



millimetre Wave Transmission (mWT); Definition of a Wireless Transport Profile for Standard SDN Northbound Interfaces (standards.iteh.ai)

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Foreword

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This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) millimetre Wave Transmission (mWT).

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Introduction

The rapid evolution of telecommunications networks towards ever higher complexity and agility requires increasing levels of automation in network and service management. The range of technologies and solutions grouped under the collective name of SDN is a fundamental component of such automation.

Automation through SDN applies to every segment and layer of the telecommunications networks, including the wireless transmission technology.

SDN adoption is still in the early phases, and there exists a multitude of standards from several SDOs, that are in principle applicable to wireless transmission. Often these standards are specified in a way covering a very wide spectrum of applications and transmission technologies. This creates potentially a very large number of standard-compliant but non-interoperable implementations of SDN even for a single technology or application.

The purpose of the present document is to describe a parsimonious subset ("Profile") of the relevant available standards, and a set of recommendations for best practices, suitable to support the functionalities described in the wireless transmission Use Cases in Clause 4.2.

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1 Scope

The present document defines a Profile for standard SDN northbound interfaces in Wireless transmission networks. Specifically, the NBI refers to the MPI interface as defined in IETF RFC 8453 [12].

The term Profile is used for the present document because it identifies the selection of standard Models and the selection Attributes therein from the IETF library as specified in Annex A, but does not define any additional standard models or attributes.

This Profile applies exclusively to a single MW or mmW domain. A domain may be composed by one or more homogeneous regions, all managed by a single PNC.

In addition, Annex B contains the description of the usage of the LLDP protocol [17] for the automatic detection of inter-domain Ethernet access links, and an algorithm to calculate the inter-domain-plug-id [16] value.

2 References

2.1 Normative references

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[1] IETF draft-ietf-ccamp-mw-topo-yang-02: "A YANG Data Model for Microwave Topology".

NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-ccamp-mw-topo-yang/>.

[2] IETF draft-ietf-ccamp-eth-client-te-topo-yang-01: "A YANG Data Model for Ethernet TE Topology".

NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-ccamp-eth-client-te-topo-yang/>.

[3] IETF draft-ietf-ccamp-client-signal-yang-06: "A YANG Data Model for Transport Network Client Signals".

NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-ccamp-client-signal-yang/>.

[4] IETF draft-ietf-teas-yang-te-28: "A YANG Data Model for Traffic Engineering Tunnels, Label Switched Paths and Interfaces".

NOTE: <https://datatracker.ietf.org/doc/draft-ietf-teas-yang-te/>.

[5] IETF RFC 6991: "Common YANG Data Types".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc6991>.

[6] IETF RFC 7950: "The YANG 1.1 Data Modeling Language".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc7950>.

[7] IETF RFC 7951: "JSON Encoding of Data Modeled with YANG".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc7951>.

[8] IETF RFC 8040: "RESTCONF Protocol".

NOTE: Available at <https://tools.ietf.org/html/rfc8040>.

[9] IETF RFC 8294: "Common YANG Data Types for the Routing Area".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc8294>.

[10] IETF RFC 8342: "Network Management Datastore Architecture (NMDA)".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc8342>.

[11] IETF RFC 8345: "A YANG Data Model for Network Topologies".

NOTE: Available at <https://tools.ietf.org/html/rfc8345>.

[12] IETF RFC 8453: "Framework for Abstraction and Control of TE Networks (ACTN)".

NOTE: Available at <https://tools.ietf.org/html/rfc8453>.

[13] IETF RFC 8525: "YANG Library".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc8525>.

[14] IETF RFC 8527: "RESTCONF Extensions to Support the Network Management Datastore Architecture".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc8527>.

[15] IETF RFC 8528: "YANG Schema Mount".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc8528>.

[16] IETF RFC 8795: "YANG Data Model for Traffic Engineering (TE) Topologies".

NOTE: Available at <https://datatracker.ietf.org/doc/html/rfc8795>.

[17] IEEE 802.1AB™: "IEEE Standard for Local and metropolitan area networks - Station and Media Access Control Connectivity Discovery".

NOTE: Available at https://standards.ieee.org/standard/802_1AB-2016.html.

[18] IEEE 802.1Q™-2018: "IEEE Standard for Local and Metropolitan Area Networks-Bridges and Bridged Networks".

NOTE: Available at https://standards.ieee.org/standard/802_1Q-2018.html.

[19] IETF draft-ietf-teas-yang-te-types-13: "Traffic Engineering Common YANG Types".

NOTE: Available at <https://datatracker.ietf.org/doc/html/draft-ietf-teas-yang-te-types>.

2.2 Informative references

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] MEF 4 Technical Specification: "Metro Ethernet Network Architecture Framework - Part 1: Generic Framework".

NOTE: Available at <https://www.mef.net/wp-content/uploads/2004/05/MEF-4.pdf>.

[i.2] MEF 10.3 Technical Specification: "Ethernet Services Attributes Phase 3".

NOTE: Available at <https://www.mef.net/wp-content/uploads/2013/10/MEF-10-3.pdf>.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

access ethernet link: external ethernet link that is connected to a final user (e.g. NodeB), usually of UNI-C type

NOTE: See MEF 4 [i.1].

domain: (by default) entirety of the domain controlled by the PNC implementing the MPI under consideration

edge ethernet LTP: ethernet LTP that is connected to an external ethernet link

ethernet connection: bi-directional construct comprising two uni-directional ethernet links connecting a couple of ethernet LTPs

external ethernet link: ethernet link that has one termination inside and the other one outside of the domain managed by the PNC

NOTE 1: It can be further classified as an inter-domain ethernet link, or an access ethernet link.

NOTE 2: The PNC has no information about the nature of such links, in particular if these are a UNI or an NNI and whether they are connected to a final client (e.g. NodeB) or to another transport domain (e.g. router, DWDM, etc.).

full ethernet connectivity: complete reachability of all ethernet edge LTPs with one another

homogeneous region: subset of microwave network elements within a domain, that have full ethernet connectivity, and provide the same VLAN functionality on all edge LTPs

inter-domain ethernet link: external ethernet link that is connected to a transport domain (e.g. router, DWDM etc.), or to another MW domain, usually of NNI type

NOTE: See MEF 4 [i.1].

internal ethernet link: ethernet link connecting Ethernet LTPs belonging the TE Ethernet topology of the domain managed by the PNC

multi-region domain: microwave domain that is composed internally by more than one homogeneous region, lacking full ethernet connectivity amongst them

partial ethernet connectivity: incomplete reachability of some ethernet edge LTPs with one another

VLAN isolation: capability of a homogeneous region to isolate the internal VLAN addressing space for path selection from any external one

NOTE: The MDSC does not need to have any information about the VLAN operation capabilities, addressing space, available ranges inside a region that provides VLAN isolation, and does not need to coordinate the external VLAN ID addressing space with the internal domain one.

VLAN transparency: lack of VLAN isolation capability by a homogeneous region

NOTE 1: The MDSC may or may not have visibility of these information; in any case its ability to configure any of those parameters is regulated according to the chosen Abstraction Level (see Clause 4.3).

NOTE 2: If MDSC does not take into account the VLAN ID usage inside the domain, and coordinate it with the external VLAN ID address space, the PNC may not be able to instantiate a requested service, resulting in a trial and error process by the MDSC.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACTN	Abstraction and Control of TE Networks
AL	Abstraction Level
AN	Abstract Node
B2B	Business to Business
BWP	Bandwidth Profile
CBS	Committed Burst Size
CIR	Committed Information Rate
CLTP	Carrier Link Termination Point
CM	Connectivity Matrix
C-VID	C-VLAN ID
C-VLAN	Client-Side VLAN
DWDM	Dense Wavelength Division Multiplexing
E2E	End to End
EBS	Excess Burst Size
eeLTP	Ethernet edge LTP
EIR	Excess Information Rate
eLTP	Ethernet LTP
ETH	Ethernet
GE	Gigabit Ethernet
IDID	Identity
JSON	JavaScript Object Notation
LLDP	Link Layer Discovery Protocol
LTP	Link termination point
MDSC	Multi-Domain Service Coordinator
mmW	Millimetre millimetre waveWave
MPI	MDSC-PNC Interface
MW	Microwave
NBI	Northbound Interface
NE	Network Element
NMDA	Network Management Datastore Architecture
NNI	Network Network Interface
PNC	Provisioning Network Controller
RFC	Request for Comments
RLTP	Radio Link Termination Point
ro	read-only
rw	read-write
SDN	Software Defined Networking
SDO	Standard Defining Organization
S-VLAN	Service-Side VLAN
TE	Traffic Engineering
TLV	Type-Length-Value
UNI	User Network Interface
UNI-C	User Network Interface – Customer Edge
VID	VLAN ID
VLAN	Virtual Local Area Network
WBH	Wireless Backhaul
WTN	Wireless Transmission Network

4 Scope of the Profile

4.1 Network Architecture

This Profile applies to a single domain of MW and mmW devices. The interactions with other domains are covered by the selection of the attributes necessary to identify the Ethernet access links from [2], and the Ethernet service characteristics from [3].

The Profile applies to physical WTN topologies that do not allow for multiple paths to connect two eeLTPs. Only wireless links of point-to-point type are considered, i.e. radio links comprising two radio NEs.

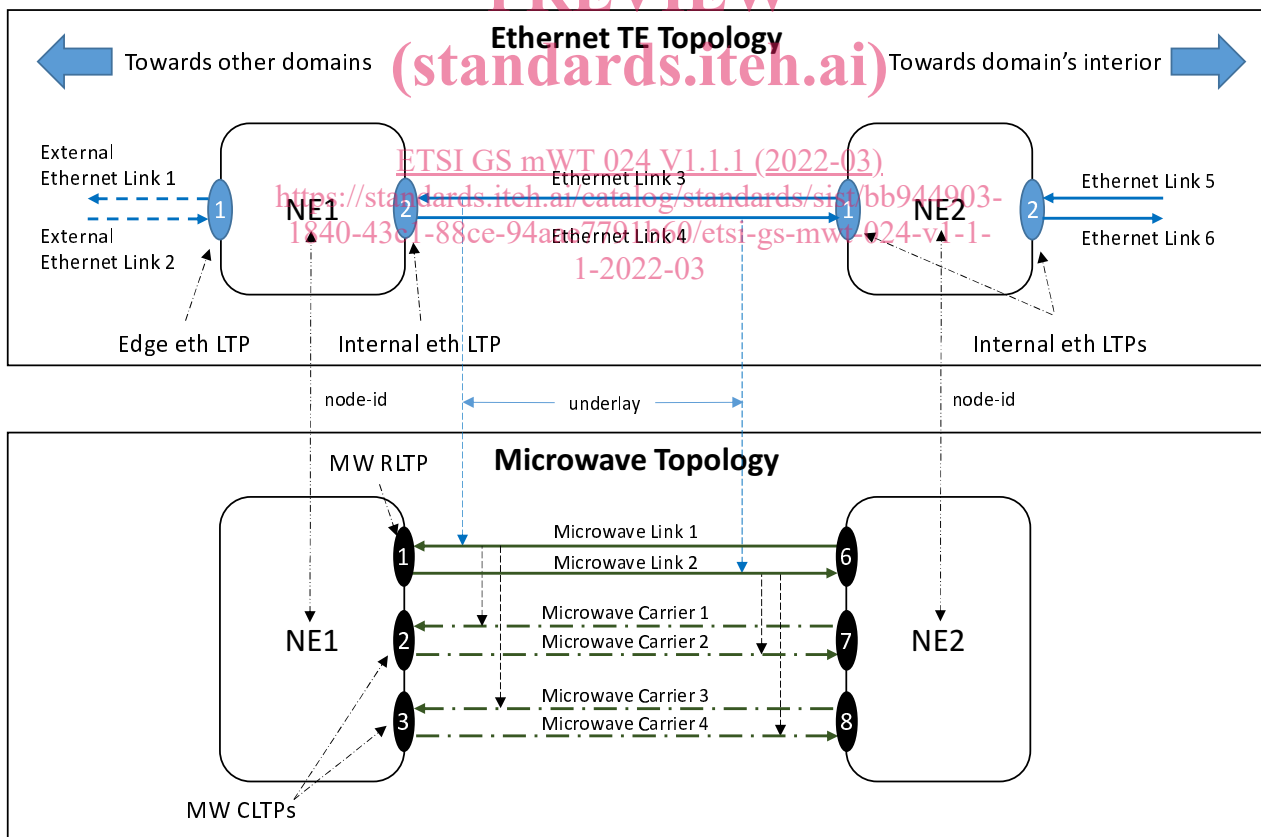
4.2 Use Cases

4.2.1 Microwave and Ethernet Topology Discovery

4.2.1.1 Overview

The network discovery Use Case is the basic functionality needed for network and service management automation, in that it shall provide the inventory of the microwave topology, the Ethernet topology and the Ethernet service information.

Figure 4.2.1.1.1 shows the relationships between the Microwave and the ethernet topologies for a microwave link with two bonded radio carriers.



NOTE 1: The external ethernet links are shown for clarity only, the PNC needs to keep information only about the eeLTPs.

NOTE 2: LTPs of a given node are part of the same list and have different names (ltp-id), which are local to that node. There is no relation among the name spaces of LTPs across different nodes.

Figure 4.2.1.1.1: Microwave and Ethernet Topologies

4.2.1.2 Microwave Topology

The microwave topology provides identification of the physical network by means of the microwave nodes, LTPs and radio links.

The following clarifications shall apply:

- 1) The two nodes are connected by two microwave radio links (one for each direction), each of which can consist of more than one radio carrier, attached to the respective radio LTPs. Microwave links and radio carriers are modelled as separate link entities, `microwave-radio-link` and `microwave-carrier`, and each of them is attached to specific LTP (`microwave-rltp` and `microwave-cltp`). It is assumed that the multiple carriers associated to the microwave link carry the data traffic associated to the Ethernet services as a bundle, with some form of load balancing among them, which is out of scope of the present document.
- 2) The MW radio links are associated to the corresponding Ethernet link in the Ethernet topology (one per direction), via the underlay attribute in the Ethernet TE topology model [2].
The `node-id` attribute of the microwave topology and the `node-id` attribute in the Ethernet topology shall be set to the same value, consisting of a dotted quad of numbers between 0 and 255. For ease of identification, this value should coincide with the IPv4 management plane address of the corresponding physical microwave NE.

4.2.1.3 Ethernet TE Topology

4.2.1.3.1 Introduction

The Ethernet TE topology model provides information about TE nodes (which correspond 1:1 to the MW nodes), eLTPs, Ethernet links connecting the NEs and providing the possible path(s) over which the Ethernet services can be provisioned:

- a) The Ethernet links are associated to the corresponding Microwave link (one per direction), via the underlay attribute in the Ethernet TE topology model [2] and [1].
- b) Internal (or intra-domain) Ethernet links connect the ethernet eLTPs belonging to one another.
- c) External (or access or inter-domain) Ethernet links connect an eLTP to an external equipment.
- d) The `node-id` attribute of the microwave topology and the `node-id` attribute in the Ethernet topology shall be set to the same value, consisting of a dotted quad of numbers between 0 and 255. For ease of identification, this value should coincide with the IPv4 management plane address of the corresponding microwave NE.

The Ethernet TE topology contains information about all eLTPs available on the NEs, regardless if these are connected to another MW NE, to any other external device, or even are unconnected. The MDSC determines which eLTPs are relevant for its purposes, based on the existence of Ethernet links connected to them.

Clause 4.2.1.3.2 discusses how the MDSC can differentiate eeLTPs from eLTPs that are unconnected. eLTPs connected to a faulty Ethernet link appear as unconnected, regardless of the internal or external nature of the faulty link.

4.2.1.3.2 External Ethernet Links and Inter-Domain Connectivity

One of the main purposes of the MDSC is to coordinate and provision services across multiple domains. Since no PNC can know or manage the inter-domain links, these have to be modelled by the MDSC based on information about the eeLTPs from the corresponding domains.

Two attributes of an eLTP concur in defining it as an eeLTP:

- 1) The `inter-domain-plug-id` attribute shall be present, and shall have a network-wide-unique value:
 - a) If the eLTP is not an eeLTP, the attribute shall be missing.
- 2) The `client-facing` attribute shall be present, and shall have the Boolean value "true":
 - a) If the eLTP is not an eeLTP, the attribute shall be missing or, if present, it shall assume the Boolean value "false".

Both attributes may be configured either manually or automatically. Both attributes shall be managed in the same way, either both manually, or both automatically.

In case of automatic configuration:

- 1) The algorithm specified in Annex B shall be used to calculate the inter-domain-plug-id attribute, regardless of the presence and value of the client-facing attribute.
- 2) The PNC may be able to infer the edge nature of the eLTP independently from the inter-domain-plug-id attribute's successful configuration, but the inter-domain-plug-id attribute shall always have priority to determine if an eLTP is an eeLTP actually connected to an external domain.

It may happen that an eLTP is changed to eeLTP, or vice-versa, during the lifetime of the network, reflecting the changes in physical topology (e.g. addition or removal of links and/or equipment, delays in configuring external NEs, etc.). The MDSC shall update its picture of the network by regularly uploading it or by subscribing to the relevant attributes' notifications.

4.2.2 Ethernet Service Configuration

4.2.2.1 Ethernet Services

The service types specified in this Profile are VLAN-based Ethernet point-to-point services as defined in [3]. This profile does not cover point to multipoint or multipoint to multipoint types of Ethernet service.

Details about the domain-internal transport mechanism (which may not even be ethernet-based), or where which VLAN operations are performed within the MW domain may not be exposed over the MPI to the MDSC, depending on the adopted Abstraction Level (see Clause 4.3).

Ethernet services can be established between any couple of eLTPs described in the retrieved Ethernet TE topology.

Whereas the overall goal of the MDSC is to coordinate E2E services across multiple domains, i.e. between eeLTPs. It may be of practical value to create services between eLTPs, either for testing purposes, or in case of time delays in the coordination with other domains (e.g. delayed configuration of the LLDP protocol on the external domain's eLTP).

But in general, the object of the present GS are the data services between two eeLTPs, and falling into one of the 6 Types defined in Table 4.2.2.1.1

Table 4.2.2.1.1 Service Classification

Service Type	Classification @ LTP A	Classification @ LTP Z	Reference	Remarks
Type 1	Untagged	Untagged	C-VLAN bridge, Provider bridge as per [18]. MEF 10.3 [i.2].	Note 2.
Type 2	Untagged	C-VLAN	C-VLAN bridge, Provider bridge as per [18]. MEF 10.3 [i.2].	Note 2.
Type 3	Untagged	S-VLAN	Provider bridge as per [18].	Note 2.
Type 4	C-VLAN	C-VLAN	C-VLAN bridge, Provider bridge as per [18]. MEF 10.3 [i.2]	The C-VLAN values at the two edges can be the same (C-VLAN preservation) or different (no C-VLAN preservation).
Type 5	S-VLAN	S-VLAN	Provider bridge as per [18].	The S-VLAN values at the two edges can be the same (S-VLAN preservation) or different (no S-VLAN preservation). The C-VLAN is ignored but always preserved, if present.
Type 6	S-VLAN	C-VLAN	Provider bridge as per [18].	The C-VLAN is always preserved.
NOTE 1: A VLAN for internal path selection is used by the bridges within the network, but its configuration is performed autonomously by the PNC based on the equipment characteristics.				
NOTE 2: When the Classification is Untagged, in the egress direction all the frames are transmitted as untagged. In the ingress direction, only untagged frames are expected to be received. However, if received, priority-tagged frames and frames tagged with the VLAN ID equal to the LTP's port VID also matches this classification, as specified in MEF 10.3 [i.2], and are forwarded as specified for the service configuration.				