TDS Wholesale Carrier Ethernet Services

TDS Mobile Backhaul Service Description

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History Revision

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12/2/2015	2.0	Eric Timm	Rev 2
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1. General

This document defines the Mobile Backhaul Ethernet Virtual Connection (EVC) Services offered by TDS Telecom. This document uses a combinations of standards created by The MEF and are reproduced with the permission of the MEF Forum including:

- "MEF 6.2 – EVC Ethernet Services Definitions – Phase 3"
- "MEF 10.3 – Ethernet Services Attributes – Phase 3"
- "MEF 17 – Service OAM Requirements & Framework – Phase 1"
- "MEF 22.1 – Mobile Backhaul – Phase 2"

The basic concept for an EVC Service is that a Service Provider is responsible for the EVC, with all of its related attributes, from end-to-end. Note that a Service Provider need not be an Operator.

1.1. Carrier Ethernet Stakeholders

The MEF defines two principle stakeholders of MBH Services:

- **Service Provider** – The organization from which the Mobile Operator purchases the mobile backhaul service
- **Mobile Operator** – The organization purchasing the mobile backhaul service

The key service constructs are the EVC itself and EVC End Points at the External Interfaces (EIs - the User Network Interfaces (UNI)). A Mobile Backhaul network can take on many forms. This document focuses on the Mobile Backhaul network between the User Network Interface (UNI) at a Radio Base Station (RAN BS) site and the UNI at a Radio Network Controller (RAN NC) site, as shown in Figure 1 (below).

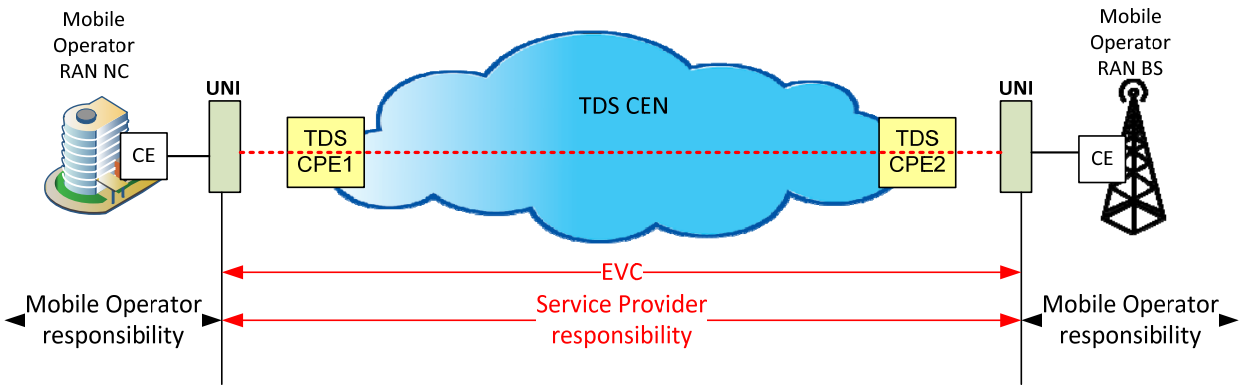

Figure 1: Mobile Operator/Service Provider Relationship

1.2. Additional Terminology

The following terms defined and described here are used throughout this document:

- **All-to-One Bundling** – The association of all internal services (c-tags) at a UNI
- **Bundling** – The association of select internal services (c-tags) at a UNI
- **Carrier Ethernet Network (CEN)** – The entire Service Provider network used to transport Ethernet services
- **Committed Burst Size (CBS)** – The maxiumum number (in Bytes) of CIR-conformant service frames allowed on an EVC
- **Committed Information Rate (CIR)** – The guaranteed bandwidth (in bits per second) of an EVC for service frames that are eligible for performance objectives
- **Customer Edge equipment (CE)** - The equipment at the Subsciber location that connects to the TDS CPE
- **Customer Tag (c-tag)** – The inner VLAN tag that is coordinated between the Service Provider and Subscriber to differentiate bundled internal services at a UNI
- **Ethernet Virtual Connection (EVC)** – The logical association of the entire service connection between two or more external interfaces (UNIs)
- **EVC End-Point** – The association of a specific EVC with a specific external interface (UNI)
- **EVC Service Tag (s-tag)** – The outer VLAN tag that is applied by the Service Provider to differentiate network services at a UNI
- **Excess Burst Size (EBS)** – The maximum number (in Bytes) of EIR-conformant service frames allowed on an EVC
- **Excess Information Rate (EIR)** – The bandwidth (in bits per second) of an EVC for service frames that are outside of the CIR and not eligible for performance objectives (TDS does not offer an EIR product)
- **Inside Plant (ISP)** – The cabling and equipment installed within a TDS facility
- **Radio Access Network (RAN)** – The entire wireless access network, including the mobile backhaul network connecting RAN CEs
- **RAN Base Station (RAN BS)** – A cell tower/site
- **RAN Network Controller (RAN NC)** – A node that aggregates traffic from multiple base stations and provides a gateway to the public phone network and/or Internet
- **Service Multiplexing** – The association of multiple network services (s-tags) at an UNI
- **UNI Client (UNI-C)** – Refers to the UNI's Subscriber-facing port that serves as the demarcation point and physical handoff to the Subscriber
- **UNI Network (UNI-N)** – Refers to the UNI's network-facing port that connects the UNI to the Service Provider's CEN

- **User-to-Network Interface (UNI)** – The physical demarcation point between the subscriber domain and the service provider domain

2. TDS Mobile Backhaul Services

TDS provides MBH services compliant to the standards and service attributes established by the MEF. Conformance to MEF standards is highly recommended. For every EVC ordered, TDS and the Mobile Operator will coordinate a common S-tag assignment for transport across each UNI.

2.1. TDS Mobile Backhaul Ethernet Private Line (MBH EPL)

An MBH EPL is an Ethernet Line (E-Line), port-based, point-to-point service that associates exactly 2 UNIs within the TDS CEN. Due to the port-based nature of this service, only one OVC can be associated to a UNI. As a result, all tagged and untagged Service Frames are mapped to that single EVC at the UNI. There is no need to coordinate a detailed EVC end-point map.

Figure 2 (below) shows an example of MBH services delivered as multiple EPLs. The delivery of these services requires a dedicated UNI for each EVC. This method may be preferred in cases where there is a desire for 1:1 port level correspondence between the RAN NC and RAN BS and is the equivalent to the leased line services used for Mobile Backhaul services. However, scalability is limited. In this example, the Mobile Operator has 2 internal services (orange, green) between the RAN NC and RAN BS1. Two MBH EPL EVCs (red, blue) are ordered to traverse the TDS CEN. At each UNI, TDS will POP the TDS S-Tag to deliver the internal services untagged.

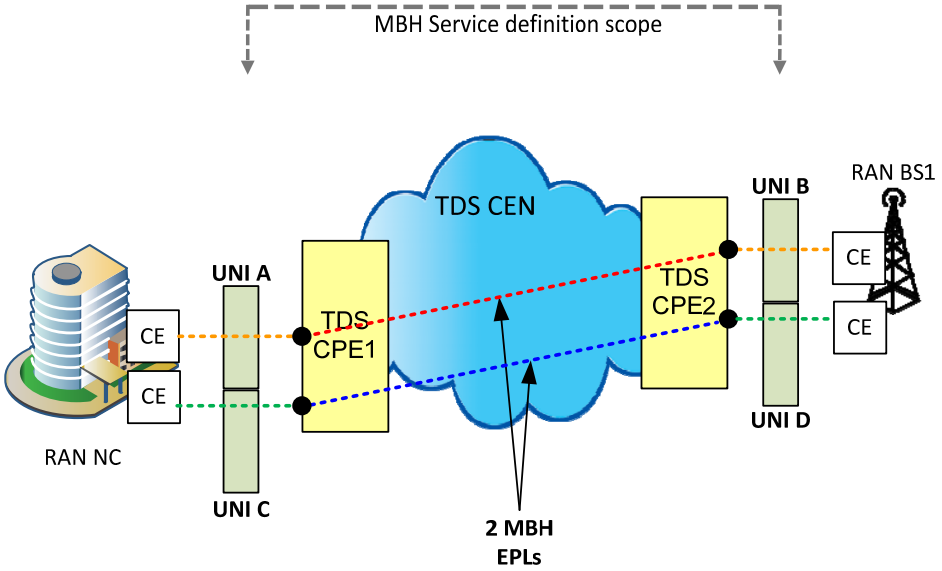

Figure 2: Mobile Backhaul via multiple MBH EPLs

2.2. TDS Mobile Backhaul Ethernet Virtual Private Line (MBH EVPL)

An MBH EVPL is an E-Line, VLAN-based, point-to-point service that associates exactly 2 UNIs within the TDS CEN. Due to the VLAN-based nature of this service, multiple EVCs can be associated to a single UNI. As a result, tagged and untagged Service Frames must be mapped to a specific EVC at the UNI.

Figure 3 (below) shows an example of MBH services delivered as multiple EVPLs. The delivery of these services requires only a single UNI at each location. In general, this method is largely preferred over MBH EPL delivery because it allows for efficient use of each UNI. In this example, the Mobile Operator has 2 internal services (orange, green) between the RAN NC and RAN BS1 and 2 internal services (pink, black) between the RAN NC and RAN BS2. Four MBH EVPL EVCs (red, blue, yellow, purple) are ordered to traverse the TDS CEN. At each UNI, TDS will hand off the coordinated S-Tag for each EVC.

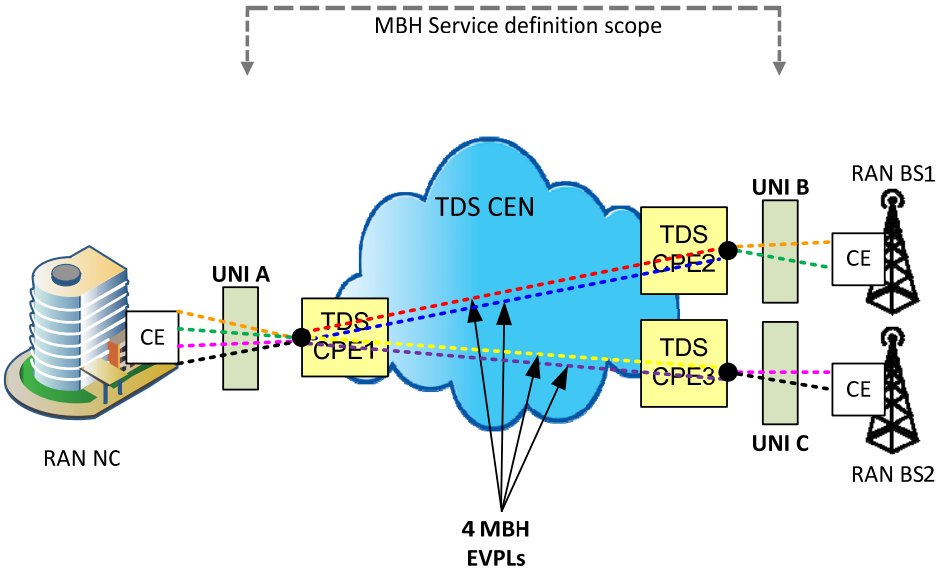

Figure 3: Mobile Backhaul via multiple MBH EVPLs

2.3. TDS Mobile Backhaul Ethernet Private Local Area Network (MBH EP-LAN)

An MBH EP-LAN is an Ethernet LAN (E-LAN), port-based, multipoint service that associates 3 or more UNIs within the TDS CEN. Due to the port-based nature of this service, only one EVC can be associated to a UNI. As a result, all tagged and untagged Service Frames are mapped to that single EVC at the UNI. There is no need to coordinate a detailed EVC end-point map.

Figure 4 (below) shows an example of MBH services delivered as an MBH EP-LAN along with an MBH EPL. The delivery of these services requires a dedicated UNI per EVC per location. An MBH EP-LAN may be preferred if the Mobile Operator wants to interconnect all sites to appear to be on the same LAN. In this example, the Mobile Operator wants to distribute 1 internal service (orange) to all 3 RAN BSs and a second internal service (green) to RAN BS2. 1 MBH EP-LAN EVC (red) and 1 MBH EPL EVC (blue) is ordered to traverse the TDS CEN. At each UNI, TDS will POP the TDS S-Tag to deliver the internal services untagged.

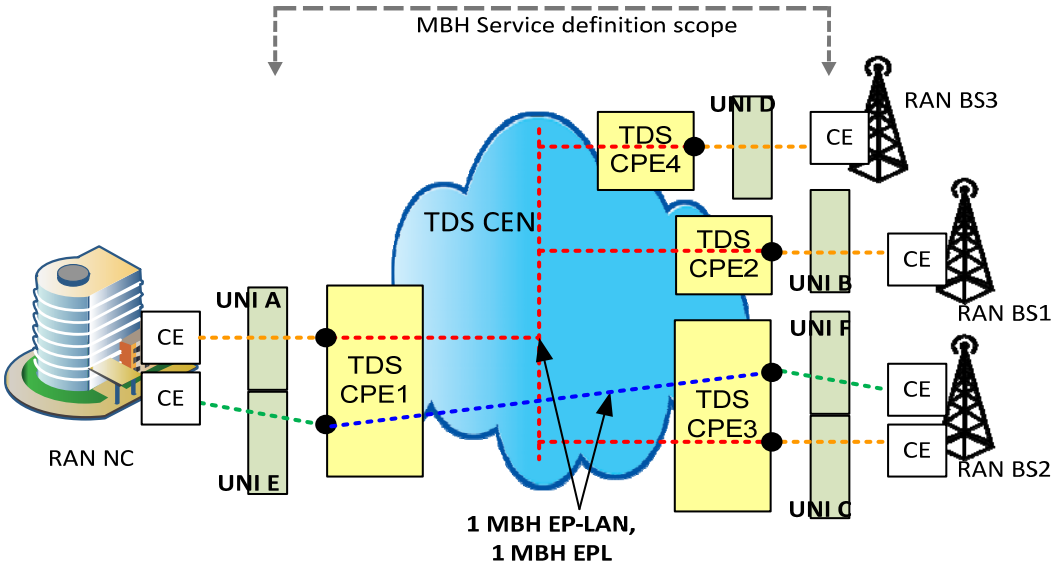

Figure 4: Mobile Backhaul via MBH EP-LAN with second service

2.4. TDS Mobile Backhaul Ethernet Virtual Private Local Area Network (MBH EVP-LAN)

An MBH EVP-LAN is an E-LAN, VLAN-based, multipoint service that associates 3 or more UNIs within the TDS CEN. Due to the VLAN-based nature of this service, multiple EVCs can be associated to a single UNI. As a result, tagged and untagged Service Frames must be mapped to a specific EVC at the UNI.

Figure 5 (below) shows an example of MBH services delivered as an MBH EVP-LAN along with an MBH EVPL. The delivery of these services requires only a single UNI at each location. This service may be preferred if the Mobile Operator wants to interconnect all sites to deliver a single service while efficiently delivering another service to one (or more) of those sites. In this example, the Mobile Operator wants to distribute one internal service (orange) to all 3 RAN BSs and a second internal service (green) to RAN BS2. 1 MBH EVP-LAN EVC (red) and 1 MBH EVPL EVC (blue) is ordered to traverse the TDS CEN. At each UNI, TDS will hand off the coordinated S-Tag for each EVC.

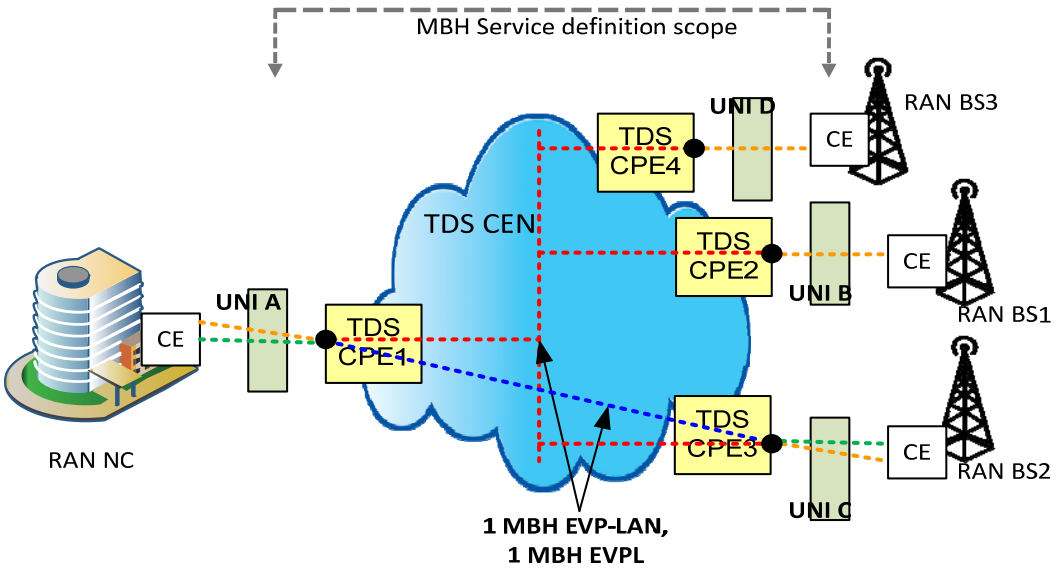

Figure 5: Mobile Backhaul via MBH EVP-LAN with second service

3. Carrier Ethernet Mobile Backhaul Attributes

3.1. EVC Service Attribute Values

In addition to the service descriptions above, TDS will default to the values shown below for the following EVC Service Attributes:

- EVC MTU Size: 1526 – 9000 Bytes
- CE-VLAN ID Preservation: Yes
- CE-VLAN CoS ID Preservation: Yes
- Ability to provide Service Level Specification (SLS) metrics
- Unicast Service Frame Delivery: Deliver Unconditionally
- Multicast Service Frame Delivery: Deliver Unconditionally
- Broadcast Service Frame Delivery: Deliver Unconditionally
- Layer 2 Control Protocol Tunneling:
    - CDP
    - STP
    - UTP
    - PVST
    - DTP
    - LLDP
    - ULD
    - All others are discarded

3.2. UNI Physical Attributes

Table 1 shows the Physical Mediums supported by the UNI devices deployed by TDS.

IEEE Designation	Description
1000BASE-T	Category 5 UTP or better; up to 100m
1000BASE-SX	MMF; up to 550m
1000BASE-LX	SMF; up to 5,000m
1000BASE-EX	SMF; up to 40,000m
1000BASE-ZX	SMF; up to 70,000m
10GBASE-SR	MMF; up to 300m
10GBASE-LR	SMF; up to 10,000m
10GBASE-ER	SMF; up to 40,000m
10GBASE-ZR	SMF; up to 80,000m

Table 1: UNI Physical Layer Values

3.3. UNI Service Attributes

For Mobile Backhaul services, TDS deploys the following UNI Devices:

- Accedian MetroNID-TE for 1G Fiber (1G UNI Handoff)
- Accedian MetroNODE-LT for 10G Fiber (1G or 10G UNI Handoff)

Those devices support UNI Service Attributes with the following values:

- Physical Layer: see Table 1(above)
- Fiber UNI MTU Size: 1526 – 9000 Bytes
- Support for Bandwidth Profiles

3.4. Bandwidth Profiles

TDS uses ingress and egress bandwidth profiles for traffic management. In Carrier Ethernet terms, “ingress” and “egress” are from the perspective of the CEN. An Ingress Bandwidth Profile manages the amount of traffic sent into the CEN from a UNI while an Egress Bandwidth Profile manages the amount of traffic delivered from the CEN to a UNI.

For a point-to-point EVC, TDS applies both ingress and egress bandwidth profiles at both UNIs using the CIR value ordered by the Mobile Operator.

For a multipoint EVC, TDS applies both ingress and egress bandwidth profiles at each UNI using the CIR value ordered by the Mobile Operator for each leg of the service. TDS will then build a network multipoint service across the TDS CEN using a specified CIR value ordered by the Mobile Operator. The CIR value for the network multipoint service must be equal to or greater than the leg with the largest CIR value, up to 10Gb. Multipoint EVCs are only eligible for a Basic or Best Effort SLA tier, depending on the deployment.

Figure 6 (below) shows an example of a multipoint EVC oversubscribed to share the same amount of bandwidth. Each leg is provisioned with an ingress and egress bandwidth profile of 500Mb. The network multipoint service is also provisioned for 500Mb. In this scenario, each RAN BS has enough bandwidth to send their max to the RAN NC, but if each BS sent 500Mb toward the NC at the same time, a total of 1500Mb of traffic would be generated over the 500Mb multipoint service, resulting in dropped frames. Therefore, this scenario would only be eligible for a Best Effort SLA.

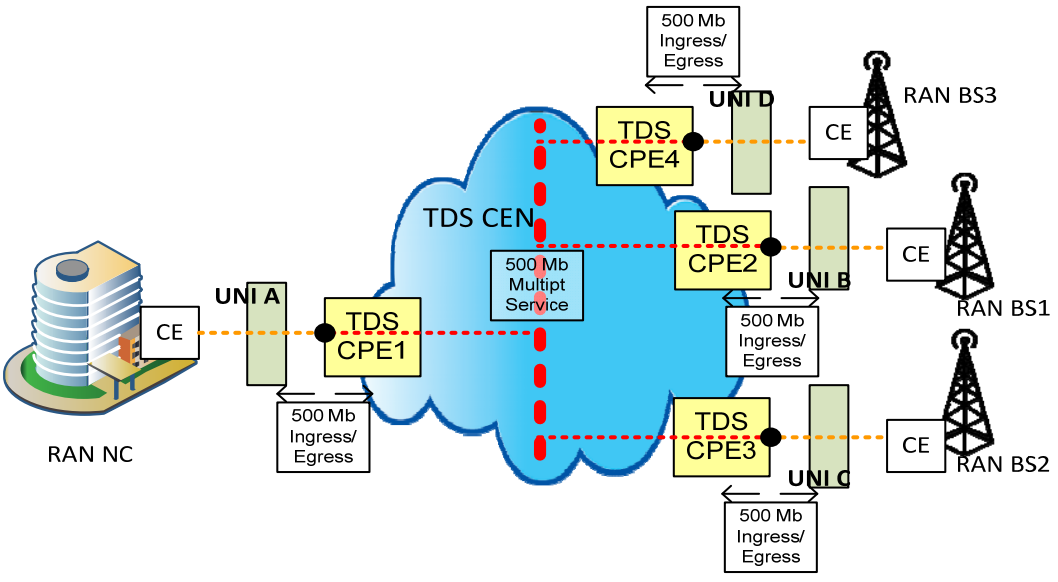

Figure 6: Oversubscribed Multipoint EVC with same CIR for each leg

Figure 7 (below) shows an example of a multipoint EVC oversubscribed with different CIR values at each leg. Each leg is provisioned with a specific ingress and egress bandwidth profile (500Mb for the RAN NC at UNI A, 500Mb at UNI B, 100Mb at UNI C, and 50Mb at UNI D). The network multipoint service is provisioned for 500Mb, which is equal to the largest leg (UNIs A,B). In this scenario, each RAN BS has enough bandwidth to send their max to the RAN NC individually. However, if each BS sent their max (500 Mb, 100Mb and 50Mb) toward the NC at the same time, a total of 650Mb of traffic would be generated over the 500Mb network multipoint service, resulting in dropped frames. Therefore, this scenario would only be eligible for a Best Effort SLA.

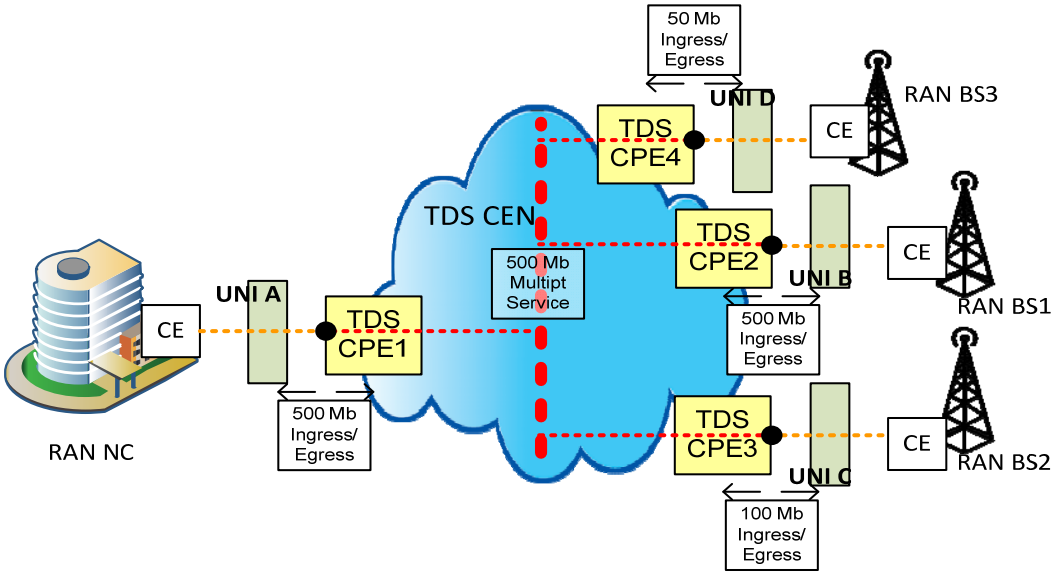

Figure 7: Oversubscribed Multipoint EVC with different CIR legs

Figure 8 (below) shows an example of a multipoint EVC that is not oversubscribed (from the perspective of the RAN NC). Each leg is provisioned with a specific ingress and egress bandwidth profile (500Mb for the RAN NC at UNI A, 250Mb at UNI B, 100Mb at UNI C, and 50Mb at UNI D). The network multipoint service is provisioned for 500Mb, which is equal to the largest leg (UNI A). In this scenario, each RAN BS has enough bandwidth to send their max to the RAN NC at the same time. Doing so would result in a total of 400Mb of traffic generated over the 500Mb network multipoint service, resulting in zero dropped frames.* This scenario would be eligible for a Basic or Best Effort SLA.

* NOTE – This applies only to green frames between a given BS and the NC, which is the method set by MEF for SLA measurement of a multipoint service. Any BS to BS traffic is ineligible for SLA consideration.

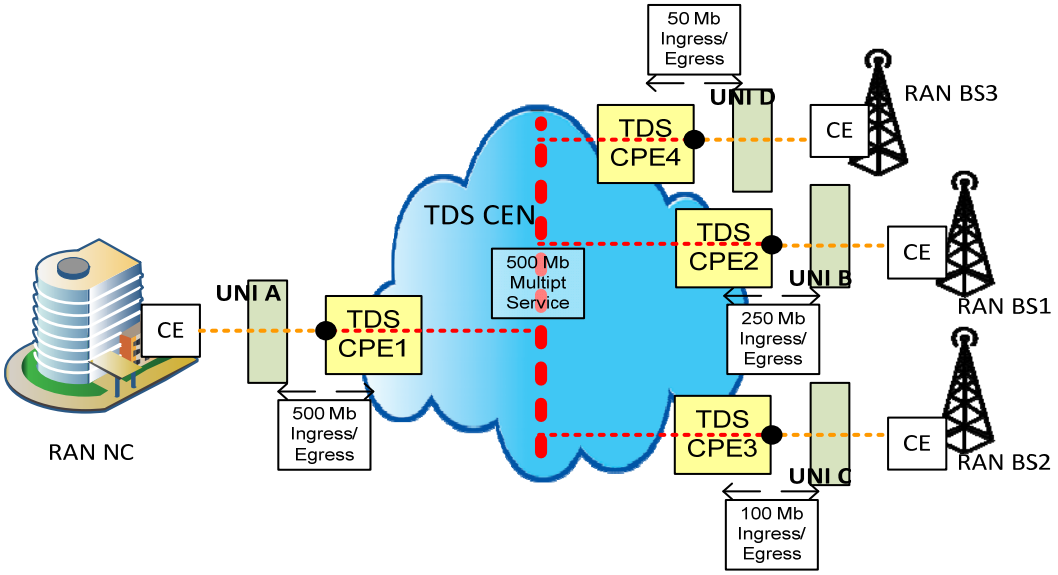

Figure 8: Non-oversubscribed Multipoint EVC

Table 2 (below) shows the MBH Bandwidth Profiles offered by TDS. While the MEF does not have a published standard for Committed Burst Size (CBS), TDS follows the baselines generally accepted within the industry. The value for CBS is a size (i.e. Kb) and not a rate (i.e. Kbps) and should be determined in relation to the maximum frame size (MTU) supported. Microbursts of 8 frames is the generally accepted baseline for determining CBS size.

TDS supports MTU sizes up to 9000 bytes (or 9Kb) for fiber fed services. Therefore, by setting a minimum CBS value of 72Kb, respectively, TDS allows microbursts of 8 frames (8 frames x 9Kb). To accommodate common requests from the industry, TDS has chosen to increase the CBS value in tiers above 100Mb and 1G, shown below.

Via Fiber (1G UNI w/9000 MTU)						**Via Fiber (10G UNI w/ 9000 MTU)**				
CIR (Mbps)	CBS (in KBytes)	CBS (in Kbits)	EIR (Mbps)	EBS (KB)		CIR (Mbps)	CBS (in KBytes)	CBS (in Kbits)	EIR (Mbps)	EBS (KB)
10	72	576	0	0		10	72	576	0	0
20	72	576	0	0		20	72	576	0	0
50	72	576	0	0		50	72	576	0	0
100	72	576	0	0		100	72	576	0	0
250	180	1440	0	0		250	180	1440	0	0
500	180	1440	0	0		500	180	1440	0	0
1000	180	1440	0	0		1000	180	1440	0	0
						2000	315	2520	0	0
						5000	315	2520	0	0
						10000	315	2520	0	0

Table 2: CIR Values with associated CBS, EIR and EBS values

3.5. Oversubscription

The Mobile Operator may NOT oversubscribe any UNI. The sum of the CIR values for all EVCs provisioned on a given UNI must be less than or equal to the UNI port speed. To account for potential Layer 3 traffic and its overheads, TDS recommends following the MEF recommendation of limiting the sum of CIR values of the EVCs provisioned on a given UNI to 70% or less of the UNI port speed.

4. Service Level Agreements and Management

4.1. Sales Quote Interval

TDS is committed to completing sales quotes at a budgetary level within 48 hours. A formal Engineering quote will require up to 15 business days to complete. Based upon the estimated cost of a project (generally, less than $30,000 in new capitol), a budgetary quote is binding.

4.2. Installation Interval

For MBH EVCs ordered to an existing UNI that is within a TDS Telecom CEN, the installation interval is 5 business days.

For MBH EVCs ordered that require fiber builds and turn up of a new UNI, the typical installation interval is 120 calendar days (additional time may be needed for extraordinary requirements).

4.3. Service Acceptance Testing

TDS will complete an RFC-2544 service acceptance test for all MBH EVCs ordered with a Premium or Basic SLA. The acceptance test will measure and record One-way Frame Delay, Inter Frame Delay Variation and One-way Frame Loss Ratio at the time of turn up to create a birth certificate to be kept on file.

4.4. Performance SLA Options

TDS offers Service Level Agreements in accordance to the Performance Tiers and Class of Service metrics standardized by the MEF. The Premium SLA tier is available only for fiber-based, point-to-point MBH services. Table 3 (below) details the specifications against which the TDS SLAs are measured. SLA thresholds are averages per calendar month.

TDS Carrier Ethernet Performance Parameters	PT1 High Short Reach	PT1 High Standard	PT2 High Standard
Premium SLA			
Maximum EVC/OVC Fiber Distance	**50 miles**	**150 miles**	**500 miles**
One-way Frame Delay	**5ms**	**10ms**	**25ms**
Inter Frame Delay Variation	**2ms**	**3ms**	**8ms**
One-way Frame Loss Ratio	**0.01%**	**0.01%**	**0.01%**
One-way Availability	**99.99%**	**99.99%**	**99.99%**
Basic SLA			
Maximum EVC/OVC Fiber Distance	**50 miles**	**150 miles**	**500 miles**
One-way Frame Delay	**30ms**	**30ms**	**30ms**
Inter Frame Delay Variation	**10ms**	**10ms**	**10ms**
One-way Frame Loss Ratio	**0.10%**	**0.10%**	**0.10%**
One-way Availability	**99.90%**	**99.90%**	**99.90%**
Best Effort			
Maximum EVC/OVC Fiber Distance	**50 miles**	**150 miles**	**500 miles**
One-way Frame Delay	**BE**	**BE**	**BE**
Inter Frame Delay Variation	**BE**	**BE**	**BE**
One-way Frame Loss Ratio	**BE**	**BE**	**BE**
One-way Availability	**BE**	**BE**	**BE**
ADDITIONAL NOTES			
* Operators can provide more stringent values than the Max MEF values			
* Both FD and MFD values not required, but at least one must be specified			
* Both IFDV and FDR values not required, but at least one must be specified			
* All values apply to Green frames only			
* MEF 23.1 does not define values for multipoint EVCs/OVCs			

Table 3: Network Performance SLA Parameters

4.4.1. Service OAM Methodologies

TDS offers performance monitoring for point-to-point EVCs ordered with a Premium SLA using ITU-T Y.1731 standards. TDS follows the Y.1731 Maintenance End-point Group (MEG) Level recommendations from the MEF, as shown in Figure 9 (below). TDS will assign MEG Level 3 to each EVC ordered by the Mobile Operator.

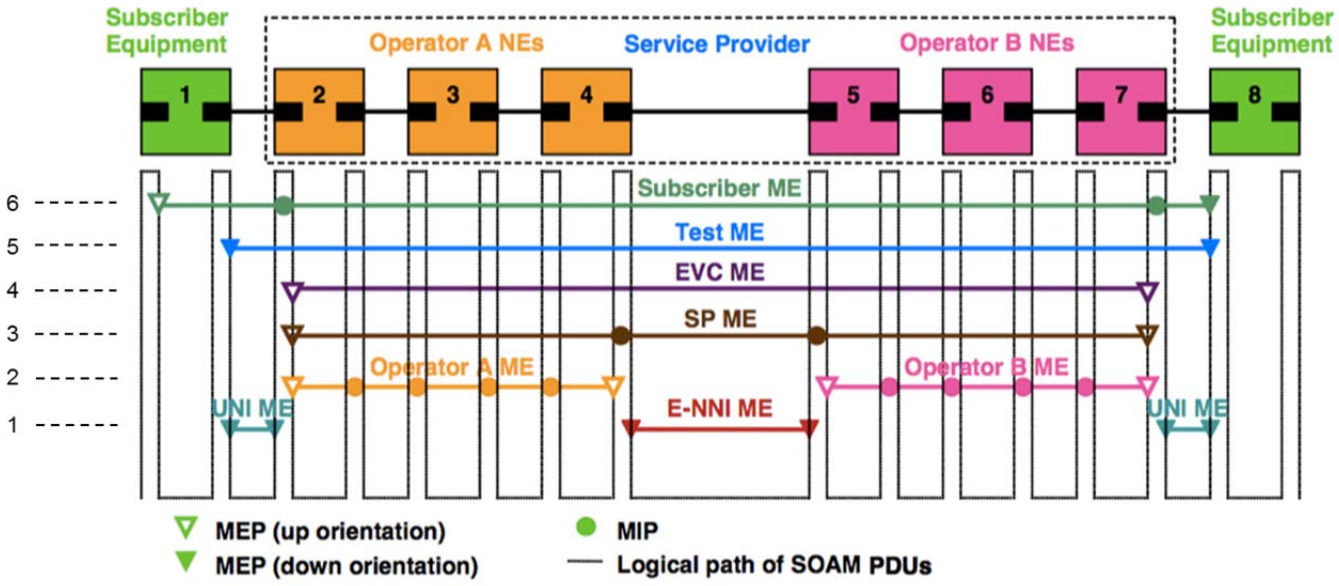

Figure 9: Y.1731 MEG Levels

4.5. Response and Repair

NOC access for TDS Mobile Backhaul service support is available 24x7 via a toll free contact number. Once TDS support is contacted and a trouble ticket is opened, the expected Mean Time to Repair (MTTR) is 4 hours, calculated over a calendar month. Force Majure, external fiber cuts, and planned maintenance are excluded from the aggregate MTTR.

4.6. Maintenance Notification

TDS will give Mobile Operators 10 calendar days for notifications of upcoming inside plant maintenance events. Maintenance notifications will be provided to the effected Mobile Operator(s) via e-mail notification to the address on record. Additional negotiation can then be facilitated to meet the business needs of the effected parties.

4.7. Resolution

Resolution of any disputes regarding the fulfillment of agreed upon SLA expectations will be done through discussion between TDS Carrier Sales Support and the Service Provider. Within the discussion will be a review of the events in dispute as well as identification of the specific terms of the Master Service Agreement with the Mobile Operator.

5. Mobile Backhaul Network Channel and Interface Codes

The following tables provide the proper NC/NCI codes used when putting in an ASR order for any of the TDS MBH services presented above. TDS is committed to using valid COMMON LANGUAGE® codes where possible; however, in some instances, non-standard coding may be necessary. Code combinations are outlined below for the following order scenarios:

- A NC/NCI combination for the physical build at the ENNI
- A NC/NCI combination for the physical build to the UNI
- A NC/NCI combination for the Ethernet Virtual Connection

5.1. MBH EPL UNI & EVC Codes

NC Codes - MBH EPL (Fiber)

SERVICE CODE	SERVICE DESCRIPTION	OPTION CODE	OPTION DESCRIPTION	CONNECTION TYPE	SERVICE CODE MODIFIE	UNI	EVC
KF	ETHERNET at 1 GBPS	L-	LAN - None, No further options	CLCI S/S	KF, LU	X	
KF	ETHERNET at 1 GBPS	LA	LAN - Network Monitoring	CLCI S/S	KF, LU	X	
KG	ETHERNET at 10 GBPS	L-	LAN PHY at 10.3125 Gbps, Ethernet Frames, payload only - None, No further options	CLCI S/S	KG, LZ	X	
KG	ETHERNET at 10 GBPS	LA	LAN PHY at 10.3125 Gbps, Ethernet Frames, payload only - Network Monitoring	CLCI S/S	KG, LZ	X	
VL	Metro Ethernet Virtual Connection	P-	Point-to-point Ethernet Virtual Connection (EVC). Defined in MEF 10 as an association of exactly two UNIs. - None, No further options	CLCI S/S	CU, VL		X

UNI NCI Codes - MBH EPL (Fiber)

NCI	CONDUCTO	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (CO)
08LN9.1GE	8	Local Area/Wide Area Network (LAN/WAN) Interface	100 Ohms	1000BASE-T Ethernet (Applicable for KF Service Code only)	X	
02LNF.AA2	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1310 nm, Single-mode Fiber (e.g. 100BASE-LX10, 1000BASE-LX, 10GBASE-LR and 10GBASE-LW in IEEE 802.3) w/Auto Negotiation	X	
02LNF.AA3	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1550 nm, Single-mode Fiber (e.g. 10GBASE-ER and 10GBASE-EW in IEEE 802.3, and 1000BASE-ZX, 10GBASE-ZR, and 10GBASE-ZW based on specific vendor implementations) w/Auto Negotiation	X	
02LNF.AA4	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	850 nm, 50 micron multimode Fiber (e.g. specified for 10BASE-FL, 1000BASE-SX, 10GBASE-SR and 10GBASE-SW in IEEE 802.3) w/Auto Negotiation	X	
02CXF.1GE	2	Digital Termination On A Switch/Router	Fiber	1 Gbps Ethernet User to Network Interface (UNI) (Applicable for KF Service Code only)		X
02CXF.10G	2	Digital Termination On A Switch/Router	Fiber	10 Gbps Ethernet User to Network Interface (UNI) (Applicable for KG Service Code only)		X

EVC/OVC NCI Codes - MBH EPL

NCI	CONDUCTO	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (UNI)
02VLN.A2	2	Ethernet/Operator Virtual Connection (EVC/OVC) Termination per MEF 10 and MEF 26 (Describes how the EVC/OVC being ordered interacts with the associated UNI/NNI)	None (virtual)	PORT MAP WITH ALL TO ONE BUNDLE (This EVC/OVC accepts ALL frames ingressing the UNI/ENNI, No service multiplexing)	X	X

5.2. MBH EVPL UNI & EVC Codes

NC Codes - MBH EVPL (Fiber)

SERVICE CODE	SERVICE DESCRIPTION	OPTION CODE	OPTION DESCRIPTION	CONNECTION TYPE	SERVICE CODE MODIFIER	UNI	EVC
KF	ETHERNET at 1 GBPS	E-	Supports Service Multiplexing - None, No further options	CLCI S/S	KF, LU	X	
KF	ETHERNET at 1 GBPS	EA	Supports Service Multiplexing - Network Monitoring	CLCI S/S	KF, LU	X	
KG	ETHERNET at 10 GBPS	E-	LAN PHY (10.3125 Gbps), Supports Service Multiplexing - None, No further options	CLCI S/S	KG, LZ	X	
KG	ETHERNET at 10 GBPS	EA	LAN PHY (10.3125 Gbps), Supports Service Multiplexing - Network Monitoring	CLCI S/S	KG, LZ	X	
VL	Metro Ethernet Virtual Connection	P-	Point-to-point Ethernet Virtual Connection (EVC). Defined in MEF 10 as an association of exactly two UNIs. - None, No further options	CLCI S/S	CU, VL		X

UNI NCI Codes - MBH EVPL (Fiber)

NCI	CONDUCTOR	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (CO)
08LN9.1GE	8	Local Area/Wide Area Network (LAN/WAN) Interface	100 Ohms	1000BASE-T Ethernet (applicable for KF Service Code only)	X	
02LNF.A02	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1310 nm, Single-mode Fiber (e.g. 100BASE-LX10, 1000BASE-LX, 10GBASE-LR and 10GBASE-LW in IEEE 802.3)	X	
02LNF.A03	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1550 nm, Single-mode Fiber (e.g. 10GBASE-ER and 10GBASE-EW in IEEE 802.3, and 1000BASE-ZX, 10GBASE-ZR, and 10GBASE-ZW based on specific vendor implementations)	X	
02LNF.A04	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	850 nm, 50 micron multimode Fiber (e.g. specified for 10BASE-FL, 1000BASE-SX, 10GBASE-SR and 10GBASE-SW in IEEE 802.3)	X	
02CXF.1GE	2	Digital Termination On A Switch/Router	Fiber	1 Gbps Ethernet User to Network Interface (UNI) (Applicable for KF Service Code only)		X
02CXF.10G	2	Digital Termination On A Switch/Router	Fiber	10 Gbps Ethernet User to Network Interface (UNI) (Applicable for KG Service Code only)		X

EVC/OVC NCI Codes - MBH EVPL

NCI	CONDUCTOR	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (UNI)
02VLN.V	2	Ethernet/Operator Virtual Connection (EVC/OVC) Termination per MEF 10 and MEF 26 (Describes how the EVC/OVC being ordered interacts with the associated UNI/NNI)	None (virtual)	PORT + CE-VLAN MAP(This EVC/OVC accepts only tagged frames with a specific CE-VLAN ID)	X	X
02VLN.VB	2	Ethernet/Operator Virtual Connection (EVC/OVC) Termination per MEF 10 and MEF 26 (Describes how the EVC/OVC being ordered interacts with the associated UNI/NNI)	None (virtual)	PORT + Bundled CE-VLAN MAP. (This EVC/OVC accepts only tagged frames with two or more specific CE-VLAN IDs. It should not be confused with All-to-one bundling which is a different attribute. See MEF 10 for clarification)	X	X

5.3. MBH EP-LAN UNI & EVC Codes

NC Codes - MBH EP-LAN (Fiber)							
SERVICE CODE	SERVICE DESCRIPTION	OPTION CODE	OPTION DESCRIPTION	CONNECTION TYPE	SERVICE CODE MODIFIER	UNI	EVC
KF	ETHERNET at 1 GBPS	L-	LAN - None, No further options	CLCI S/S	KF, LU	X	
KF	ETHERNET at 1 GBPS	LA	LAN - Network Monitoring	CLCI S/S	KF, LU	X	
KG	ETHERNET at 10 GBPS	L-	LAN PHY at 10.3125 Gbps, Ethernet Frames, payload only - None, No further options	CLCI S/S	KG, LZ	X	
KG	ETHERNET at 10 GBPS	LA	LAN PHY at 10.3125 Gbps, Ethernet Frames, payload only - Network Monitoring	CLCI S/S	KG, LZ	X	
VL	Metro Ethernet Virtual Connection	M-	Multipoint-to-multipoint Capable Ethernet Virtual Connection (EVC per MEF 10 or OVC per MEF 26). An association of two or more UNIs or ENNIs. - None, No further options	CLCI S/S	CU, VL		X

UNI NCI Codes - MBH EP-LAN (Fiber)						
NCI	CONDUCTORS	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (CO)
08LN9.1GE	8	Local Area/Wide Area Network (LAN/WAN) Interface	100 Ohms	1000BASE-T Ethernet (Applicable for KF Service Code only.)	X	
02LNF.AA2	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1310 nm, Single-mode Fiber (e.g. 100BASE-LX10, 1000BASE-LX, 10GBASE-LR and 10GBASE-LW in IEEE 802.3) w/Auto Negotiation	X	
02LNF.AA3	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1550 nm, Single-mode Fiber (e.g. 10GBASE-ER and 10GBASE-EW in IEEE 802.3, and 1000BASE-ZX, 10GBASE-ZR, and 10GBASE-ZW based on specific vendor implementations) w/Auto Negotiation	X	
02LNF.AA4	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	850 nm, 50 micron multimode Fiber (e.g. specified for 10BASE-FL, 1000BASE-SX, 10GBASE-SR and 10GBASE-SW in IEEE 802.3) w/Auto Negotiation	X	
02CXF.1GE	2	Digital Termination On A Switch/Router	Fiber	1 Gbps Ethernet User to Network Interface (UNI) (Applicable for KF Service Code only)		X
02CXF.10G	2	Digital Termination On A Switch/Router	Fiber	10 Gbps Ethernet User to Network Interface (UNI) (Applicable for KG Service Code only)		X

EVC/OVC NCI Codes - MBH EP-LAN						
NCI	CONDUCTORS	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (UNI)
02VLN.A2	2	Ethernet/Operator Virtual Connection (EVC/OVC) Termination per MEF 10 and MEF 26 (Describes how the EVC/OVC being ordered interacts with the associated UNI/NNI)	None (virtual)	PORT MAP WITH ALL TO ONE BUNDLE (This EVC/OVC accepts ALL frames ingressing the UNI/ENNI, No service multiplexing)	X	X

5.4. MBH EVP-LAN UNI & EVC Codes

NC Codes - MBH EVP-LAN(Fiber)							
SERVICE CODE	SERVICE DESCRIPTION	OPTION CODE	OPTION DESCRIPTION	CONNECTION TYPE	SERVICE CODE MODIFIER	UNI	EVC
KF	ETHERNET at 1 GBPS	E-	Supports Service Multiplexing - None, No further options	CLCI S/S	KF, LU	X	
KF	ETHERNET at 1 GBPS	EA	Supports Service Multiplexing - Network Monitoring	CLCI S/S	KF, LU	X	
KG	ETHERNET at 10 GBPS	E-	LAN PHY (10.3125 Gbps), Supports Service Multiplexing - None, No further options	CLCI S/S	KG, LZ	X	
KG	ETHERNET at 10 GBPS	EA	LAN PHY (10.3125 Gbps), Supports Service Multiplexing - Network Monitoring	CLCI S/S	KG, LZ	X	
VL	Metro Ethernet Virtual Connection	M-	Multipoint-to-multipoint Capable Ethernet Virtual Connection (EVC per MEF 10 or OVC per MEF 26). An association of two or more UNIs or ENNIs. - None, No further options	CLCI S/S	CU, VL		X

UNI NCI Codes - MBH EVP-LAN (Fiber)						
NCI	COND UCTOR	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (CO)
08LN9.1GE	8	Local Area/Wide Area Network (LAN/WAN) Interface	100 Ohms	1000BASE-T Ethernet (applicable for KF Service Code only)	X	
02LNF.A02	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1310 nm, Single-mode Fiber (e.g. 100BASE-LX10, 1000BASE-LX, 10GBASE-LR and 10GBASE-LW in IEEE 802.3)	X	
02LNF.A03	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	1550 nm, Single-mode Fiber (e.g. 10GBASE-ER and 10GBASE-EW in IEEE 802.3, and 1000BASE-ZX, 10GBASE-ZR, and 10GBASE-ZW based on specific vendor implementations)	X	
02LNF.A04	2	Local Area/Wide Area Network (LAN/WAN) Interface	Fiber	850 nm, 50 micron multimode Fiber (e.g. specified for 10BASE-FL, 1000BASE-SX, 10GBASE-SR and 10GBASE-SW in IEEE 802.3)	X	
02CXF.1GE	2	Digital Termination On A Switch/Router	Fiber	1 Gbps Ethernet User to Network Interface (UNI) (Applicable for KF Service Code only)		X
02CXF.10G	2	Digital Termination On A Switch/Router	Fiber	10 Gbps Ethernet User to Network Interface (UNI) (Applicable for KG Service Code only)		X

EVC/OVC NCI Codes - MBH EVP-LAN						
NCI	COND UCTOR	PROTOCOL DESCRIPTION	IMPEDANCE	OPTION DESCRIPTION	NCI (UNI)	SECNCI (UNI)
02VLN.V	2	Ethernet/Operator Virtual Connection (EVC/OVC) Termination per MEF 10 and MEF 26 (Describes how the EVC/OVC being ordered interacts with the associated UNI/NNI)	None (virtual)	PORT + CE-VLAN MAP(This EVC/OVC accepts only tagged frames with a specific CE-VLAN ID)	X	X
02VLN.VB	2	Ethernet/Operator Virtual Connection (EVC/OVC) Termination per MEF 10 and MEF 26 (Describes how the EVC/OVC being ordered interacts with the associated UNI/NNI)	None (virtual)	PORT + Bundled CE-VLAN MAP. (This EVC/OVC accepts only tagged frames with two or more specific CE-VLAN IDs. It should not be confused with All-to-one bundling which is a different attribute. See MEF 10 for clarification)	X	X