MEF

Introducing the Specifications of the Metro Ethernet Forum

MEF 28: External Network Network Interface (ENNI) Support for UNI Tunnel Access and Virtual UNI

Agenda

- **Approved MEF Specifications**
- **This presentation**
- **About this Specification**
- **In Scope / Out of Scope**
- **Terminology, Concepts & Relationship to other standards**
- **Section Review**
- **Examples/Use Cases**
- **Summary**

Approved MEF Specifications

REF	Description
MEF 2	Requirements and Framework for Ethernet Service Protection
MEF 3	Circuit Emulation Service Definitions, Framework and Requirements in Metro Ethernet Networks
MEF 4	Metro Ethernet Network Architecture Framework Part 1: Generic Framework
MEF 6.1	Metro Ethernet Services Definitions Phase 2
MEF 7.1	EMS-NMS Information Model
MEF 8	Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks
MEF 9	Abstract Test Suite for Ethernet Services at the UNI
MEF 10.2	Ethernet Services Attributes Phase 2*
MEF 11	User Network Interface (UNI) Requirements and Framework
MEF 12	Metro Ethernet Network Architecture Framework Part 2: Ethernet Services Layer
MEF 13	User Network Interface (UNI) Type 1 Implementation Agreement
MEF 14	Abstract Test Suite for Traffic Management Phase 1
MEF 15	Requirements for Management of Metro Ethernet Phase 1 Network Elements
MEF 16	Ethernet Local Management Interface

* MEF 6.1 replaced MEF 6., MEF 7.1 replaced MEF 7, MEF 10 .2 replaced MEF 10.1.1, MEF 10.1, MEF 10 which replaced MEF 1 and MEF 5.

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Approved MEF Specifications

| REF	Description
MEF 17	Service OAM Framework and Requirements
MEF 18	Abstract Test Suite for Circuit Emulation Services
MEF 19	Abstract Test Suite for UNI Type 1
MEF 20	User Network Interface (UNI) Type 2 Implementation Agreement
MEF 21	Abstract Test Suite for UNI Type 2 Part 1: Link OAM
MEF 22	Mobile Backhaul Implementation Agreement Phase 1
MEF 23	Class of Service Implementation Agreement Part 1
MEF 24	Abstract Test Suite for UNI Type 2 Part 2: E-LMI
MEF 25	Abstract Test Suite for UNI Type 2 Part 3: Service OAM
MEF 26	External Network Network Interface (ENNI) – Phase 1
MEF 27	Abstract Test Suite For UNI Type 2 Part 5: Enhanced UNI Attributes & Part 6: L2CP Handling
MEF 28	External Network Network Interface (ENNI) Support for UNI Tunnel Access and Virtual UNI
MEF 29	Ethernet Services Constructs
MEF 30	Service OAM Fault Management Implementation Agreement
MEF 31	Service OAM Fault Management Definition of Managed Objects
MEF 32	Requirements for Service Protection Across External Interfaces

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MEF Specification Overview

MEF 28	External Network Network Interface Support for UTA and VUNI
Purpose	This Technical Specification extends the ENNI by defining the UNI Tunnel Access (UTA) which associates a Virtual UNI (VUNI), a remote UNI, and at least one supporting OVC.
Audience	All service provider/operators interested in enabling UNI tunneling

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This Presentation

- **Purpose:**
  - This presentation is an introduction to MEF 28

- **Audience**
  - Equipment Manufacturers building devices that will carry Carrier Ethernet Services.
  - Useful for Service Providers architecting their systems

- **Other Documents**
  - Presentations of the other specifications and an overview of all specifications is available on the MEF web site
  - Other materials such as white papers and case studies are also available

- Brings Carrier Ethernet to a new level by enabling new functionality to Carrier Ethernet attributes of scalability, service management, reliability, QoS and standardized services
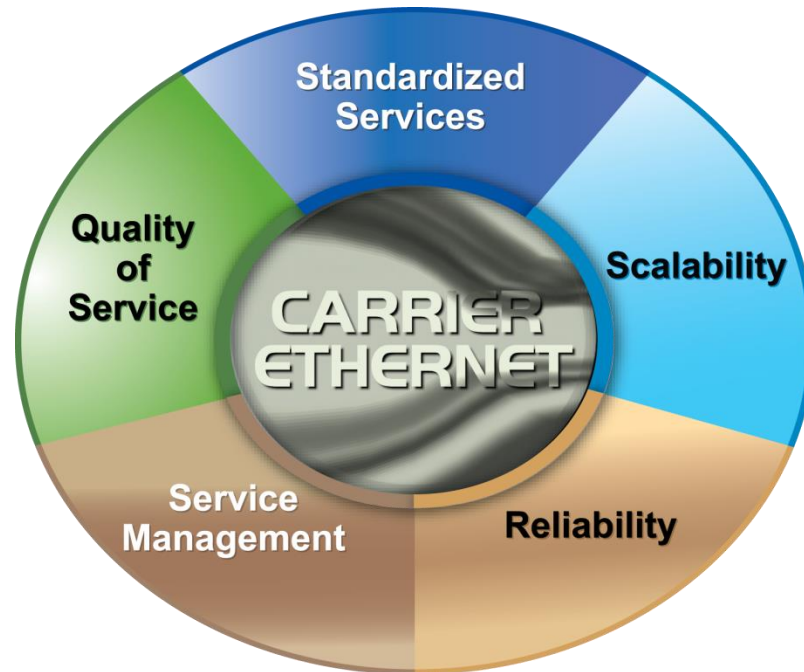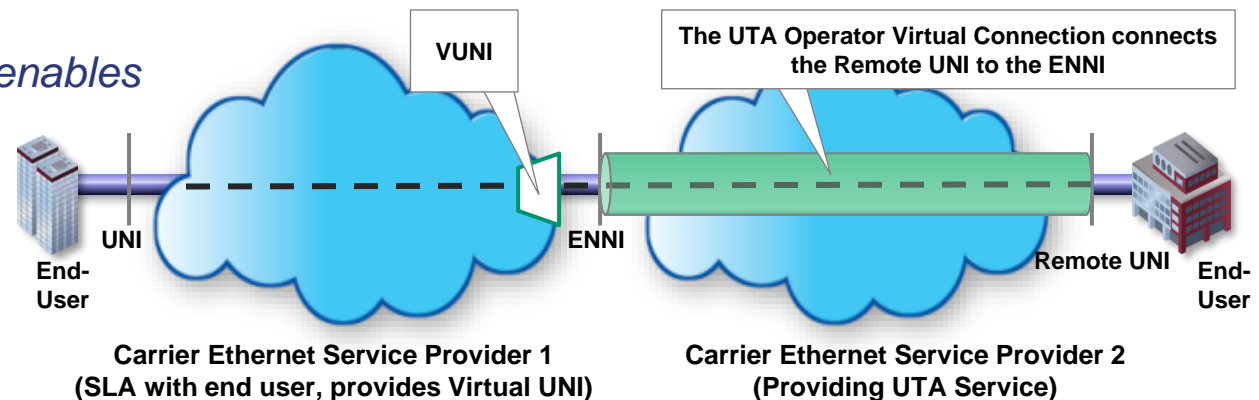
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Overview of MEF 28

About the Specification

Technical Specification extends the ENNI by defining the UNI Tunnel Access (UTA) which associates a Virtual UNI (VUNI), a remote UNI, and at least one supporting OVC

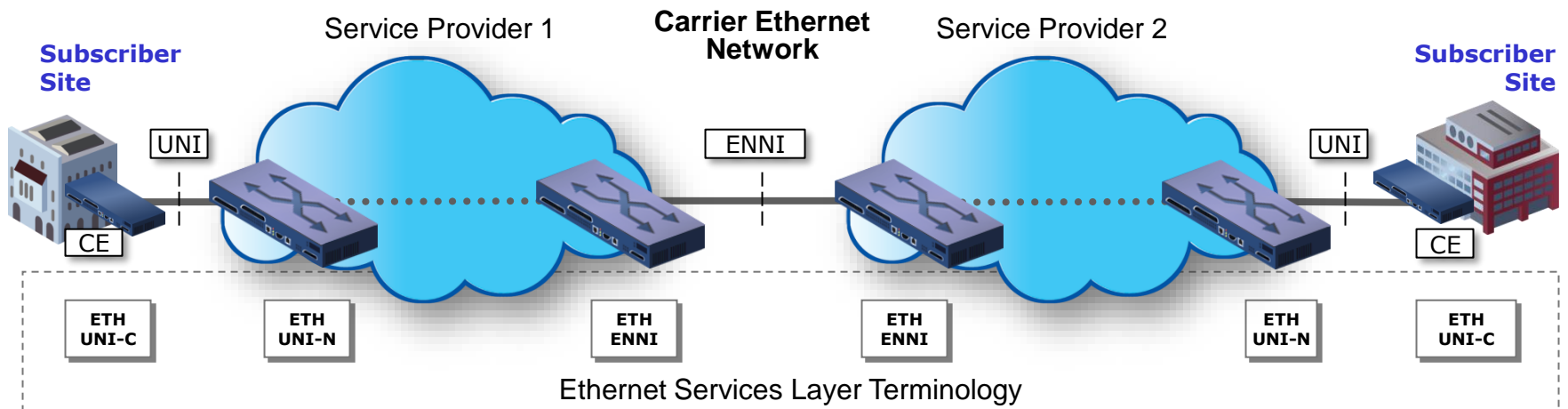**This specification specifies:**

- The requirements for the UNI Tunnel Access (UTA) in sufficient detail to ensure interoperability between MENs.

- The service attributes necessary to realize UTA.

- The Virtual UNI (VUNI), remote UNI constraints, and related service attributes

UNI Tunnel Access (UTA) enables EVC service frames associated with a remote user's UNI to be tunneled through an Off-Net providers' network
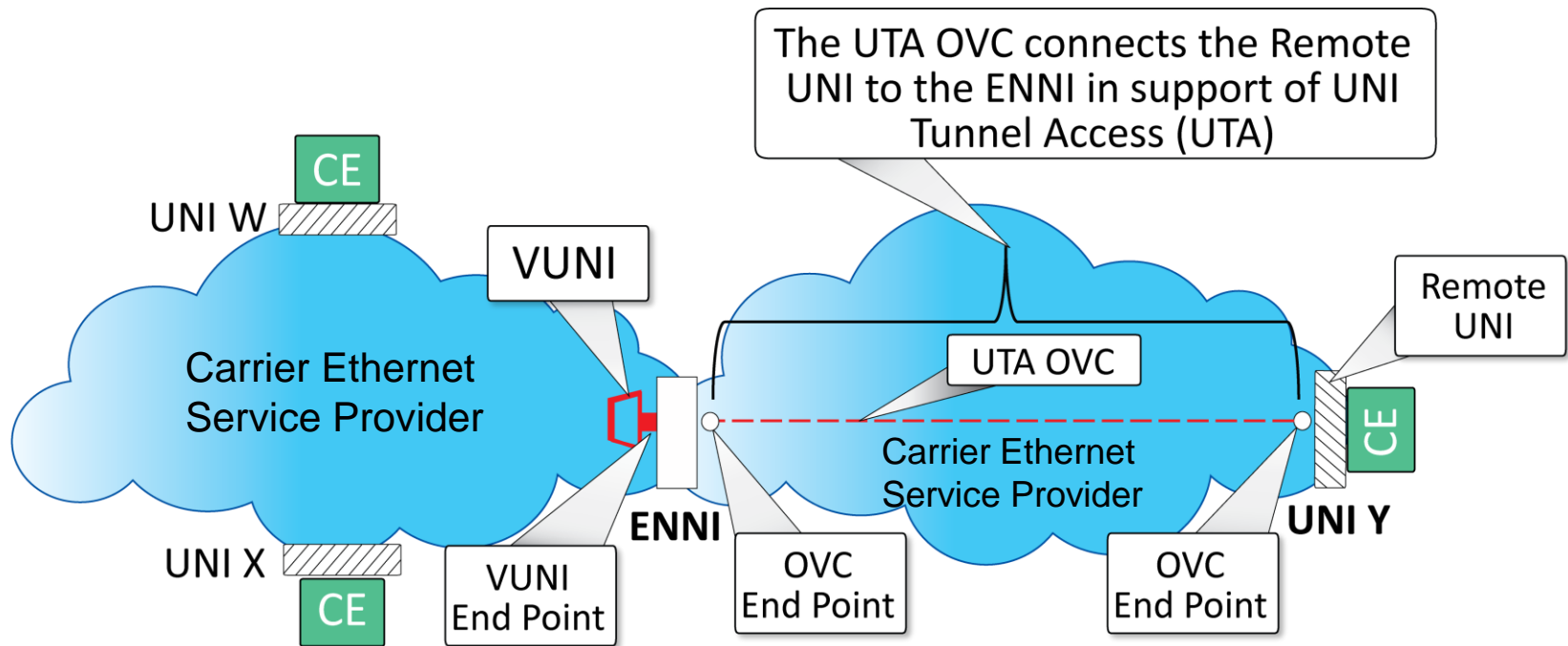
VUNI

The UTA Operator Virtual Connection connects the Remote UNI to the ENNI

UNI

ENNI

End-User

Remote UNI

End-User

**Carrier Ethernet Service Provider 1
(SLA with end user, provides Virtual UNI)**

**Carrier Ethernet Service Provider 2
(Providing UTA Service)**

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ENNI as the foundation

- ## External Network Network Interface (ENNI) is a reference point

  - describes the interface between two Metro Ethernet Networks (MENs);

  - intended to support the transparent extension of Ethernet services across multiple Network Operator MENs;

  - where each Network Operator MEN is under the control of a distinct administrative authority

Subscriber Site

Service Provider 1

Carrier Ethernet Network

Service Provider 2

Subscriber Site

UNI

ENNI

UNI

CE

CE

| ETH UNI-C | ETH UNI-N | ETH ENNI | ETH ENNI | ETH UNI-N | ETH UNI-C |

Ethernet Services Layer Terminology

In Scope for this Specification

The UNI Tunnel Access (UTA) provides a means for the Service Frames of EVCs associated with a remote subscriber's UNI to be tunneled through a Network Operator's MEN to an ENNI connecting a Network Operator's MEN with the VUNI Provider's MEN

Network Operator provides the OVC for transfer of Service Frames between the remote UNI and the ENNI.

Assumes the following business model

- The Subscriber contracts with a Service Provider (who either acts as the VUNI Provider, or contracts with the VUNI Provider) to provide Ethernet Services among UNIs, including those UNIs outside of the Service Provider's serving area; EVC Service Level Specification (SLS) remains UNI to UNI.

- The Service Provider selects and contracts with one or more Network Operators to provide one UTA OVC to reach each remote UNI.

- It is the responsibility of the Service Provider to ensure the appropriate connectivity properties for each UTA such that the UNI-to-UNI service features purchased by the Subscriber can be delivered.

In Scope for this Specification

- For this initial phase, the remote UNI is supported by a Network Operator MEN as a UNI with specific attribute constraints (as described in this document) that is not aware of the EVC services. For future phases, an EVC service aware remote UNI may be considered.

- UTA is minimally supported by the UTA OVC within the Network Operator MEN that provides the remote UNI. Future versions of UTA may additionally be supported by OVCs traversing intermediate providers in order to "extend" the tunnel.
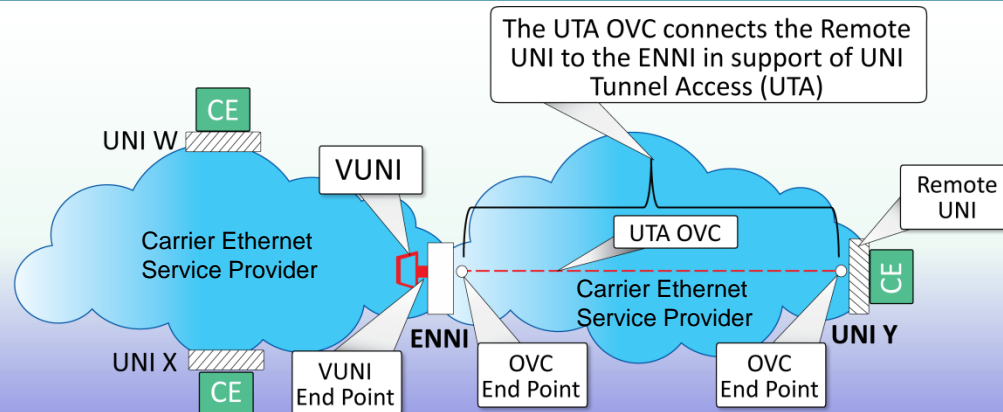
Out of Scope for this Specification

- **A service arrangement involving one or more "Intermediate Network Operators" between the VUNI Provider MEN and the Network Operator MEN supporting the remote UNI is a possible extension to the service model; however, details around this Use Case are left as a "For Future Study" (FFS) item.**

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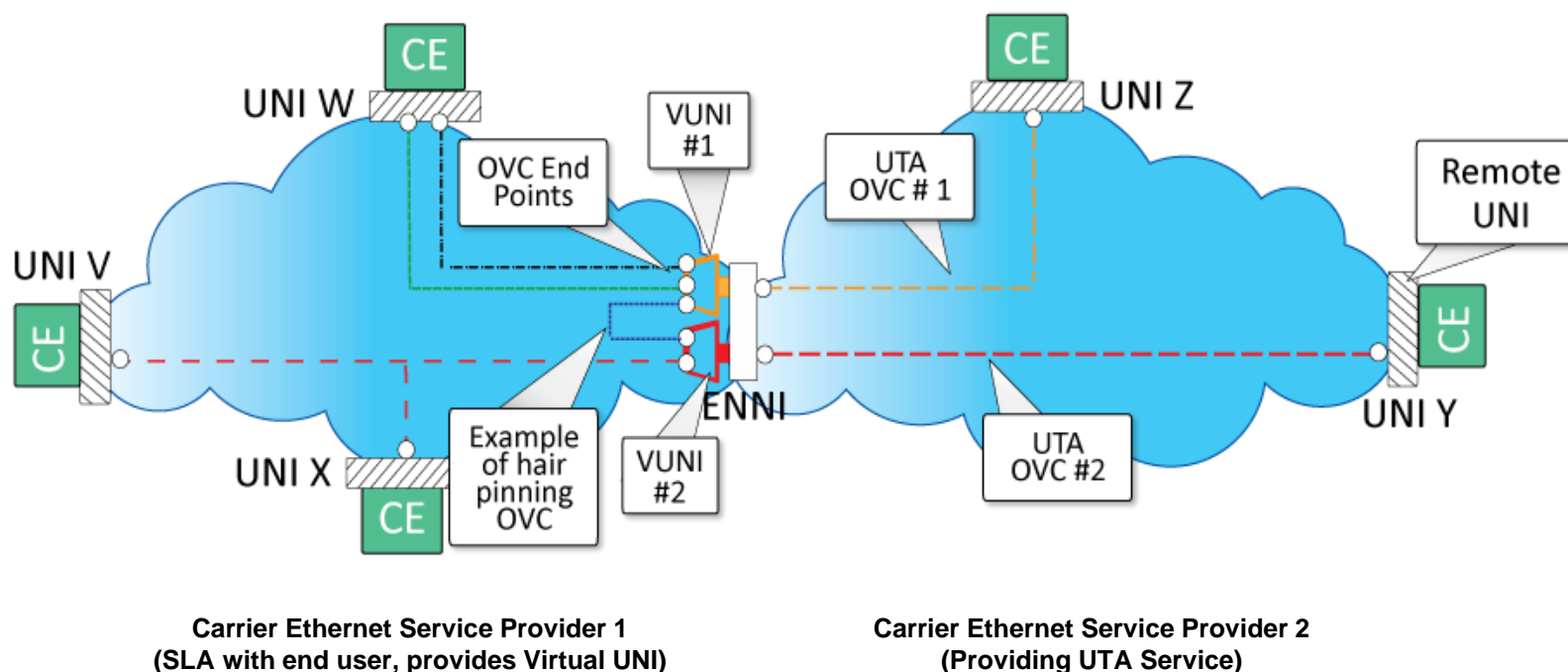## Terminology, Concepts & Relationship to other standards

MEF 28 Terminology

UNI Tunnel Access Model

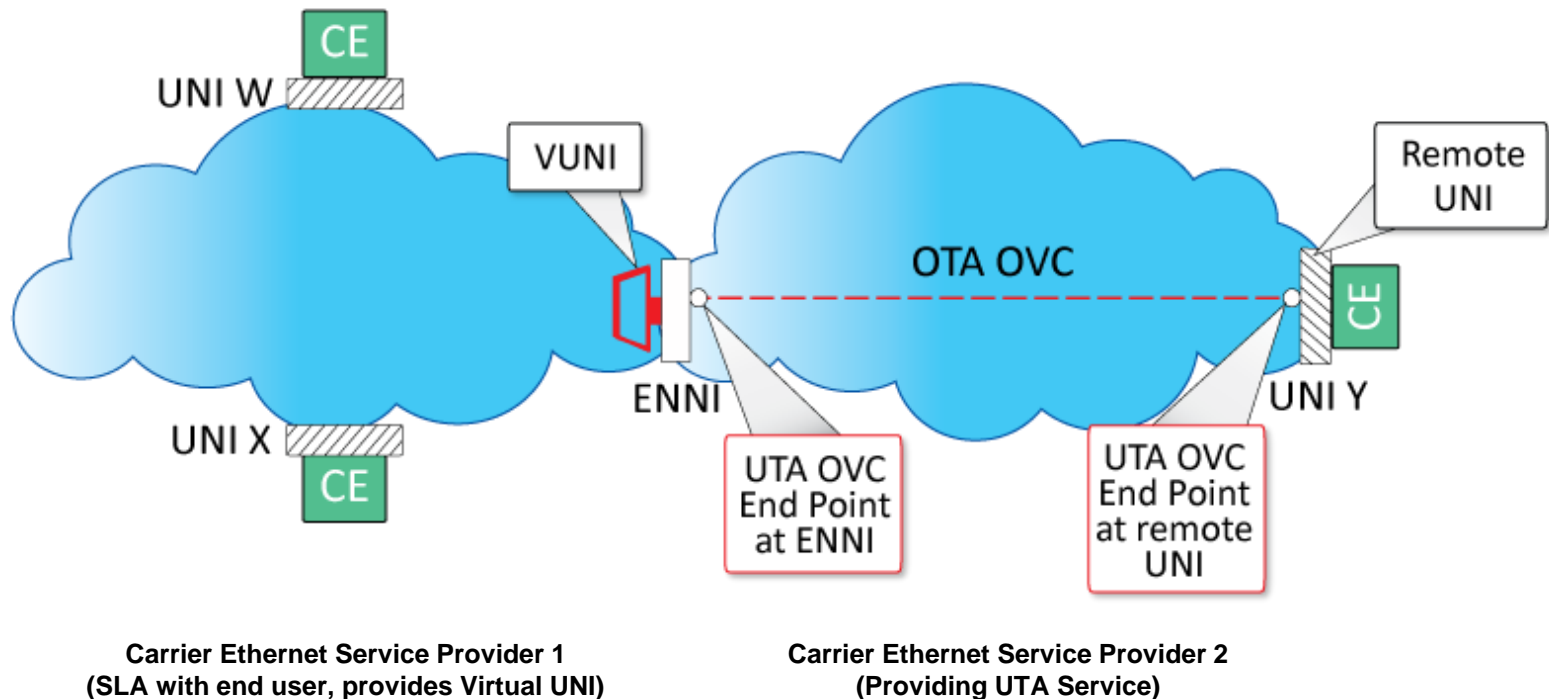| Term	Definition
Remote UNI	Remote UNI is a UNI serving as the UTA component consisting of a collection of service attributes in the UNI within an Operator's MEN. The remote UNI is paired with a VUNI in a VUNI Provider's MEN. At the remote UNI, Service Frames are exchanged between the Subscriber and the Network Operator MEN.[1]
UTA	The UNI Tunnel Access (UTA) associates a VUNI and remote UNI and is composed of VUNI and remote UNI Components and at least one supporting OVC[2].
UTA Component	Specific set of capabilities which may be used as part of UTA.
UTA OVC	An OVC in the Network Operator's MEN that provides an association of a remote UNI with an ENNI in support of UTA.
VUNI	Virtual UNI (VUNI) is the component consisting of a collection of service attributes in the VUNI Provider's MEN. The VUNI is paired with a remote UNI in a Network Operator's MEN. The main function of the VUNI is to map frames between a set of one or more OVCs present in the VUNI Provider domain and a single UTA.
VUNI End Point	An End Point at the VUNI Provider's side of a specific ENNI that associates the ENNI with a VUNI in support of UTA.
VUNI Provider	The Operator MEN providing the VUNI.

VUNI in Providers Network

In the VUNI Provider's network, the relationship between the UTA OVC and the VUNI is realized by an S-VLAN ID present at the ENNI, whose value is negotiated between the VUNI Provider and the Network Operator.

Carrier Ethernet Service Provider 1
(SLA with end user, provides Virtual UNI)

Carrier Ethernet Service Provider 2
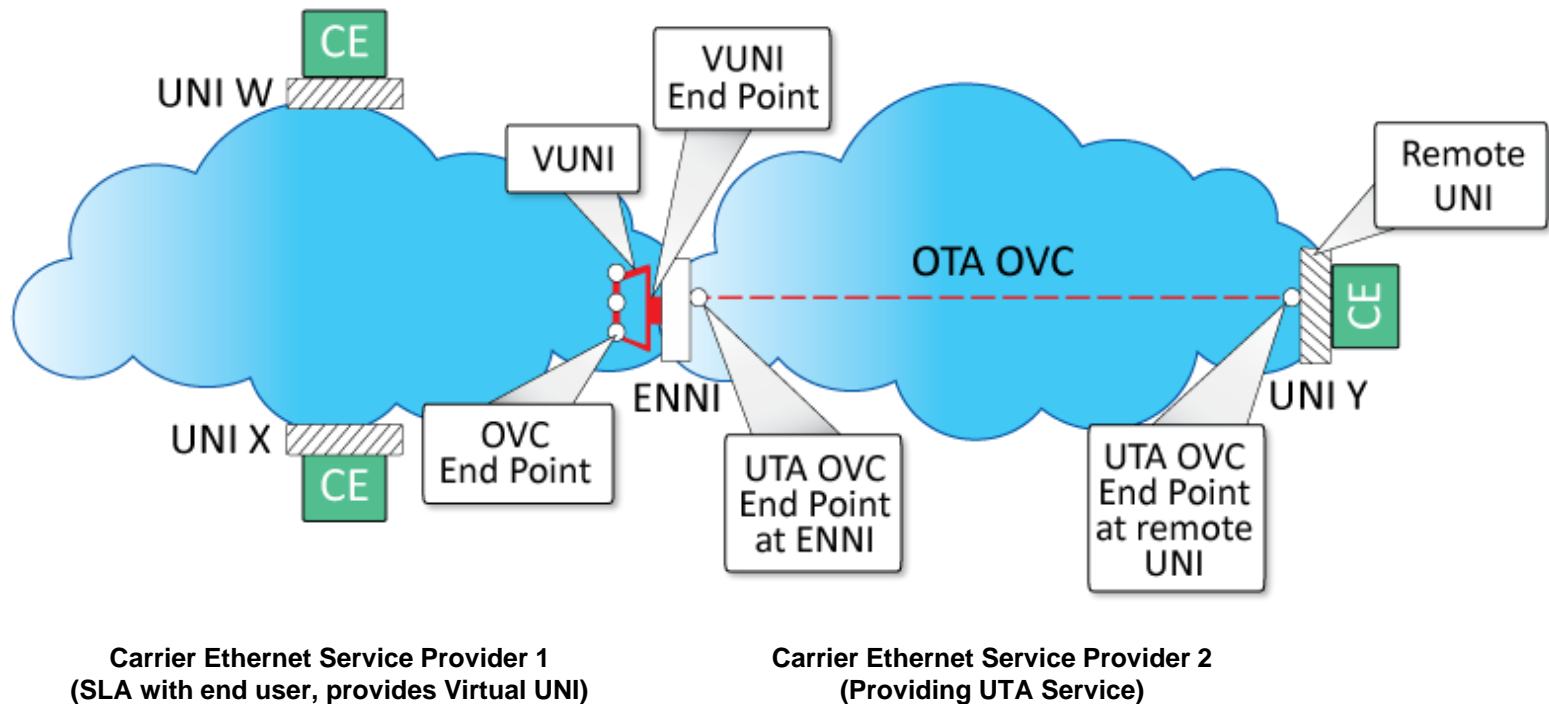**(Providing UTA Service)**

Description of the UTA Mechanism

- The Remote UNI is instantiated by the Network Operator (CE Service Provider 2) as a UNI where the Network Operator maps all Service Frames to the single OVC End Point supporting the UTA OVC.

Carrier Ethernet Service Provider 1
(SLA with end user, provides Virtual UNI)

Carrier Ethernet Service Provider 2
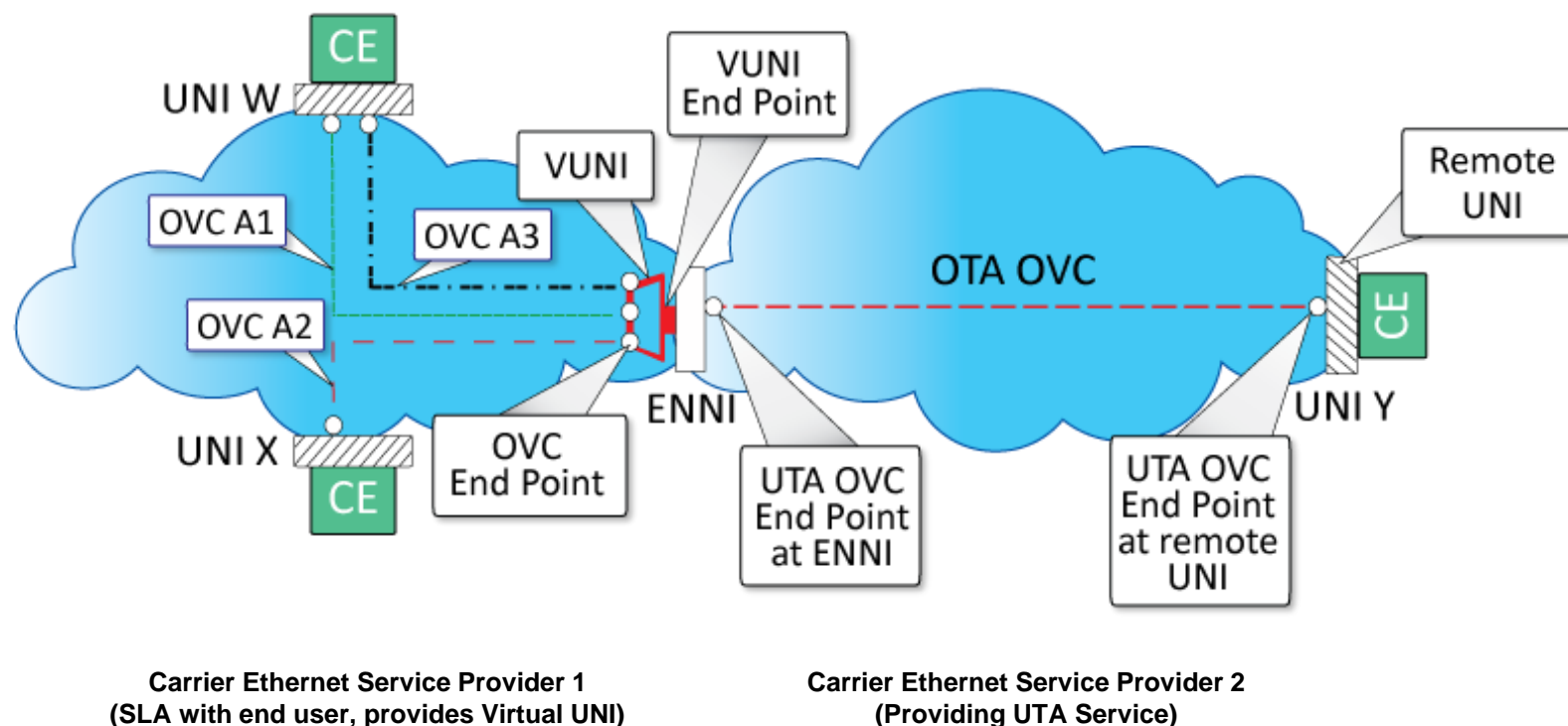**(Providing UTA Service)**

Mapping ENNI Frames to OVC End Point

- At the UTA OVC End Point at the Network Operator's side of the ENNI, an S-VLAN ID is used to map ENNI Frames to the OVC End Point supporting the UTA.

- At the ENNI, when receiving an ENNI Frame, the VUNI Provider maps a single S-VLAN ID to a VUNI End Point associated with a VUNI.


Carrier Ethernet Service Provider 1
(SLA with end user, provides Virtual UNI)

Carrier Ethernet Service Provider 2
(Providing UTA Service)

VUNI Maps Frames to OVC End Point

- The VUNI then maps frames based on their CE-VLAN ID to the appropriate OVC End Point for each OVC.

Carrier Ethernet Service Provider 1
(SLA with end user, provides Virtual UNI)

Carrier Ethernet Service Provider 2
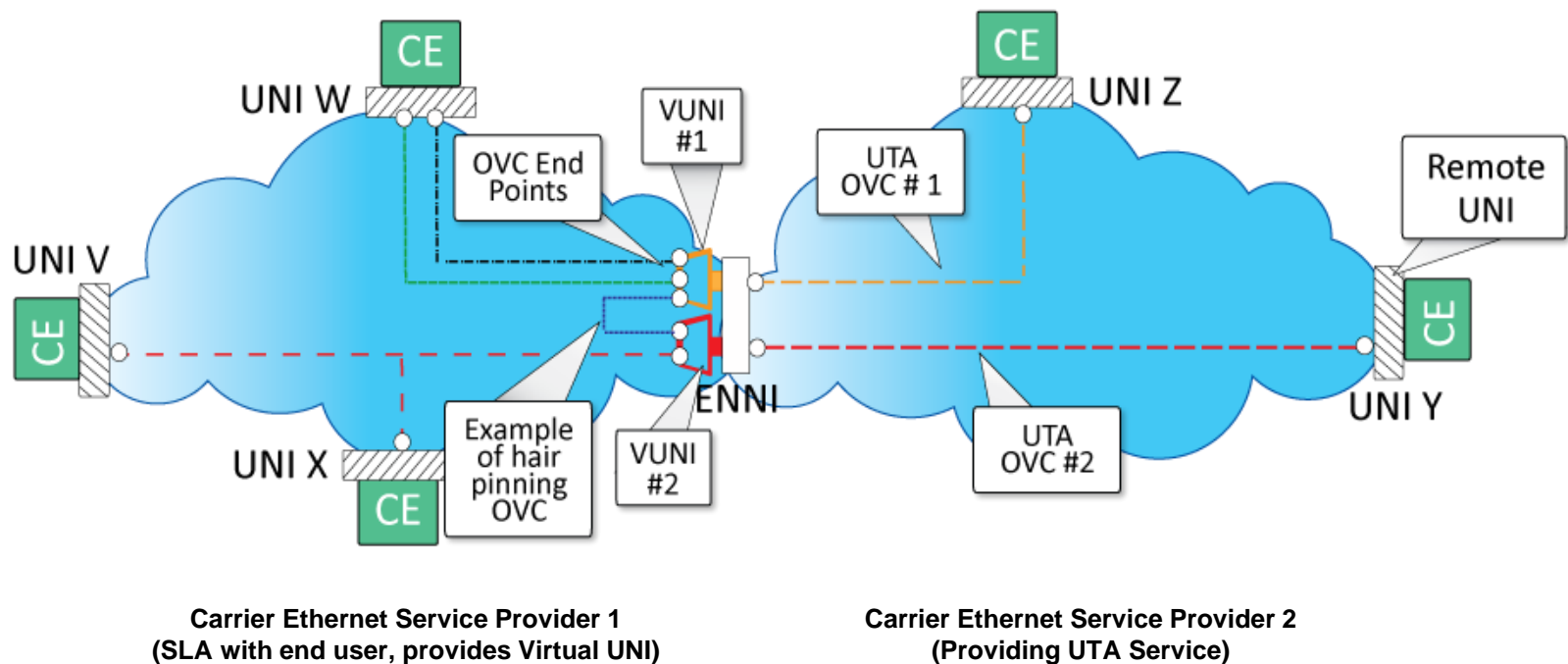**(Providing UTA Service)**

VUNI Multiplexes Frames into Tunnel

- In the reverse direction, the VUNI multiplexes frames from OVCs into a tunnel denoted by a unique S-VLAN ID, which is associated with the Network Operator's UTA OVC.
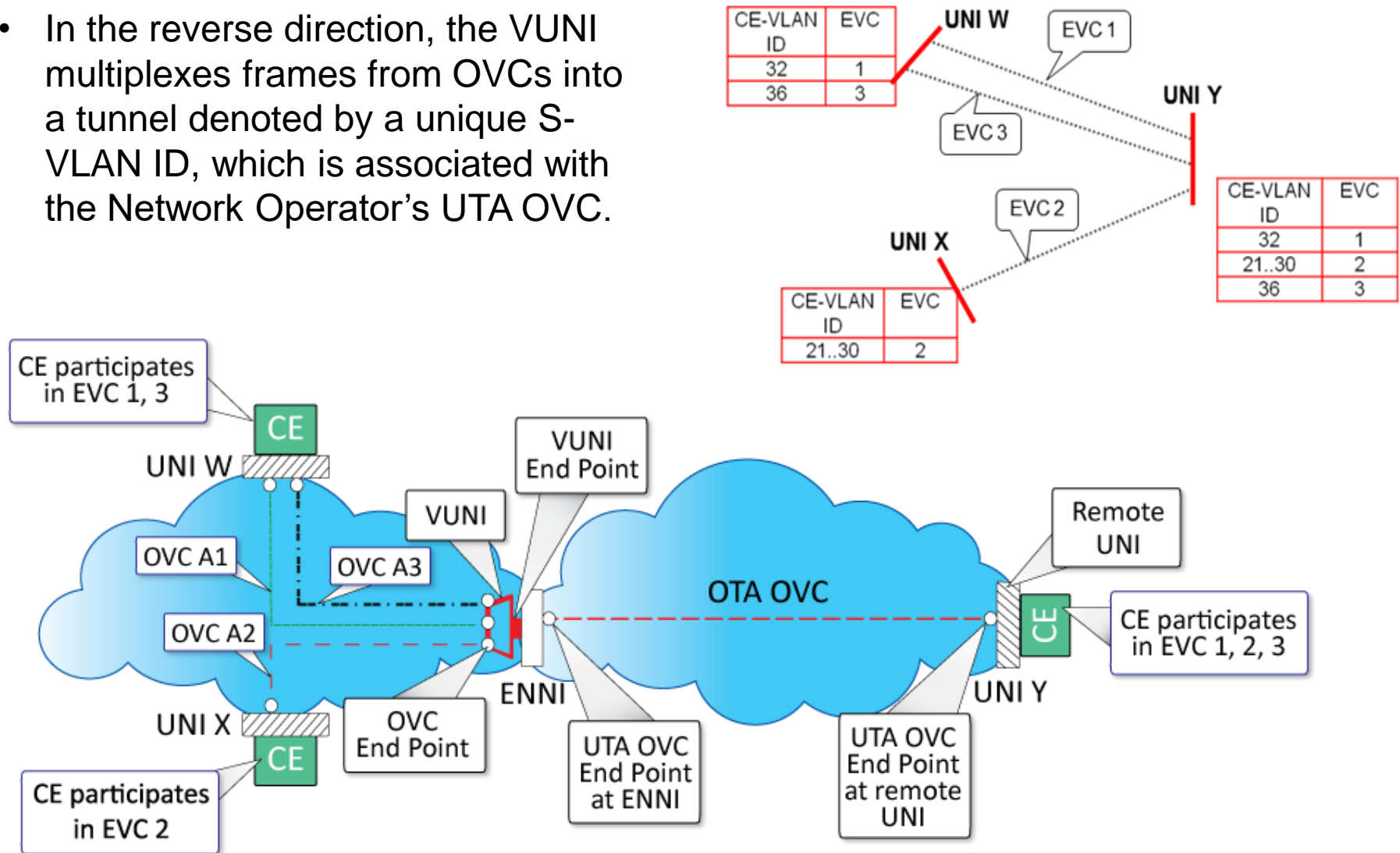
ENNI For Multiple VUNI's

Example with Multiple VUNIs Associated with a Single ENNI. The OVC End Points associated by each VUNI in this figure represent the association of OVCs with the ENNI as specified in [MEF 26].

Carrier Ethernet Service Provider 1
(SLA with end user, provides Virtual UNI)

Carrier Ethernet Service Provider 2
(Providing UTA Service)

MEF Specification Section Review

The UTA OVC Component

The UTA OVC is an OVC in the Network Operator's MEN that associates a remote UNI with an ENNI in support of the UTA.

The behavior of the UTA OVC are observed by the following Service attribute constraints which are defined in Section 7 of MEF 26. However, some **specific service attributes have been further constrained and are described in the requirements for each of the following in the MEF 28 Technical Specification document:**

- UTA OVC service attributes constraints

- OVC End Point at the remote UNI service attribute constraints for the UTA OVC

- OVC End Point at the ENNI service attribute constraints for the UTA OVC

- Service attribute constraints for the ENNI participating in the UTA OVC

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The Remote UNI Component

- The remote UNI is configured to support a single OVC End Point to which all CE VLAN IDs are mapped at the remote UNI.

- For the UTA, the remote UNI service attributes are constrained to have the OVC type being Point-to-Point across the service providers MEN

- Reuses the UNI service attributes specified in MEF 26 (Section 7.4)

- A Bandwidth Profile is specified for the OVC End Point of the UTA OVC at the remote UNI.

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The VUNI Component

- The VUNI component's responsibilities include:

  – Mapping of the VUNI End Point to the ENNI

  – Mapping of ENNI Frames between one or more VUNI Provider OVC End Points and the VUNI End Point for the UTA in support of Subscriber services.

- The behavior at the VUNI is specified by the following sets of attributes (*Refer to MEF 28 Technical Specification Section 7.x):*

  – VUNI Service Attributes

  – ENNI Service Attributes for the ENNI supporting the VUNI

  – Service Attributes for OVC End Points associated by the VUNI

OVC End Point per UNI Service Attribute Constraints for UTA OVC End Point at the Remote UNI (From MEF 28)

OVC End Point per UNI Service Attribute	Additional Constraints for the UTA OVC End Point at the Remote UNI
UNI OVC Identifier	*No additional constraints*
OVC End Point Map	All CE-VLAN ID values at the remote UNI **MUST** map to the single OVC End Point
Class of Service Identifiers	**MUST** provide only a single Class of Service Identifier
Ingress Bandwidth Profile Per OVC End Point at a UNI (remote UNI)	If an Ingress Bandwidth Profile per OVC End Point at a remote UNI is supported, it **MUST** be configured as color blind and **MUST** specify either CIR as ZERO or EIR as ZERO. For more information on this Bandwidth Profile, please see [MEF 10.2]
Ingress Bandwidth Profile Per Class of Service Identifier at a UNI (remote UNI)	**MUST NOT** specify
Egress Bandwidth Profile Per OVC End Point at a UNI (remote UNI)	**MUST NOT** specify
Egress Bandwidth Profile Per Class of Service Identifier at a UNI (remote UNI)	**MUST NOT** specify

OVC Service Attributes Constraints for UTA OVC (From MEF 28)

OVC Service Attribute Name	Additional Constraints for UTA OVC
OVC Identifier	*No additional constraints*
OVC Type	**MUST** be Point-to-Point
OVC End Point List	The list **MUST** identify exactly two OVC End Points: Exactly one of the OVC End Points **MUST** be at a remote UNI; and Exactly one of the OVC End Points **MUST** be at the Network Operator side of an ENNI.
Maximum Number of UNI OVC End Points	**MUST** be 1
Maximum Number ENNI OVC End Points	**MUST** be 1
OVC Maximum Transmission Unit Size	*No additional constraints*
S-VLAN ID Preservation	*No additional constraints*
S-VLAN CoS Preservation	*No additional constraints*
CE-VLAN ID Preservation	**MUST** be Yes
CE-VLAN CoS Preservation	**MUST** be Yes
Color Forwarding	**MUST** be No
SLS	*No additional constraints*
Unicast Service Frame Delivery	**MUST** Deliver Unconditionally
Multicast Service Frame Delivery	**MUST** Deliver Unconditionally
Broadcast Service Frame Delivery	**MUST** Deliver Unconditionally

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VUNI Service Attributes (from MEF28)

VUNI Service Attribute	Service Attribute Parameters and Constraints for UTA
VUNI Identifier	Arbitrary text string of no more than 45 bytes to identify the VUNI. The VUNI Identifier **MUST** be unique among all VUNI Identifiers within the scope of all ENNIs supported by the VUNI Provider MEN.
ENNI CE-VLAN ID value for ENNI Frames with no C-Tag or a C-Tag whose VLAN ID value is 0	**MUST** specify CE-VLAN ID value in the range of 1-4094.
Maximum number of related OVC End Points in the VUNI Provider MEN	**MUST** be an integer ≥ 1.
Ingress Bandwidth Profile Per VUNI	**MEF 28[R23]** When an Ingress Bandwidth Profile per VUNI is in force, the algorithm and parameters described in Section 7.6.1 of [MEF 26] **MUST** be applied to all incoming ENNI Frames mapped to the VUNI End Point of the VUNI. **MEF 28[R24]** When an Ingress Bandwidth Profile per VUNI is in force, ingress ENNI Frames mapped to the VUNI End Point of the VUNI **MUST NOT** be subjected to any other type of ingress bandwidth profile.
Egress Bandwidth Profile Per VUNI	**MEF 28[R25]** When an Egress Bandwidth Profile per VUNI is in force, suitable parameters <CIR, CBS, EIR, EBS, CF, CM> as defined in Section 7.6.1 of [MEF 26] **MUST** be specified and all egress ENNI Frames mapped to the given VUNI End Point MUST have the property defined in 7.6.3 of [MEF 26]. **MEF 28[R26]** When an Egress Bandwidth Profile per VUNI is in force, egress ENNI Frames mapped to the VUNI End Point of the VUNI **MUST NOT** be subjected to any other type of egress bandwidth profile.

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Service Attributes for OVC End Point associated by the VUNI (from MEF28)

Service Attributes for an OVC End Point associated by the VUNI	Service Attribute Parameters and Values
VUNI OVC Identifier	An arbitrary string of no more than 45 bytes formed by the concatenation of the VUNI Identifier and the OVC Identifier
OVC End Point Map	A list of one or more CE-VLAN ID values mapped to the OVC End Point
Class of Service Identifiers	The way that a Class of Service is determined for ingress ENNI Frames that are mapped to a VUNI (see Section 7.3.1 of MEF 28)
Ingress Bandwidth Profile Per OVC End Point associated by a VUNI	**MEF 28 [R27]** When the Ingress Bandwidth Profile per OVC End Point associated by a VUNI is in force for a given OVC End Point, suitable parameters <CIR, CBS, EIR, EBS, CF, CM> as defined in Section 7.6.1 of [MEF 26] MUST be specified and the algorithm of Section 7.6.1 of [MEF 26] MUST be applied to all ingress ENNI Frames that are mapped to the given OVC End Point.
Ingress Bandwidth Profile Per Class of Service Identifier associated by a VUNI	**MEF 28[R28]** When the Ingress Bandwidth Profile per Class of Service Identifier per OVC End Point associated by a VUNI is in force, suitable parameters <CIR, CBS, EIR, EBS, CF, CM> as defined in Section 7.6.1 of [MEF 26] **MUST** be specified and the algorithm of Section 7.6.1 of [MEF 26] **MUST** be applied to all ingress ENNI Frames mapped to the OVC End Point that have the given Class of Service Identifier.
Egress Bandwidth Profile Per OVC End Point associated by a VUNI	**MEF 28[R29]** When the Egress Bandwidth Profile per OVC End Point associated by a VUNI is in force for a given OVC End Point, suitable parameters <CIR, CBS, EIR, EBS, CF, CM> as defined in Section 7.6.1 of [MEF 26] **MUST** be specified and all egress ENNI Frames mapped to the given OVC End Point **MUST** have the property defined in 7.6.3 of [MEF 26].
Egress Bandwidth Profile Per Class of Service Identifier associated by a VUNI	**MEF 28[R30]** When the Egress Bandwidth Profile per Class of Service Identifier per OVC End Point associated by a VUNI is in force, suitable parameters <CIR, CBS, EIR, EBS, CF, CM> as defined in Section 7.6.1 of [MEF 26] **MUST** be specified and all egress ENNI Frames mapped to the given OVC End Point that have the Class of Service Identifier **MUST** have the property defined in 7.6.3 of [MEF 26].

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ENNI Service Attributes as applied to UTA

ENNI Service Attribute	Service Attribute Parameters and Constraints for VUNI Provider
Operator ENNI Identifier	*No additional constraints*
Physical Layer	*No additional constraints*
Frame Format	*No additional constraints*
Number of Links	*No additional constraints*
Protection Mechanism	*No additional constraints*
ENNI Maximum Transmission Unit Size	*No additional constraints*
End Point Map	At an ENNI in the VUNI Provider MEN, the End Point Type within an End Point Map for ENNI frames mapped to a VUNI **MUST** take the value of "VUNI"
Maximum Number of OVCs	*No additional constraints*
Maximum Number of OVC End Points per OVC	*No additional constraints*

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Bandwidth Profiles at the Remote UNI

- The Bandwidth Profile attribute of the UTA OVC End Point at the remote UNI describes the color marking of each egress ENNI Frame (i.e. toward the VUNI provider) that is mapped to the UTA OVC End Point at the ENNI by the ENNI End Point Map.

- Ingress color marking is not carried across the network to the ENNI

Bandwidth Profiles at the VUNI

- VUNI Bandwidth Profiles in this Technical Specification use the parameters and algorithm described in MEF 26 Section 7.6.1

- Each ingress ENNI Frame can be the subject of at most one ingress Bandwidth Profile

- The Ingress Bandwidth Profile per VUNI manages bandwidth non-discriminately for all OVCs supported by the VUNI.

- The Egress Bandwidth Profile per VUNI, when present, manages bandwidth non-discriminately for all OVCs supported by the VUNI. Therefore, some OVCs may get more bandwidth while others may get less.
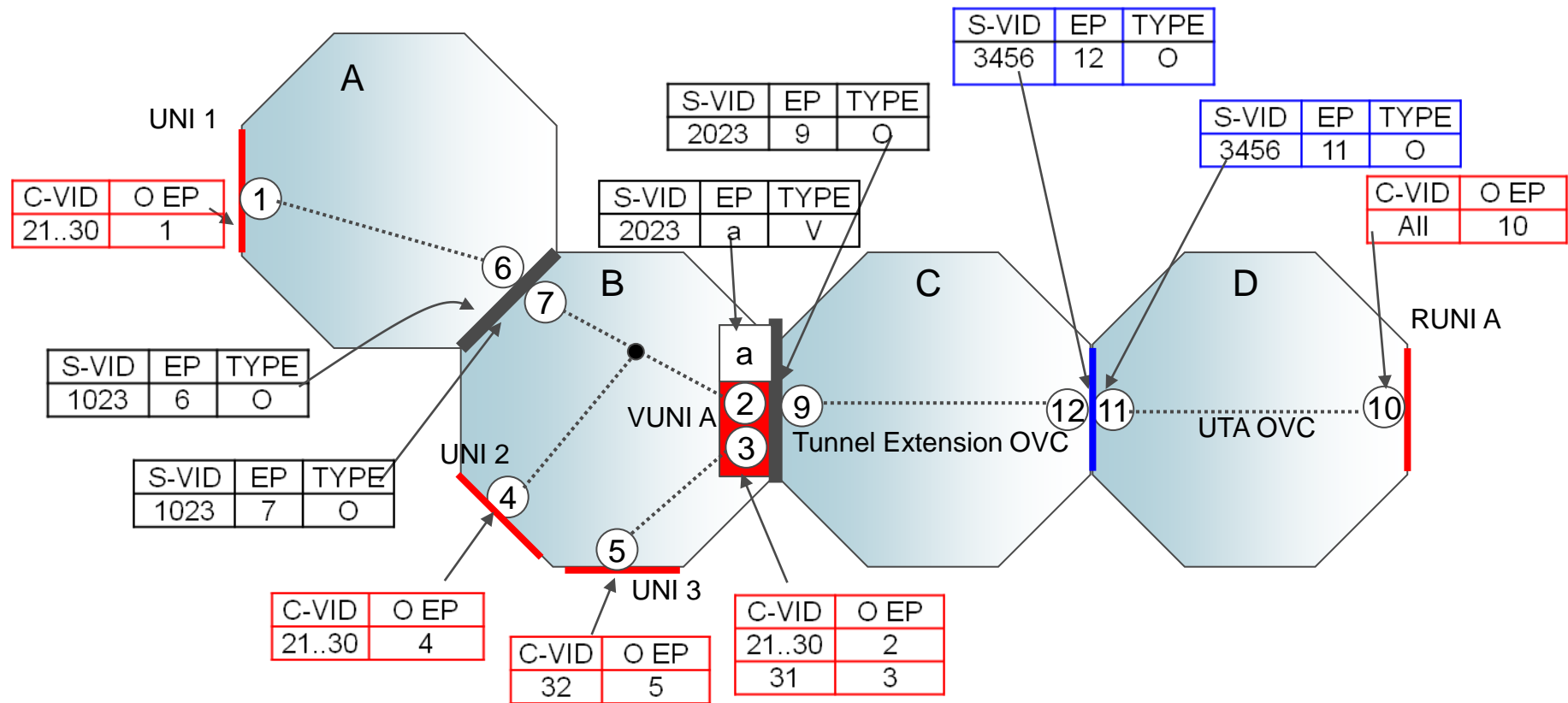
Examples/Use Cases

Multi-MEN UNI tunnel access model

- The UNI tunnel access model may be generalized to multi-MEN scenarios.

- Provides a model showing the context for the UTA among two Network Operators and the VUNI Provider. (See 802.1Qbc for more details.)
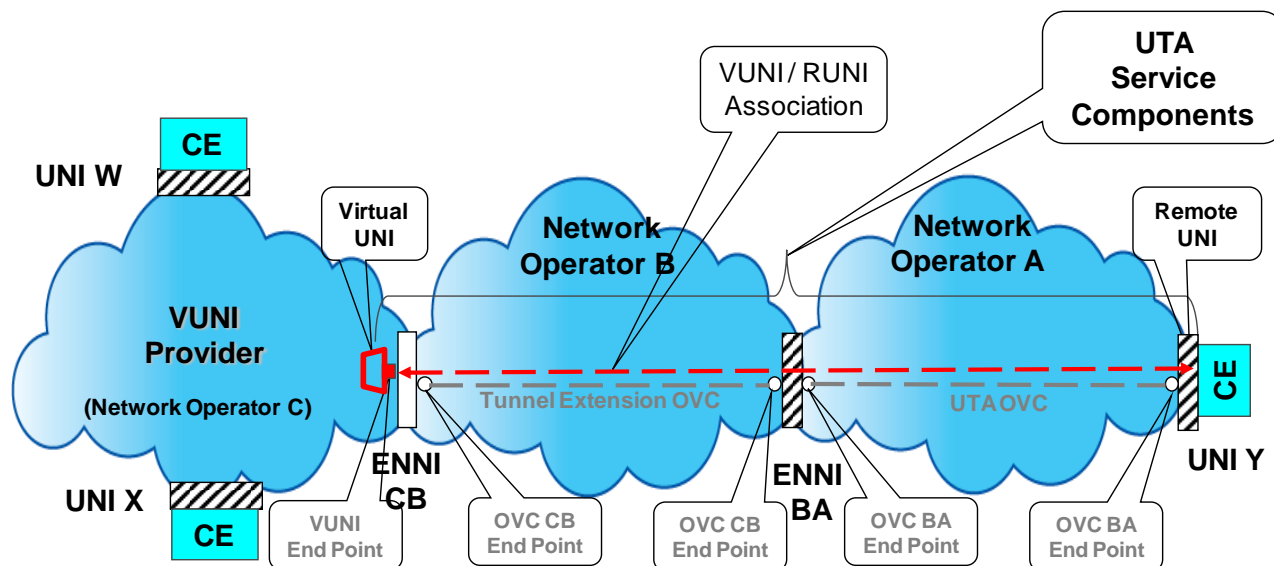
Summary

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Summarizing MEF 28

UNI Tunnel Access (UTA) enables EVC service frames associated with a remote user's UNI to be tunneled through an Off-Net providers' network

- Takes advantage of key works in MEF 26

- Interoperability between MENs is preserved

- Addresses Bandwidth Profiles and Color Marking

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Final Word
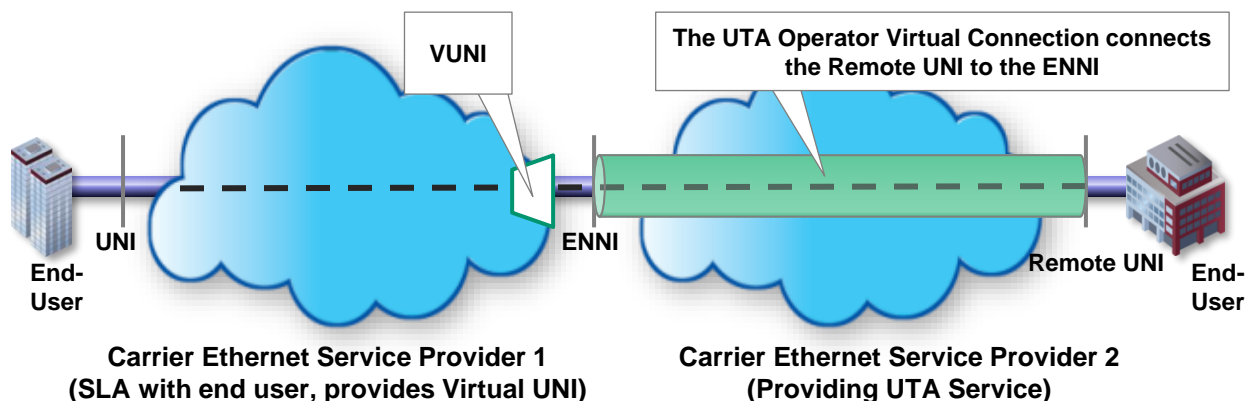
- **Next Actions**
  - Read foundational work in 6.x and 10.x
  - Read the details in MEF 26, External Network Network Interface Technical Specification

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Accelerating Worldwide Adoption of Carrier-class Ethernet Networks and Services

www.MetroEthernetForum.org