MEF Standard

MEF 22.3.1

Amendment to MEF 22.3: Transport Services for Mobile Networks

April 2020

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1 List of Contributing Members

The following members of the MEF participated in the development of this document and have requested to be included in this list.

- Bell Canada
- Ceragon Networks
- Ciena
- Ericsson
- Infinera
- Nokia
- Verizon

2 Abstract

This amendment specifies changes to the baseline document MEF 22.3 [1] to include the requirements for Ethernet Services that can be used as transport for 5G mobile networks. The services and requirements in this document are based on the Services defined in MEF 6.2 [2] as well as the Service Attributes defined in MEF 10.3 [3].

3 Introduction

This amendment makes the following changes to MEF 22.3 [1]: incorporation of Fronthaul and description of network slicing applicability.

In this amendment, changes are shown as follows.

The changes in this amendment are given as "editing instructions." relative to MEF 22.3. When inserting in MEF 22.3 a Figure or Table, or a reference to a Figure or Table, the "Amendment " prefix will be removed. When inserting a new section (such as section 9), the existing section 9 in MEF 22.3 will be renumbered as section 10, etc. When this occurs, subsequent changes refer to sections as they would be renumbered.

Subsequent sections are of a form suitable for describing the changes incorporated in this amendment.

4 Changes to Section 2, Abstract

Replace the first sentence with the following:

This document identifies the requirements for MEF Ethernet Services and MEF External Interfaces (EIs such as User-Network Interfaces (UNIs)) for use in Transport Services for Mobile Networks based on MEF specifications.

5 Changes to Section 3, Terminology

Change the Section title ("Terminology") to "Terminology and Abbreviations."

Add or modify the terms shown below in Table 1:

Term	Definition	Reference
5GC	5G Core	3GPP TS 38.300 [A1-2]
BBU	Base-Band Unit	3GPP TS 38.300 [A1-2]
CPRI	Common Public Radio Interface – the Fronthaul interface defined by the CPRI Cooperation.	CPRI [107]
CU	Centralized Unit	3GPP TS 38.401 [A1-3]
DU	Distributed Unit	3GPP TS 38.401 [A1-3]
eCPRI	A packet-based mobile fronthaul interface defined by the CPRI cooperation	eCPRI [A1-4]
eNB, eNodeB	Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Node B: the RAN Base Station in LTE. In this document an eNodeB is one of the options for a RAN Base Station.	3GPP TS 36.300 [88]
EPC	Evolved Packet Core	3GPP TS 38.300 [A1-2]
eRE	eCPRI Radio Equipment	eCPRI [A1-4]
eREC	eCPRI Radio Equipment Control	eCPRI [A1-4]
F1	A 3GPP interface for the higher layer split defined in 3GPP TS 38.401	3GPP TS 38.401 [A1-3]
Fronthaul	Connectivity between distributed components of a RAN Base Station.	This document
gNB, gNodeB	Next Generation distributable NodeB	3GPP TS 38.300 [A1-2]
HLS	High-Layer Split	3GPP TS 38.300 [A1-2]
LLS	Low-Layer Split	3GPP TS 38.300 [A1-2]
MBH	Mobile Backhaul	This document
MFHS	Mobile Fronthaul Service	This document
NG	Next Generation	This document
NR	New Radio; the air interface defined for 5G by 3GPP	3GPP TS 38.300 [A1-2]
RAN CU	RAN Centralized Unit	This document
RAN DU	RAN Distributed Unit	This document
RE	CPRI Radio Equipment	CPRI [107]
RU	Radio Unit	3GPP TS 38.300 [A1-2]
REC	CPRI Radio Equipment Control	CPRI [107]
NodeB	WCDMA RAN Base Station. In this document a NodeB is one of the options for a RAN BS	3GPP TS 21.905 [70]
RBS	RAN Base Station defined in this document and generally referred to as Base Station in 3GPP TS 21.905	This document

Term	Definition	Reference
W1	A 3GPP interface used in 4G/LTE-Advanced (4G+) that is analogous to the F1 interface	This document

Amendment Table 1 – Terminology and Abbreviations

Change the caption of Table 1 from "Terminology" to "Terminology and Abbreviations."

Note that the definition for "NodeB" replaces the previous definition for "NB, NodeB."

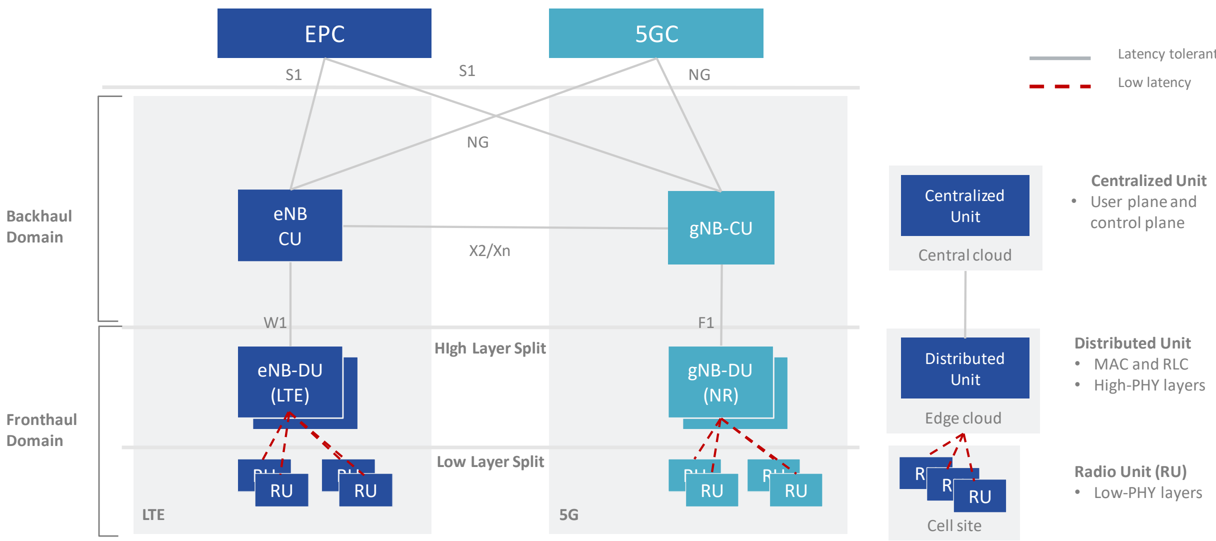
In addition:

- *Replace every occurrence of the phrase "Radio Base Station" in MEF 22.3 with "RAN Base Station", preserving case where applicable.*

6 Changes to Section 4, Introduction

Insert the following paragraph prior to Figure 1 then replace Figure 1 with Amendment Figure 1.

Release 15 (and subsequent releases) of 3GPP's mobile technology [A1-2], known as "Fifth Generation" or "5G," introduces several changes and new architectural alternatives for the evolution of mobile networks. For example, the 5G Base Station's Base-Band processing block has been decomposed into Centralized and Distributed Units (CU and DU) that need not be co-located with the Radio Unit (RU). From a transport point of view this decomposition and separation of functions introduces new optional connectivity commonly called "Fronthaul", which can utilize bridged Ethernet networks.

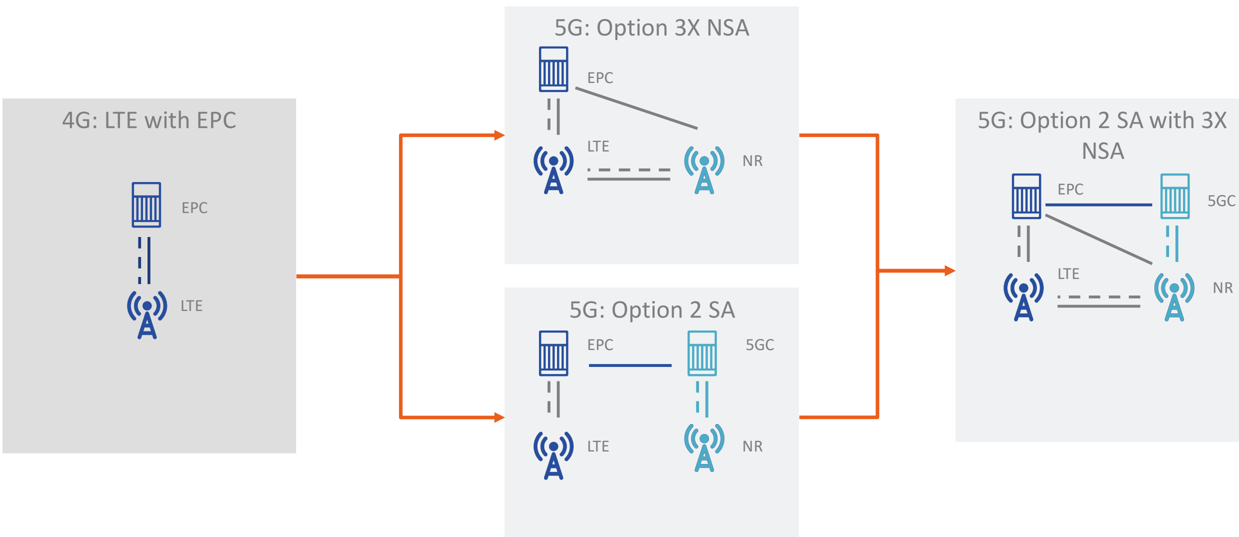


Amendment Figure 1 – High-Level RAN Architecture

7 Changes to Section 5, Mobile Network Topologies

Insert the following text and figure at the end of the text introducing section 5:

The evolution to 5G NR has been driven by operators and vendors to meet a variety of diverse market requirements and deployment scenarios, including the seamless evolution of currently deployed LTE solutions, which helps satisfy the need for global coverage early in the 5G deployment phase. As a result, 3GPP has defined several options for using LTE and 5G NR radios together with LTE core, a.k.a. Evolved Packet Core (EPC), and with the new 5G Core (5GC). Among these options, MEF considers Options 2 and Option 3X to be preferred by the industry. These two options are as illustrated in Amendment Figure 2 (where solid lines indicate user plane traffic and dashed lines indicate control plane traffic).



Amendment Figure 2 – 4G-to-5G Migration Options

Early 5G devices and networks might use Non-Standalone (NSA) Option 3X (5G NR connected to the existing EPC) for deployment speed and service continuity, leveraging LTE coverage. Option 3X uses dual connectivity between LTE and 5G radios to achieve data rate aggregation. With Option 3X, 5G NR is connected as a secondary node to the EPC which allows enhanced mobile broadband services on 5G-enabled devices while maintaining 4G EPC services. Option 3X also relies on the LTE radio for all control plane signaling and wide area radio frequency coverage.

The next distinct phase of 5G deployment will follow the completion of the Standalone (SA) core network specifications, using the Option 2 architecture which attaches 5G NR to the new 5GC. Option 2 (with or without 3X NSA support) is therefore widely seen as the long-term target architecture.

The Option 2 solution uses 5G NR for data and for control plane signaling and requires a 5G low-frequency band for wide area coverage as it cannot utilize the LTE layer as in Option 3X.

While Options 2 and 3X are preferred by the industry, other 3GPP options (known as Options 4, 5 and 7) may have some benefits in special deployments.

Insert the following as subsection 5.4:

5.4 Network Slicing

For the purposes of this document, a network slice is a RAN construction defined by 3GPP [TS 23.501]. This document considers that support for network slicing in a CEN can be accomplished using Ethernet services already defined, combined with best fit Class of Service (CoS) ID.

To support a network slice (as defined by RAN context) using an Ethernet service, it is necessary to provide a mapping from a network slice Identifier to a corresponding EVC + CoS ID, i.e. network slice data needs to be presented at a given UNI using the MEF 10.3 [7] CoS ID in a Service Frame.

The precise CoS and other Service Attribute values associated with the EVC + CoS ID will depend on specific Subscriber applications and deployments and are beyond the scope of this Standard.

For information, an example is provided in Appendix F.

8 Changes to Subsection 6.1, In Scope

Modify section 6.1 as shown with underlining:

The following work items are within the scope of this phase of this <u>document</u>:

- Mobile backhaul and midhaul, for macro and small cells, for mobile technologies referenced in standards: GSM, WCDMA, CDMA2000, WiMAX 802.16e,_LTE/LTE-A <u>and 5G</u>.
- <u>Mobile fronthaul (e.g. CPRI/eCPRI) for mobile technologies referenced in standards: LTE/ LTE-A and 5G.</u>
- Support a single CEN with External Interfaces being only UNIs for Mobile Backhaul between RAN BSs and RAN NC <u>or RAN CU</u>.
- <u>Support a single CEN with External Interfaces being only UNIs for Mobile Fronthaul between RAN DUs and RAN CUs</u>.
- <u>Support a single CEN with External Interfaces being only UNIs for Mobile Fronthaul between eRE/RE and eREC/REC.</u>
- Include Multiple CENs based on OVC Service Definitions
- Utilize existing MEF technical specifications with required extensions to interface and service attributes.
- Provide requirements for UNI-C and UNI-N beyond those in MEF 13 [12] and MEF 20 [17].
- Provide requirements for ENNI beyond those in MEF 51 [30].
- Define requirements for Mobile Backhaul <u>and Mobile Fronthaul</u> with Ethernet Services specified in MEF 6.2 [3], MEF 33 [27], and MEF 51[30].
- Provide requirements for Link OAM, Service OAM Fault Management.
- Provide requirements for Class of Service and recommend performance objectives consistent with MEF 23.2 [20], where possible.

- Provide requirements in support of network slicing for 5G.
- Specify frequency synchronization requirements where possible for packet-based synchronization methods and Synchronous Ethernet.
- Specify time and phase synchronization methods and requirements.
- Define functional requirements applicable to Generic Inter-Working Function interfaces.
- Specify resiliency related performance requirements for Mobile Backhaul and Fronthaul.

9 New Section 9

Insert the content below as section 9 and renumber existing section 9 and subsequent sections and subsections:

9. Mobile Fronthaul Service Model

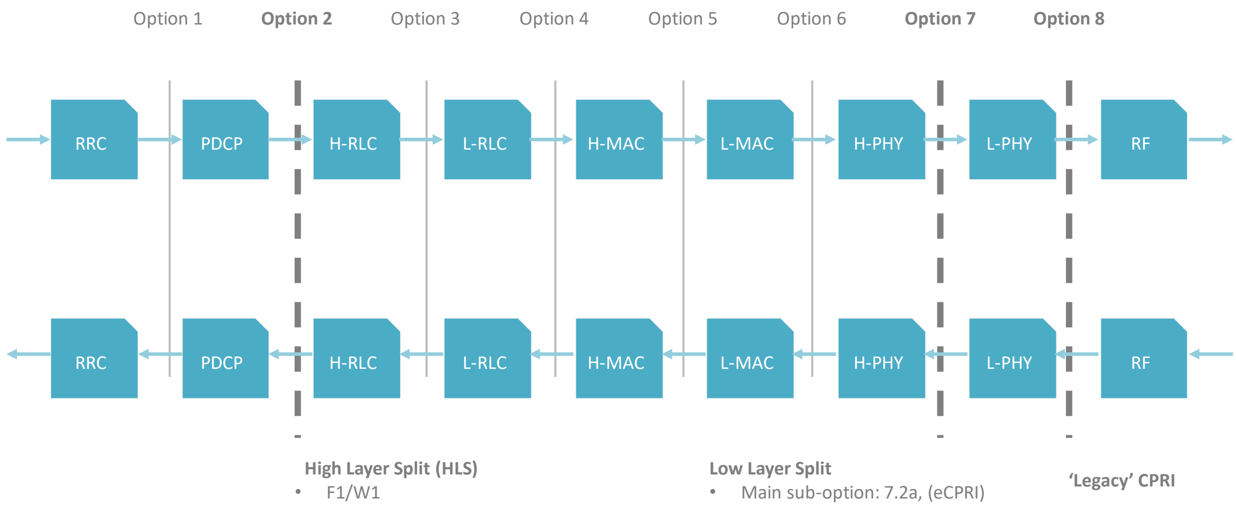
This section includes: a description of a Mobile Fronthaul reference model, definitions of reference points and functional elements, and use cases that reflect possible Mobile Fronthaul deployments.

A Mobile Fronthaul network can take on many forms depending on factors such as transport technology, mobile standard, operator preference, etc. This Standard focuses on the Mobile Fronthaul network between disaggregated elements of a RAN Base Station (RBS), an example of which is illustrated in Amendment Figure 5. In this example the Mobile Fronthaul Service (MFHS) is a MEF 6.2 EPL service between UNI demarcation points separating the Service Provider or CEN Operator's domain from the Mobile Operator's domain.

Functional blocks and internal interfaces of RAN Base Station

Until Release 15, 3GPP had treated the cellular Base Station as one functional block without any definitions of its internal architecture or interfaces. During development of Release 15 a 3GPP study was conducted to evaluate various options for functional splits and related interfaces to enable physical separation of the gNB functions. Amendment Figure 3 shows the eight options covered in that study.

The 3GPP study concluded that split Option 2 would be used for the High Layer Split (HLS). As shown in Amendment Figure 3, the Low Layer Split (LLS) Option 7 and Option 8 correspond to the use of eCPRI and CPRI, respectively.



Amendment Figure 3 – 5G RAN Base Station Functional Blocks and Split Options

Note: Terminology used in Amendment Figure 3 – including RRC (Radio Resource Control), PDCP (Packet Data Convergence Protocol), RLC (Radio Link Control), MAC (Media Access Control) and PHY (Physical Layer) – are defined for 3GPP in [A1-1]; the relationship between them is described in detail in [A1-2].

For HLS Option 2 the corresponding logical interfaces are F1 for NR and W1 for LTE. As Amendment Figure 3 above shows, the new LLS interface eCPRI specified by CPRI Cooperation is split Option 7, and the legacy CPRI interface is split Option 8), which has been in use in Remote Radio Head deployments.

A MFHS can provide connectivity at the Option 2 (F1/W1), Option 7 (eCPRI), or Option 8 (legacy CPRI) split points.

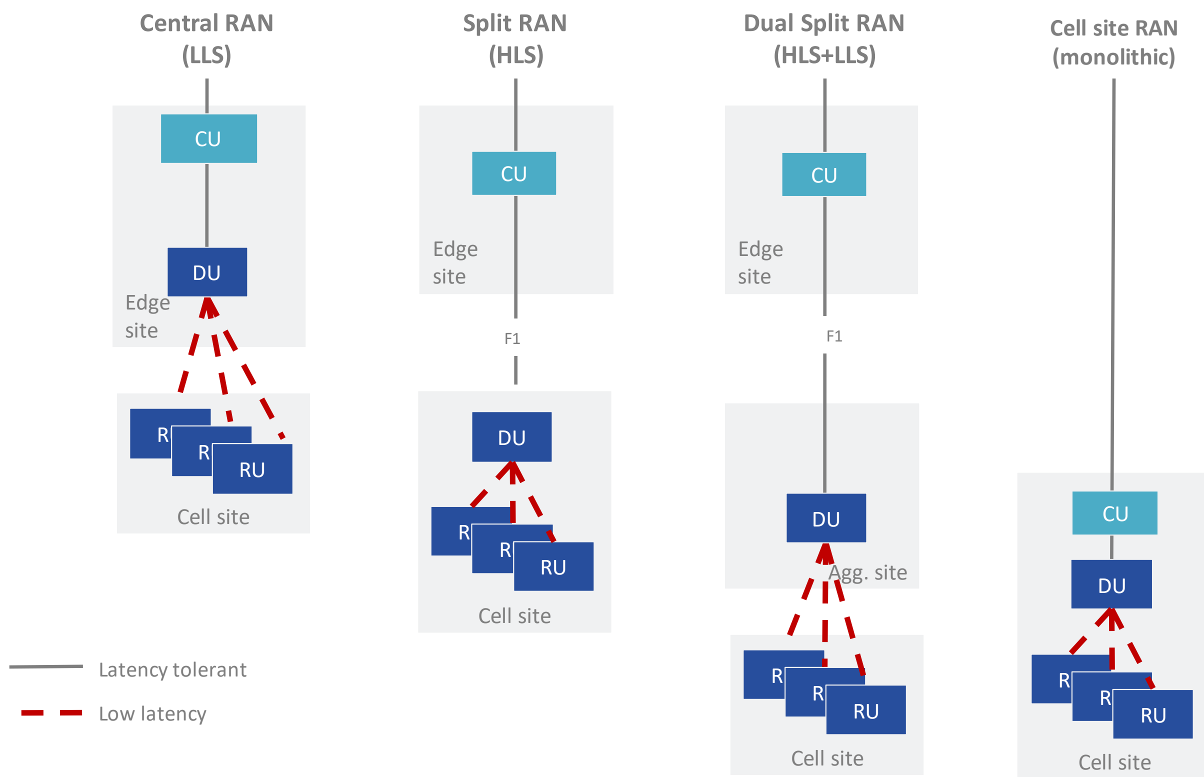
The interfaces for HLS and LLS differ in several aspects such as:

- Bandwidth requirements
- Latency tolerance
- Functionality and complexity of the Radio Unit

HLS (Option 2) requires less bandwidth and tolerates higher latency than LLS (Options 7 or Option 8).

LLS benefits from simpler and cost-efficient RUs and offer better possibilities for centralized aggregation and capacity integration.

Disaggregation of the gNB functional entities and the corresponding fronthaul interface give operators new possibilities to place the functions in separate physical locations according to their priorities. Amendment Figure 4 presents several options on placing the functions: at a cell site, at an aggregation site traditionally used for transport aggregation, or at an edge site. Selection among the options is dependent on several factors such as transport network topology, availability of sites, latency and capacity limitations and computing resource availability.

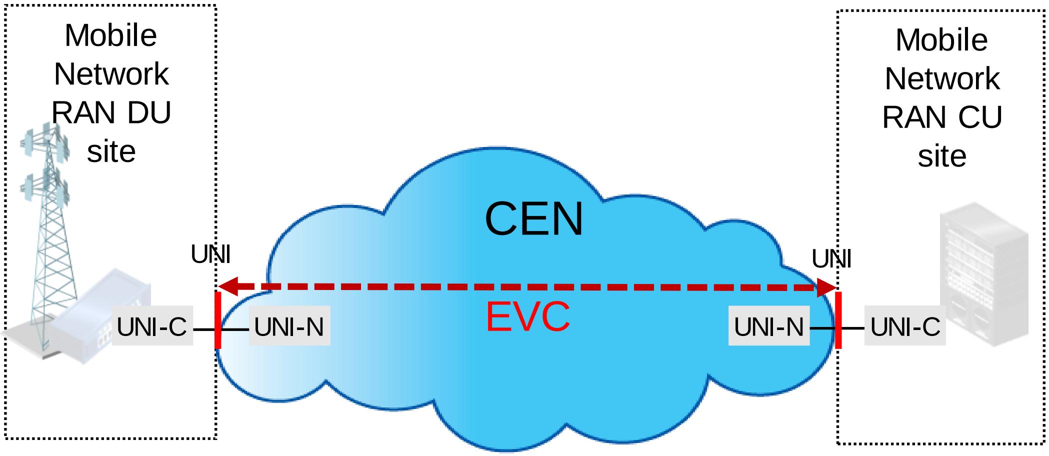


Amendment Figure 4 – Some Options for the gNB Functional Separation

9.1 Service Model Use Case

The functional split Options in Amendment Figure 3 imply a potential deployment scenario using MEF services. Although the corresponding use cases are not necessarily representative of all possible deployment scenarios, they are the foundation of this document for Mobile Fronthaul. The focus of this document for Mobile Fronthaul is to recommend capabilities at the UNI and applicable Ethernet Services in support of Mobile Fronthaul, referencing MEF specifications and specifying extensions when necessary.

Amendment Figure 5 shows an example where all traffic uses MEF 6.2 EPL service [3] across the CEN. How the Ethernet services are realized can vary depending on the mobile technology that is deployed, vendor equipment, operator requirements, and the Service types offered by the CEN.



Amendment Figure 5 – Mobile Fronthaul Example – All traffic with MEF 6.2 EPL Service across CEN

9.2 Applying Ethernet Service Definitions to Mobile Fronthaul

This section specifies requirements for Mobile Fronthaul Ethernet services. This Standard specifies requirements using:

- The baseline definition of MEF Ethernet Services in MEF 6.2 [3],
- Service Attributes defined in MEF 10.3 [7], and Class of Service concepts defined in MEF 23.2 [20],
- Additional Service Attributes defined in this document.

[A1-R1] The Mobile Fronthaul Service Provider **MUST** support an Ethernet Private Line Service that meets the mandatory requirements of MEF 6.2 [3], with the addition of the Time Synchronous Mode Service Attribute specified in Section 12.5 of this document.

Ethernet Private Line (EPL) Service emulates a direct fiber connection, which is preferred by Mobile Operators.

[A1-D1] The Mobile Fronthaul Service Provider **SHOULD** support Ethernet Virtual Private Line Services as defined in MEF 6.2 [3].

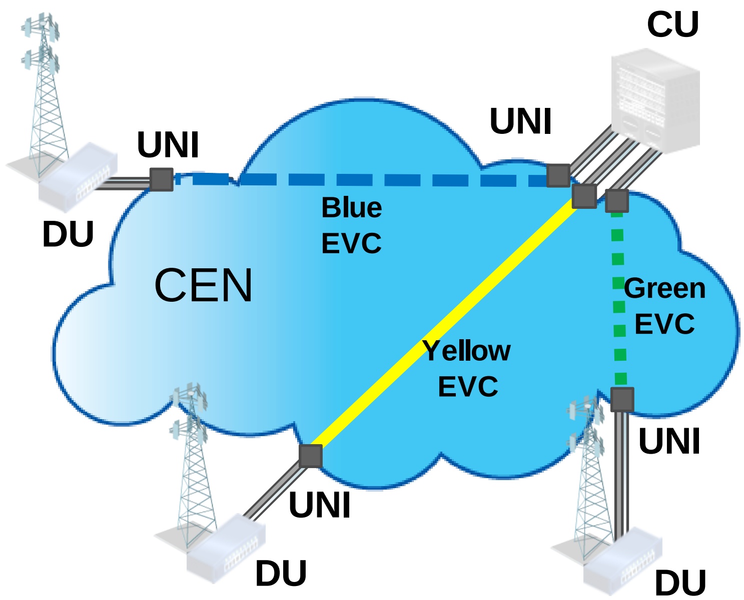
In addition to [A1-R1] and [A1-D1], see the constraints specified in Section 12.7 (UNI Service Attributes) and Section 13.5 (EVC per UNI and per EVC Service Attributes) as well as other constraints, if any, as defined in this document that apply to an Ethernet MFHS.

Note: Requirements for multipoint MFHS are for further study.

9.2.1 Ethernet Private Line Service

The Ethernet Private Line (EPL) service (MEF 6.2 [3]) is a port-based service with exactly two UNIs in an EVC. It is analogous to the leased line service that is often used for MFHS between the RAN CU and RAN DU. All Ethernet Service Frames are mapped to a single EVC at the UNI.

The EPL service might be preferred in cases where there is a desire for a 1:1 port level correspondence between the RAN CU and each RAN DU UNI as shown in Amendment Figure 6. Port-based EPL services with dedicated UNI ports at RAN CU for every DU might not be a scalable model.



Amendment Figure 6 – Ethernet Private Line (EPL) Services

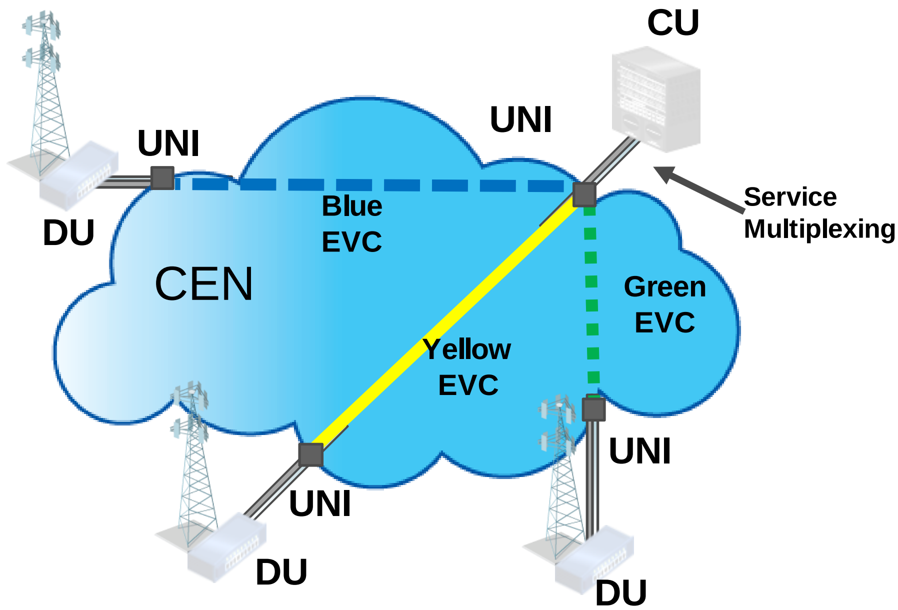
9.2.2 Ethernet Virtual Private Line Service

The Ethernet Virtual Private Line (EVPL) service (MEF 6.2 [3]) for Mobile Fronthaul is a VLAN-based service with exactly two UNIs in an EVC and is used to access multiple RAN sites with Service Multiplexing (>1 EVC) at either a RAN DU UNI or CU UNI. This allows efficient use of the RAN CU UNI, as illustrated in Amendment Figure 7. The CE-VLAN ID/EVC map and Bundling Service Attributes (MEF 10.3 [7]) are used to identify the set of CE-VLAN IDs, including the CE-VLAN ID for untagged and priority-tagged Service Frames, which map to specific EVCs at the UNI. At the RAN CU UNI, for example, if there is an EVC per RAN DU then there is an upper bound of 4094[1] RAN DUs, assuming one CE-VLAN ID per RAN DU.

[1] As mentioned in MEF 10.3 [7] Section 9.9, note that the Customer VLAN Tag values 0 and 4095 in IEEE Std 802.1Q [32] are reserved for special purposes.

Note that additional considerations, such as the bandwidth requirements associated with 5G, might reduce the practical limit on the number of EVCs to a value below the upper bound.

[1] As mentioned in MEF 10.3 [7] Section 9.9, note that the Customer VLAN Tag values 0 and 4095 in IEEE Std 802.1Q [32] are reserved for special purposes.



Amendment Figure 7 – Ethernet Virtual Private Line (EVPL) Service

Note: see also Section 4 of eCPRI Transport Network [A1-5] for requirements that might apply to an Ethernet MFHS.

10 Changes to Subsection 12.1 (renumbered Subsection 11.1), UNI Requirements

Insert "MBH" immediately prior to "Services" in requirements [R13], [R14], [D3] and [O5].

Add the following requirements to subsection 12.1, UNI Scalability:

[A1-D2] The CEN operator **SHOULD** support a minimum number of EVCs at a RAN CU UNI per MEF 13 [12] for VLAN based Mobile Fronthaul Services.

[A1-D3] The CEN operator **SHOULD** support a value of UNI Physical Layer Service Attribute (MEF 10.3 [7]) corresponding to a line rate of at least 10 Gbps at a RAN CU and DU UNI.

Insert the following paragraph at the end of subsection 12.1, UNI Scalability:

A UNI Line Rate of 10 Gbps is very likely to be expected by Mobile Operators for 5G services supporting F1 interfaces.

11 Changes to Section 14 (renumbered Section 13), Synchronization

Insert the following row at the end of Table 16:

Technology	Frequency Accuracy (ppb)	Phase Error (µs)	Reference Document
NR	+/-50 (Wide area); +/-100 (Medium Range/Local Area)	 3 µs (NR TDD)	3GPP TS 38.104 3GPP TS 38.133

Amendment Table 2 – Mobile Technology Synchronization Requirements

Insert the following note after Table 16:

Note: See also ITU-T Recommendation G.8271 Tables 1, 2, II.1 and II.2 for further synchronization-related requirements that might apply.

12 Changes to Section "References"

Note: The Reference Numbering Style for references added by this amendment uses a prefix "A1-" (in normal text font – i.e., not bold/italic) to distinguish them from the explicitly included references from MEF 22.3. This allows these additional references to be linked in this amendment.

Insert the following additional references at the end of the list of 3GPP references:

[A1-1] 3GPP TS 21.905 V15.1.0 (2018-12) "Technical Specification Group Services and System Aspects; Vocabulary for 3GPP Specifications"

[A1-2] 3GPP TS 38.300 V15.4.0 (2018-12) "Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description"

[A1-3] 3GPP TS 38.401 V15.4.0 (2018-12) "Technical Specification Group Radio Access Network; NG RAN; Architecture Description"

Revise the current CPRI reference ([107] in MEF 22.3) – to read as follows:

[107] CPRI, "Common Public Radio Interface (CPRI); Interface Specification V7.0", October 2015

Insert the following additional references at the end of the list of CPRI references:

[A1-4] eCPRI V2.0, "Common Public Radio Interface: eCPRI Interface Specification", May 2019

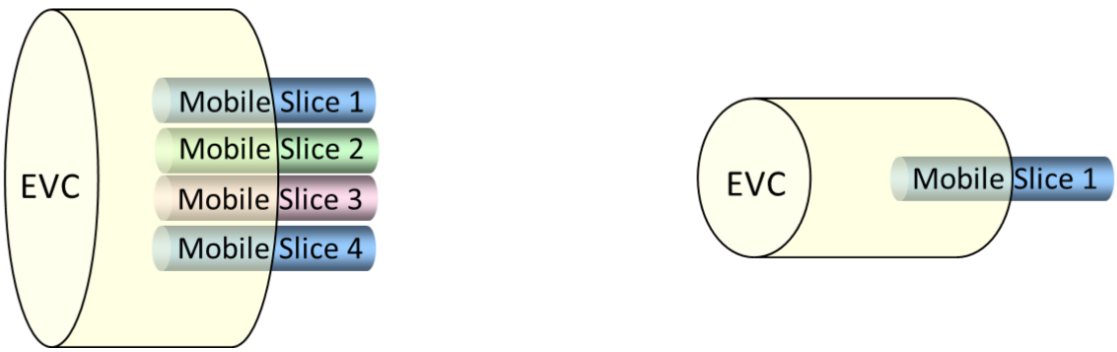
[A1-5] eCPRI Transport Network V1.2, "Common Public Radio Interface: Requirements for the eCPRI Transport Network", June 2018

13 New Appendix F

Insert the content below into the document as Appendix F.

Appendix F. Example CEN support for transport of RAN network slices

With 5G, 3GPP [TS 23.501] defines a network slice as a logical network that provides specific network capabilities and network characteristics. In MEF, this logical network is identified by an EVC + CoS ID combination. This means that there can be a 1:1 or an N:1 relationship between a network slice and an EVC supporting it in the CEN, as illustrated in Amendment Figure 8. In many cases, the MFHS provider will not have visibility to the network slice being offered by the 5G mobile operator. This would be the case if network slices are aggregated on some basis. If it is not possible for the MFHS provider to distinguish the network slice to which each offered frame belongs, then the network slices and EVC have an N:1 relationship.



Amendment Figure 8 – N:1 or 1:1 network slice to EVC Mapping

14 References

Note: This section includes the references made in this amendment that are not part of the text provided for inclusion in the amended version of MEF 22.3. A subset of the references below are explicitly listed as superseded. This amendment continues to refer to these superseded versions in order to allow the text additions provided herein to remain consistent with similar (or analogous) text in MEF 22.3 [1]. The superseding MEF Standards are included in these references.

Also note that, in text explicitly provided for inclusion in the amended version of MEF 22.3, the referenced documents use the same reference numbers as those used in MEF 22.3. These are not the same numbers as below, and the corresponding references are found in MEF 22.3.

[1] MEF 22.3, *Transport Services for Mobile Networks*, January 2018

[2] MEF 6.2, *EVC Ethernet Services Definition Phase 3*, August 2014

[3] MEF 10.3, *Ethernet Services Attributes Phase 3*, October 2013 (Superseded by MEF 10.4 [4])

[4] MEF 10.4, *Subscriber Ethernet Service Attributes*, December 2018

[5] MEF 26.2, *External Network Network Interface (ENNI) and Operator Service Attributes*, August 2016

[6] MEF 33, *Ethernet Access Services Definitions*, January 2012 (Superseded by MEF 51.1 [8])

[7] MEF 51, *OVC Services Definitions*, August 2015 (Superseded by MEF 51.1 [8])

[8] MEF 51.1, *Operator Ethernet Service Definitions*, December 2018