channel "Inter-Domain Interface" (IrDI) per ITU-T G.709 and G.959.1. This interface is the customer handoff and is always an intra-office interface based on industry standards. Known also as a "Grey Optics" interface, it is intended to be multi-vendor interoperable.
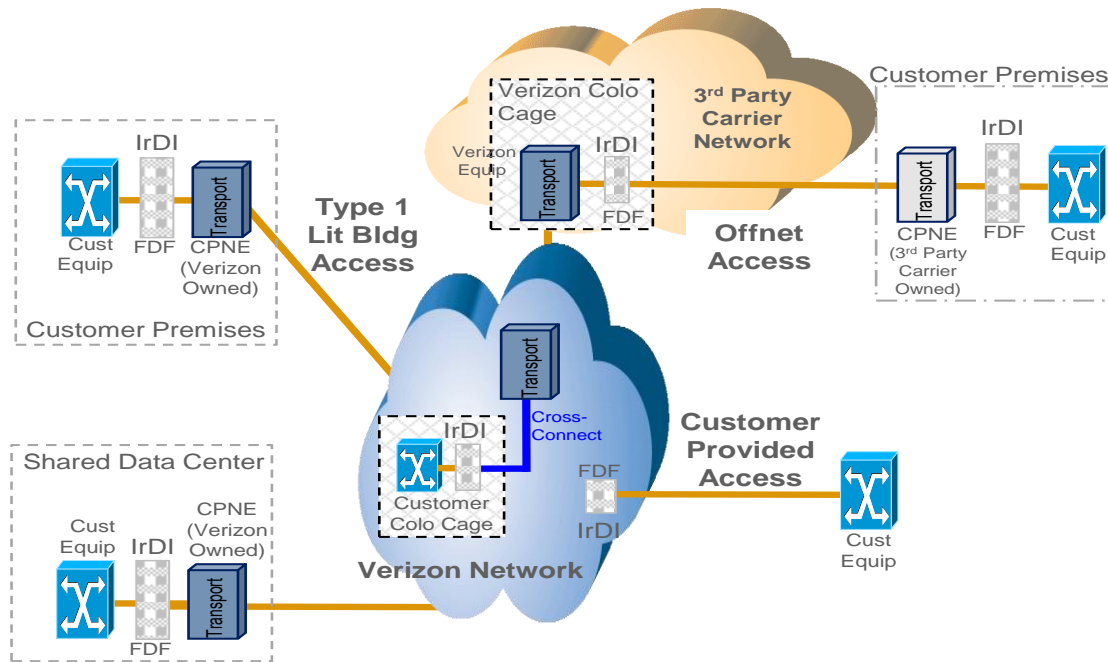
Figure 1: Network Reference Points for Verizon Wave Services.

[IrDI is the ITU definition for Inter-Domain Interfaces]

4.1   Verizon-Owned Equipment at the Customer Premises

The Verizon-owned CPNE (Customer Premises Network Equipment) is typically an Optical NID (100G OTN Multiplexer or Standalone Transponders in a 2R chassis) or a Small ROADM (re-configurable Optical Add-Drop Multiplexer) or a fixed point to point DWDM (Dense Wavelength Division Multiplexer) transport system. That system is installed, provisioned and maintained by Verizon. Space and power are provided by the customer, unless the equipment is installed in the Verizon space in a shared data center. In that case, a cross-connect to the Verizon facility is arranged by the customer with CFA provided by Verizon to detail the specific port. Verizon does not order the cross-connect.

5   Co-Location Configurations (Unprotected Service Option)

Carrier inter-connects may be executed via co-located transport equipment in either the Verizon facility or the PTT/CLEC/ILEC facility. The examples below illustrate the physical arrangement:

5.1   Verizon Co-Locations in PTT/CLEC/ILEC Facility (Unprotected)

Figure 2: Off-Net Access for Verizon Wavelength Services via Verizon co-location in PTT/CLEC/ILEC facility [10G unprotected service example]

5.2   PTT/CLEC/ILEC Co-Locations in Verizon Facility (Unprotected)

Off-Net Access for Verizon Wavelength Services
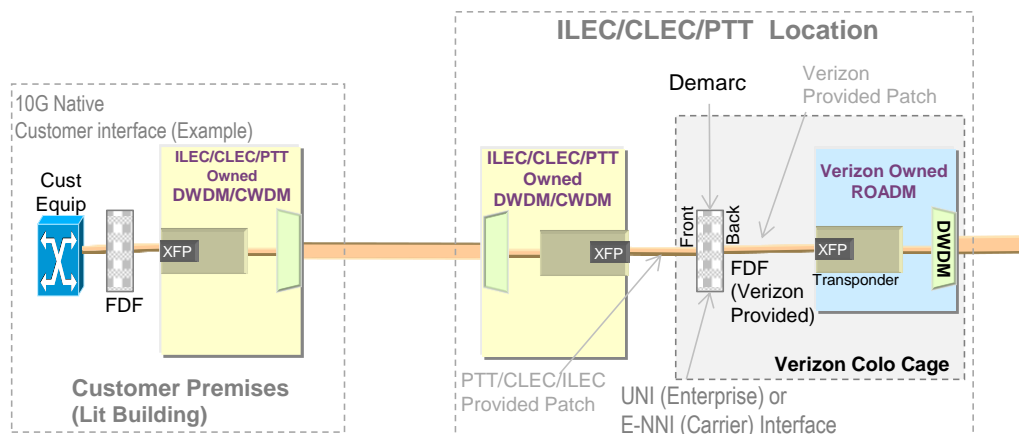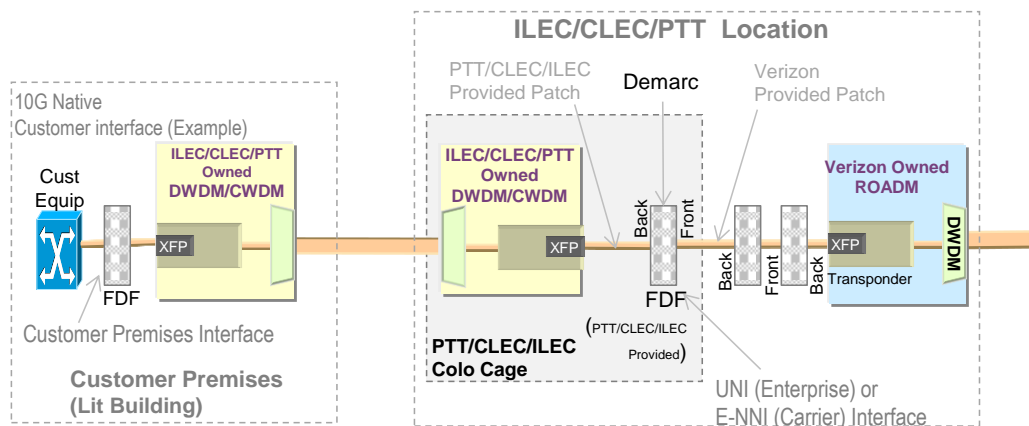via PTT/CLEC/ILEC Co-Location in Verizon Facility
(10G Un-Protected Service Example)

Figure 3: Off-Net Access for Verizon Wavelength Services via PTT/CLEC/ILEC co-location in Verizon facility [10G unprotected service example]

6   Ethernet Interfaces

The table below summarizes the Ethernet Transport Behavior for VZON EPL Service. Additional detail is also given.

Some of these behaviors require settings on the customer equipment which are traffic affecting (e.g. auto-negotiation). The customer's equipment must be provisioned to interoperate with these attributes:

Transport Atomic Function	Customer Setting for their Transport of Ethernet to the Verizon E-NNI/UNI	Notes
MAC Layer Specification	IEEE 802.3ae-2002	The UNI or E-NNI Interface MAC Layer Specification
Physical Layer Specification (PHY)	See the sections below on PHY interfaces.	The UNI or E-NNI Interface Physical Layer
Auto-negotiation	Disable	Disable auto-negotiation of the speed and duplex mode between two the adjacent 1000BASE-X interfaces facing the UNI/E-NNI.
Maximum Transmission Unit (MTU)	9600 bytes	The maximum ethernet frame size required to be transported, including Tags.
Link Aggregation	Disable	The transport system will not participate in Link Aggregation.
Drop MAC layer FCS Errored Frames	Pass errored frames	Pass the frames which are errored at the MAC layer FCS
Transparent Transport of Pause Frames	Disable	Do not transport client pause frames or respond to them.
Insert or Respond to Pause Frames	Disable	Do not insert pause frames or react to received pause frames.
LACP frame Processing	Enable	The incoming LACP (and other L2CP) frames are transparently transported.
Port TX Laser Shutdown for BOTH 3rd Party Transport and Client GbE Link Failures	Disable	Do not Shut down the client port TX laser upon detection of a remotel LAN failure (via GFP-CSF) or SONET far end alarm (PDI-P) or upon detection of LOS, LOF, LOSYNC from the line side.
SONET/SDH/OTN Signal Fail Threshold	1x10E3	Sets the BER at which the 3rd party transport will indicate a signal Failure threshold crossing condition that triggers alarms and maintenance signals.
SONET/SDH/OTN Signal Degrade Threshold	1x10E6	Sets the BER at which the 3rd party transport will indicate a signal degrade threshold crossing condition that triggers alarms and maitenance signals.
VLAN Tag Processing	Transparent	The Transport system will transparently transport the outer tag. (Non-VLAN Aware). Frames may be tagged or untagged.
Policing/Rate Limiting	None	The transport system will not perform any policing or rate limiting
Link OAM Support	Not Required	The transport system is not required to support Link OAM
Service OAM Support	Not Required	The transport sys is not required to support Service OAM

Left vertical label spanning table: Verizon Wavelength Services Inter-Domain (IrDI) Ethernet Interface

Figure 4: Ethernet interfaces table

MTU

The MTU (Maximum Transmission IrDI) defined here includes the SA, DA, Type, payload and Ethernet FCS fields. Any customer VLAN tags would subtract from the available payload length under this definition. Vendors use different methods for calculating MTU and in each case the Verizon standard value chosen makes adjustments for these differences so that all systems in a chain will be compatible. New services will support 9600 bytes including the VLAN tagging.

The minimum Ethernet Service Frame size supported on all IRDIs is 64 Bytes.

Auto-Negotiation

The Auto-negotiation parameter on the (GbE) ports will be disabled. Auto-negotiation must match the adjacent equipment to get the link up.

MAC Layer Transport in OTN is per G.7041

The Ethernet MAC layer is encapsulated via ITU-T G.7041 Generic Framing Procedure (GFP). All fields of a customer's MAC service frame (including Ethernet FCS) are to be transported through the network unchanged. The client ingress interface Ethernet frames shall be checked before GFP encapsulation is performed. Frames with an invalid Ethernet frame checksum (FCS) shall be discarded. Pause frames are also discarded. The IPG, Preamble and Service Delimiters are not transported.

Class of Service

Verizon Wave is a "best effort" frame delivery service.

For Verizon Wave, only a single Class of Service (CoS) is offered. All customer Service Frames coming in on the IRDI are considered to be in the same CoS. The transport equipment therefore does not mark or police the customer traffic. The only effect to serve as a Rate limiter is therefore the limitation of the SONET payload bandwidth on the EVC and the customer is expected to shape their traffic.

L2CP (Layer 2 Control Protocol) Processing

Per the MEF6-1 standard, Verizon intends to process the Layer 2 control protocols as follows:

Layer 2 Control Protocol	Service Provider Processing per MEF6-1 (IRDI Type 1.1)
Spanning Tree Protocols	Tunnel
Pause Frames (flow control)	Discard
LACP/LAMP	Tunnel (IRDI) Aggregation Port Facilities will Process LACP when LAG
Link OAM	Tunnel
Port Authentication	Tunnel
E-LMI	Tunnel
LLDP	Tunnel
GARP/MRP	Tunnel

Flow Control is Disabled

The inherent delay of the network can make the Pause Frame unnecessary by the time the CPE receives the message. Furthermore, since the circuit may carry different qualities of service, the Pause Frame may eliminate high priority frames, when the customer's CPE should be making this decision. MEF recommends, and Verizon concurs, that Pause Frames are to be discarded by the transport equipment. Verizon Wave will therefore drop pause frames and not generate them.

6.1   GbE Interface Specifications

Since the distinct parameters used for Ethernet transport in transmission systems are not standardized, the various vendors utilize varying combinations of behaviors within a given parameter. There can be several behaviors associated with a single parameter. Each individual behavior is called an atomic function. Since the parameters and atomic functions vary by vendor Verizon will specify the interface as a set of atomic functions. The Enterprise customer or Third Party Carrier must then determine which of their specific systems' parameters apply to each atomic function and set it accordingly. See Section 8 for these atomic functions.

GbE Fault Propagation

The Enterprise customer or Third Party Carrier's transmission systems will adhere to the fault propagation defined in G.7041. Laser shutdown is not used. Laser shutdown is not used in the Enterprise customer or 3rd Party Carrier's network. Verizon doesn't use laser shutdown for

unprotected services but it may use laser shutdown for some interop scenarios on protected services.

6.1.1   1000BASE-X Physical Layer Specifications

GbE services at the IRDI   interface may be provisioned on the GbE PHY interface (1000BASE-LX) (1310 nm on SMF) or 1000BASE-SX (850nm on MMF) as standardized by IEEE 802.3z in IEEE-802.3-2008.
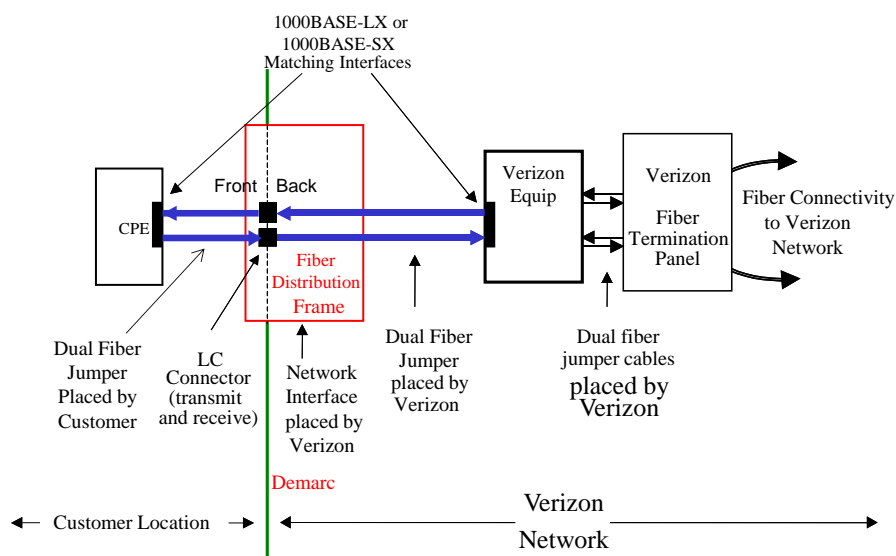
LC connectors are standard.

Figure 5: Verizon Wave: GbE Demarcation

6.2   10GbE Interface Specifications

Since the distinct parameters used for Ethernet transport in transmission systems are not standardized, the various vendors utilize varying combinations of behaviors within a given parameter. There can be several behaviors associated with a single parameter. Each individual behavior is called an atomic function. Since the parameters and atomic functions vary by vendor Verizon will specify the interface as a set of atomic functions. The Enterprise customer or Third Party Carrier must then determine which of their specific systems' parameters apply to each atomic function and set it accordingly. See section 8 for these atomic functions.

10GbE Fault Propagation

Enterprise customer or Third Party Carrier's transponders/muxponders must adhere to the detection, reporting and propagation of LF and RF ordered sets per G.709 (12/2009). The

Enterprise customer or third-party Carrier must use laser shutdown if their systems do not support the LF and RF ordered sets per the standard.

6.2.1 10GbE Physical Layer Specifications

- The 10GbE IrDI handoff will be available as either 10GBASE-LR (LAN PHY) at 1310nm on SMF or 10GBASE-ER (1550 nm over SMF).

- 10GbE is also available via 10GBASE-LW (WAN PHY) at 1310 nm on SMF or 10GBASE-EW (1550 nm over SMF).
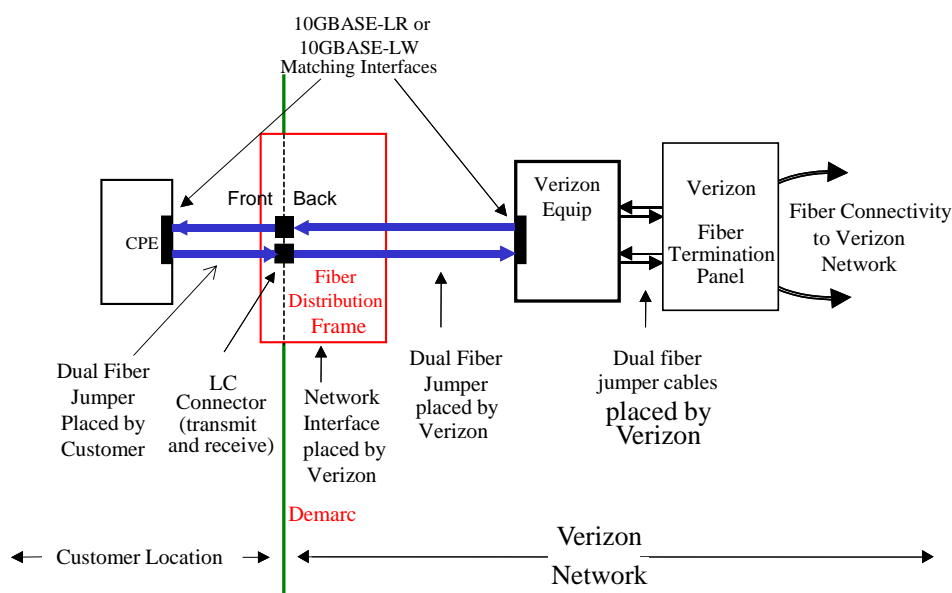
LC connectors are standard.

Figure 6: Verizon Wave: 10 GbE Demarcation

6.3 40GbE Interface Specifications

Since the distinct parameters used for Ethernet transport in transmission systems are not standardized, the various vendors utilize varying combinations of behaviors within a given parameter. There can be several behaviors associated with a single parameter. Each individual behavior is called an atomic function. Since the parameters and atomic functions vary by vendor Verizon will specify the interface as a set of atomic functions. The Enterprise customer or Third Party Carrier must then determine which of their specific systems' parameters apply to each atomic function and set it accordingly. See Section 8 for these atomic functions.

40GbE Fault Propagation

Enterprise customer or Third Party Carrier's transponders/muxponders must adhere to the detection, reporting and propagation of LF and RF ordered sets per G.709 (12/2009).

6.3.1   40GbE Physical Layer Specifications

The [40GbE] IRDI handoff will be limited to 40GBASE-LR4 per IEEE 802.3ba-2010
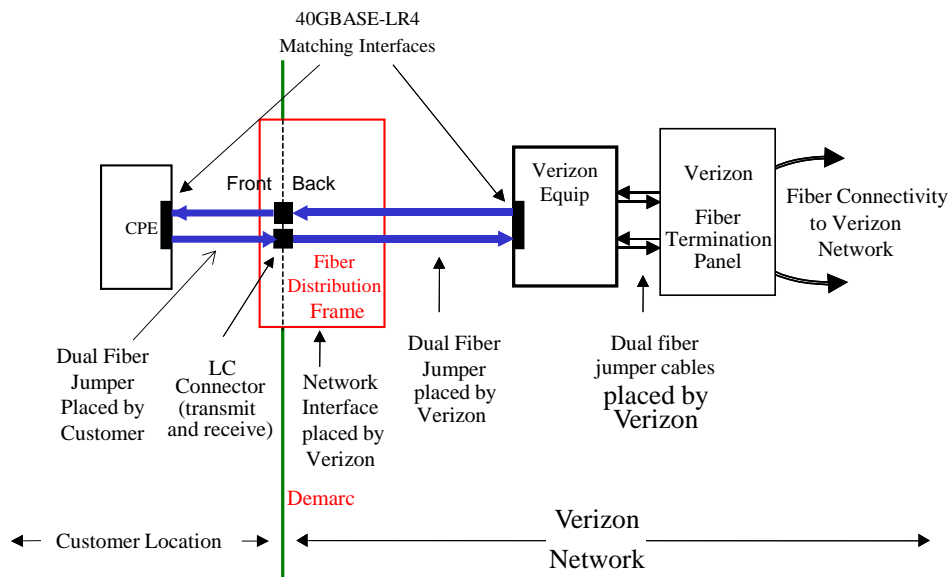
Figure 7: Verizon Wave: 40 GbE Demarcation

6.4   100GBE INTERFACE SPECIFICATIONS

Since the distinct parameters used for Ethernet transport in transmission systems are not standardized, the various vendors utilize varying combinations of behaviors within a given parameter. There can be several behaviors associated with a single parameter. Each individual behavior is called an atomic function. Since the parameters and atomic functions vary by vendor Verizon will specify the interface as a set of atomic functions. The Enterprise customer or Third Party Carrier must then determine which of their specific systems' parameters apply to each atomic function and set it accordingly. See Section 8 for these atomic functions.

100GbE Fault Propagation

Enterprise customer or 3rd Party Carrier's transponders/muxponders must adhere to the detection, reporting and propagation of LF and RF ordered sets per G.709 (12/2009).

6.4.1 100GBE PHYSICAL LAYER SPECIFICATIONS

The [100GbE] IRDI interface will be limited to IEEE 100GBASE-LR4 per IEEE 802.3ba-2010. LC connectors are standard.
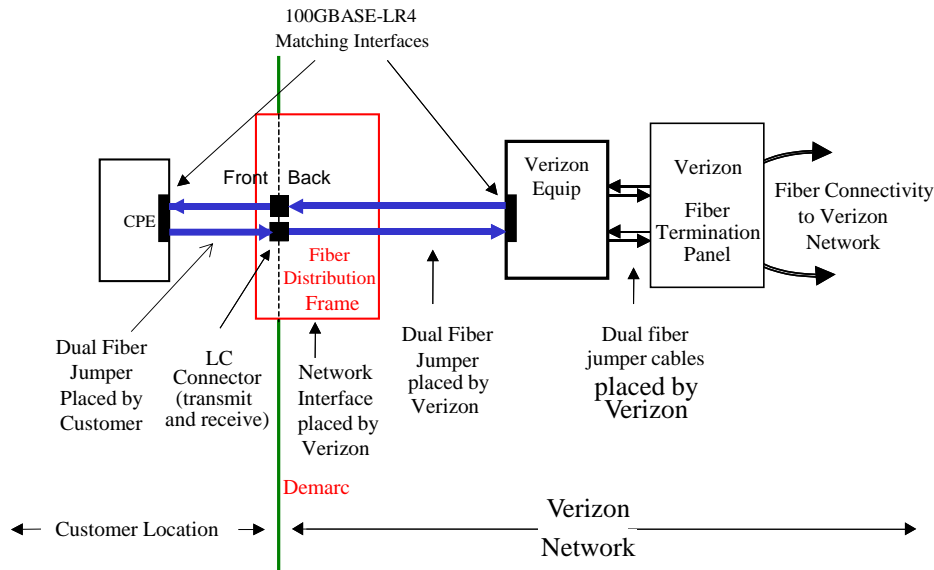

Figure 8: Verizon Wave: 100 GbE Demarcation

7 OTN Interfaces

Verizon supports OTN client interfaces as OTM-0.n client interfaces with reduced functionality per G.709. These are single channel, client side, intra-office interfaces. They are also known as OTUk (where k can be 2, 3 or 4) interfaces. Some transport systems also call them OTMk (where k can be 2, 3 or 4) facilities in their provisioning.

Because the parameters and terminology varies among the customer's transport systems, a table of "atomic functions" is given to guide the customer or Enterprise customer or Third Party Carrier on the expected behaviors.

OTN Transport Atomic Function	Customer Setting for their Transport of Ethernet to the Verizon Network	Notes
Physical Layer Specification (PHY)	See the sections below on PHY interfaces.	The UNI or E-NNI Interface Physical Layer
FEC Type	Reed Solomon (Standard) FEC	The csutomer should enable standard FEC on the OTUk (OTM-0.n) client interface.
OSC	Disabled	The OSC is not supported on the client interface.
Laser Shutdown	Disabled	Laser shutdown is normally disabled on the client interface.
Protocol Bit Rate/Clock Type	OTUk per G.709-2009	The customer must use the standard OTUk (OTM-0.n) bit rate on the client interface per ITU-T G.709. No overclocked bit rates.
ODUk Signal Degrade Interval	7	For systems which provision signal degrade threshold using block error counts, the consecutive one second intervals where the block errors exceed the block error threshold that defines the signal degrade threshold.
(ODUk Block Error) Degrade Threshold	3064 for ODU1; 82026 for ODU2; 329492 for ODU3; 128459 for ODU4	For systems which provision Signal Degrade Threshold using block error counts, the number of block errors within a one second interval that will define it as degraded in the Signal Degrade theshold calculation.
Signal Degrade Thereshold (for systems which provision it using BER)	10E-06	For systems which provision signal degrade thresholds using BER, the setting will be 10E-6.
Signal Fail Thereshold (for systems which provision it using BER)	10E-05	For systems which provision signal degrade thresholds using BER, the setting will be 10E-5.
Path Trace Monitoring/Alarming	Disabled in Verizon	Verizon does not monitor or alarm for Trace ID mismatches.
TCM Overhead Usage	TCM Overhead Usage limited to TCM 1 only	Verizon limits end customer usage of the TCM overhead channels to TCM 1 only.

Verizon Wavelength Services Inter-Domain (IrDI) OTUk (OTM-0.n) Interface

7.1 OTU2 (OTM-0.2) INTERFACE SPECIFICATIONS

The OTU2 (aka OTM-0.2) customer interface is a single channel client handoff. It follows the ITU-T definition for an OTM-0.n interface with reduced functionality as defined in G.709: The OTM-0.m supports a single optical channel on a single optical span with 3R regeneration at each end. The OSC is not supported.

7.1.1 OTU2 (OTM-0.2) PHYSICAL SPECIFICATIONS

The OTU2 physical interface in the standard product is limited to the following ITU-T application codes: ITU-T G.959.1 Application Code P1I1-2D1 (Parameters given in G.693 Application Code VSR2000-2R1). This is the 1310nm on SMF equivalent to 10GBASE-LR interfaces.

7.2 OTU3 (OTM-0.3) INTERFACE SPECIFICATIONS

The OTU3 interface is no longer deployed for new orders.

The OTU3 (aka OTM-0.3) customer interface is a single channel client handoff. It follows the ITU-T definition for an OTM-0.n interface with reduced functionality as defined in G.709: The OTM-0.m supports a single optical channel on a single optical span with 3R regeneration at each end. The OSC is not supported. The OTU3 uses a multichannel IrDI (inter-domain) interface intended to enable transverse (multi-vendor) compatibility.

7.2.1 OTU3 (OTM-0.3) INTERFACE SPECIFICATIONS

The OTU3 interface is no longer supported for new orders. The legacy OTU3 physical interface in the standard product is limited to the following ITU-T application codes: ITU-T G.695 Application Code C4S1-2D1. This is equivalent to 40GBASE-LR4 on SMF. LC connectors are standard.

7.3 OTU4 (OTM-0.4) INTERFACE SPECIFICATIONS

The OTU4 (aka OTM-0.4) interface handoff is a single channel client handoff. . It follows the ITU-T definition for an OTM-0.n interface with reduced functionality as defined in G.709: The OTM-0.m supports a single optical channel on a single optical span with 3R regeneration at each end. The OSC is not supported. The OTU4 uses a single channel IrDI (inter-domain) interface intended to enable transverse (multi-vendor) compatibility.

7.3.1 OTU4 (OTM-0.4) PHYSICAL LAYER SPECIFICATIONS

The standard interface is limited to the following application codes. ITU-T G.959.1 Application code 4I1-9D1F (equivalent to 100GBASE-LR4 for Ethernet). LC connectors are standard.

8   Transparent Synchronous Frame (TSF) Interfaces

TSF allows transparent transport of the customer's Data Communications Channel (DCC) (OH bytes D1-3 and D4-12) as well as the K1 and K2 line overhead bytes used for APS in customer BLSRs. The customer must specify SONET or SDH frame format and bit rate and they must match at the A and Z ends. Transparent transport of the other line and section overhead is performed where available but not guaranteed.

Since the distinct parameters used for transport behaviors in transmission systems are not standardized, the various vendors may utilize varying combinations of behaviors within a given parameter. There can be several behaviors associated with a single parameter. Each individual behavior is called an atomic function. Since the parameters and atomic functions vary by vendor Verizon will specify the interface as a set of atomic functions. The Enterprise customer or Third Party Carrier must then determine which of their specific systems' parameters apply to each atomic function and set it accordingly.

	Transport Atomic Function	Customer Setting for Transport of Transparent Synchronous Frame to Verizon Wave	Description
Verizon wavelength Services 10 G TSF Inter-Domain (IrDI) Interface	J0 Transport	Transparent	Set the Transmission systems to transparently transport J0 from Verizon and the Customer.
	J0 Outgoing Path Trace	Disable	Disable any creation of a trace message for J0 (See above)
	Expected (J0) Trace	Null	Disable any expected Trace based on J0
	Monitor (J0) Trace	Disable	Do not monitor the J0 Trace byte
	K1, K2 (APS) Bytes	Transparent	Verizon to transport the customer's K1, K2 bytes transparently
	D1-D12 (DCC) Bytes	Transparent	Verizon to transport the customer's D bytes transparently
	Client side Laser Shutdown	Disable	Do not perform client side laser shutdown
	Line side laser shutdown	Disable	Do not perform client side laser shutdown
	SSM Support	Disable	No requirement for SSM support
	Signal Fail Threshold	10E-3	Set the BER threshold on the OC-192 for 10E-3
	Signal Degrade Threshold	10E-6	Set the BER threshold on the OC-192 for 10E-6

Fault Propagation and Signal Degrade Thresholds
The ODU encapsulation of the TSF signal has signal degrade and signal fail thresholds in the Enterprise customer or Third Party Carrier's transmission systems. The ODU signal degrade threshold crossing should be set to a BER of 1x10E6. The ODU signal fail threshold should be set to a BER of 1x10E3.

8.1   155 MB/S TSF INTERFACE SPECIFICATIONS

155 Mb/s TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-3 port or an SDH STM-1 port on both ends of the customer service.

8.1.1   155MB/S TSF PHYSICAL LAYER INTERFACES
155Mb/s TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-3 port or an SDH STM-1 port on both ends of the customer service.

SONET-based 155 Mb/s TSF interfaces are limited to GR-253 / SONET IR-2 (Intermediate Reach, 1550nm, Single Mode Fiber).

SDH-based 155 Mb/s TSF Interfaces are limited to: ITU-T G.957 S1.1 (Short Reach, 1310nm, Single Mode Fiber)

8.2   622 MB/S TSF INTERFACE SPECIFICATIONS

622 Mb/s TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-12 port or an SDH STM-4 port on both ends of the customer service.

Fault Propagation and Signal Degrade Thresholds
The ODU encapsulation of the TSF signal has signal degrade and signal fail thresholds in the Enterprise customer or 3rd Party Carrier's transmission systems. The ODU signal degrade threshold crossing should be set to a BER of 1x10E6. The ODU signal fail threshold should be set to a BER of 1x10E3.

8.2.1   622 MB/S TSF PHYSICAL LAYER INTERFACES
622 Mb/s TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-12 port or an SDH STM-4 port on both ends of the customer service.

SONET-based 622 Mb/s TSF interfaces are limited to: GR-253 / SONET IR-2 (Intermediate Reach, 1550nm, Single Mode Fiber)

SDH-based 622 Mb/s TSF Interfaces are limited to: ITU-T G.957 S4.1 (Short Reach, 1310nm, Single Mode Fiber)

8.3   2.5 GB/S TSF INTERFACE SPECIFICATIONS

622 Mb/s TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-48 port or an SDH STM-16 port on both ends of the customer service.

Fault Propagation and Signal Degrade Thresholds

The ODU encapsulation of the TSF signal has signal degrade and signal fail thresholds in the Enterprise customer or 3rd Party Carrier's transmission systems. The ODU signal degrade threshold crossing should be set to a BER of 1x10E6. The ODU signal fail threshold should be set to a BER of 1x10E3.

8.3.1 2.5 GB/S TSF PHYSICAL LAYER INTERFACES

622 Mb/s TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-12 port or an SDH STM-4 port on both ends of the customer service.

SONET-based 2.5G TSF interfaces are limited to: GR-253 / SONET IR-2 (Intermediate Reach, 1550nm, Single Mode Fiber)

SDH-based 2.5G TSF Interfaces are limited to: ITU-T G.957 S16.1 (Short Reach, 1310nm, Single Mode Fiber)

8.4 10G TSF INTERFACE SPECIFICATIONS

10G TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-3 port or an SDH STM-1 port on both ends of the customer service.

Fault Propagation and Signal Degrade Thresholds

The ODU encapsulation of the 10G TSF signal has signal degrade and signal fail thresholds in the Enterprise customer or 3rd Party Carrier's transmission systems. The ODU signal degrade threshold crossing should be set to a BER of 1x10E6. The ODU signal fail threshold should be set to a BER of 1x10E3.

8.4.1 10G TSF PHYSICAL LAYER INTERFACES

10G TSF is a semi-transparent SONET or SDH frame format with the K bytes and D bytes transported transparently through the network. It uses either a SONET OC-192 port or an SDH STM-64 port on both ends of the customer service.

SONET-based 10G TSF interfaces are limited to: GR-253 / SONET IR-2 (Intermediate Reach, 1550nm, Single Mode Fiber)

SDH-based 10G TSF Interfaces are limited to: ITU-T G. 691 S64.1 or ITU-T G.959.1 P1S1-2D1 (short reach interface, 1310nm, Single Mode Fiber) or ITU-T G. 691 S64.2 or ITU-T G.959.1 P1S1-2D2 (short reach interface, 1550nm, Single Mode Fiber)