ETSI TS 103 859 V7.0.2 (2022-09)

Publicly Available Specification (PAS); O-RAN Fronthaul Control, User and Synchronization Plane Specification v07.02; (O-RAN-WG4.CUS.0-v07.02)

CAUTION

The present document has been submitted to ETSI as a PAS produced by O-RAN WG4 and approved by the ETSI Technical Committee MSG.

Reference
DTS/MSG-001140

Keywords
control, fronthaul, interface, PAS, synchronization

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.
Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx.

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Copyright Notification

Contents

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This Technical Specification (TS) has been produced by O-RAN Alliance and approved by ETSI Technical Committee MSG.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The contents of the present document are subject to continuing work within O-RAN and may change following formal O-RAN approval. Should the O-RAN Alliance modify the contents of the present document, it will be re-released by O-RAN with an identifying change of release date and an increase in version number as follows:

Release x.y.z

where:

- x the first digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc. (the initial approved document will have x=01).
- y the second digit is incremented when editorial only changes have been incorporated in the document.
- z the third digit included only in working versions of the document indicating incremental changes during the editing process.

The present document specifies the control plane, user plane and synchronization plane protocols used over the fronthaul interface linking the O-DU (O-RAN Distributed Unit) with the O-RU (O-RAN Radio Unit) with a Lower Layer Functional Split-7-2x based architecture (explained below). The scope of this document includes both LTE and NR (5G). A separate document contains the O-RAN M-Plane (management plane) specification.

In the following, “Layer 1” and “Physical Layer” are assumed to be synonymous.

In the main body of this specification (in any “clause”) the information contained therein is normative meaning binding on any compliant system, unless explicitly described as informative (a capability described as “optional” may or may not be included in a compliant system but if it is included it shall comply with the optional capability description). Information contained in an “Annex” to this specification is always informative.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in Release 15.

Referenced documents which are not found to be publicly available in the expected location might be found at https://o-ran.org/Reference.

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

The following referenced documents are necessary for the application of the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] eCPRI Transport Network V1.2 (2018-06-25) "Common Public Radio Interface: Requirements for the eCPRI Transport Network".

[3] IEEE Std 1588-2008 "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems".

[4] 3GPP TS 38.211 V15.1.0: "NR; Physical channels and modulation".

[5] R1-1800296, "NR OFDM Symbol Generation Option Analysis", Intel, 3GPP TSG RAN WG1 AH#18-01, Vancouver, Canada, Jan. 22-26, 2018

[6] R1-1800802, "OFDM signal generation", Nokia, 3GPP TSG RAN WG1 AH#18-01, Vancouver, Canada, Jan. 22-26, 2018

[7] ORAN-WG4.MP.0-v07.01: "O-RAN Fronthaul Working Group Management Plane Specification, Release 07.01".

[8] 3GPP TS 38.104 "Base Station (BS) radio transmission and reception", Release 15, v15.2.0 (2018-06).

[9] 3GPP TS 36.104 "Base Station (BS) radio transmission and reception", Release 16, v16.7.0 (2020-07).

[10] RFC 1166: "Internet Numbers".

[11] "IEEE Standard for Local and metropolitan area networks -- Time-Sensitive Networking for Fronthaul," in IEEE Std 802.1CM-2018, 8 June 2018.

[12] "IEEE Standard for Local and metropolitan area networks -- Time-Sensitive Networking for Fronthaul - Amendment 1: Enhancements to Fronthaul Profiles to Support New Fronthaul Interface, Synchronization, and Syntonization Standards," in IEEE Std 802.1CMde-2020 (Amendment to IEEE Std 802.1CM-2018, Oct. 2020.

[13] 3GPP. TR 38.801 V14.0.0: "Study on new radio access technology: Radio access architecture and interfaces".

[14] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[15] ITU-T G.781 (04/2020): "Synchronization layer functions for frequency synchronization based on the physical layer".

[16] ITU-T G.810 (08/1996): "Definitions and terminology for synchronization networks ".

[17] ITU-T G.8260 (03/2020): "Definitions and terminology for synchronization in packet networks".

[18] ITU-T G.8261/Y.1361 (2019) Amendment 2 (10/2020) Timing and synchronization aspects in packet networks

[19] ITU-T G.8262/Y.1362 (2018) Amendment 1 (03/2020) Timing characteristics of a synchronous Ethernet equipment slave clock

[20] ITU-T G.8262.1/Y.1362 (2019) Amendment 1 (08/2019) Timing characteristics of an enhanced synchronous equipment slave clock

[21] ITU-T G.8264/Y.1364 (08/2017) Amendment 1 (03/2018) Distribution of timing information through packet networks

[22] ITU-T G.8271/Y.1366 (03/2020): "Time and phase synchronization aspects of telecommunication networks".

[23] ITU-T G.8271.1/Y.1366.1 (10/2020): "Network limits for time synchronization in packet networks with full timing support from the network".

[24] ITU-T G.8271.2/Y.1366.2 (05/2021): "Network limits for time synchronization in packet networks with partial timing support from the network".

[25] ITU-T G.8272/Y.1367 (11/2018) Amendment 1 (03/2020) Timing characteristics of primary reference time clocks

[26] ITU-T G.8272.1/Y.1367. (11/2016) Amendment 2 (08/2019) Timing characteristics of enhanced primary reference time clocks

[27] ITU-T G.8273/Y.1368 (2018) Corrigendum 1 (10/2020) Framework of phase and time clocks

[28] ITU-T G.8273.2/Y.1368.2 (10/2020): "Timing characteristics of telecom boundary clocks and telecom time slave clocks".

[29] ITU-T G.8273.3/Y.1368.3 (10/2017) Amendment. 1 (11/2018) Timing characteristics of telecom transparent clocks for use with full timing support from the network

[30] ITU-T G.8275/Y.1369 (2020) Amendment 1 (05/2021) Architecture and requirements for packet-based time and phase distribution

[31] ITU-T G8275.1/Y.1369.1 (2020) Amendment 2 (06/2021) Precision time protocol telecom profile for phase/time synchronization with full timing support from the network

[32] ITU-T G8275.2/Y.1369.2 (2020) Amendment 2 (06/2021) Precision time protocol telecom profile for time/phase synchronization with partial timing support from the network

[33] IEEE Std 1588-2019 "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems", November 2019.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz".

[i.2] 3GPP TR 36.932: "Scenarios and requirements for small cell enhancements for E-UTRA and E-UTRAN".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

C-Plane: Control Plane: refers specifically to real-time control between O-DU and O-RU, and should not be confused with the UE's control plane

Cascade mode: Mode of Shared cell which is realized by several O-RUs cascaded in chain. (See clause 13)

DL: DownLink: data flow towards the radiating antenna (generally on the LLS interface)

eAxC: extended Antenna-Carrier: a data flow for a single antenna (or spatial stream) for a single carrier in a single sector. Includes the fields BandSector_ID, CC_ID, RU_Port_ID and DU_Port_ID (see clauses 5.1.3.1.6 and 5.1.3.2.4)

FFO: Fractional Frequency Offset. This is defined as Δf/f_norm which is used to describe frequency error, typically on the output of the T-TSC filter in the O-RU. It is the same as the Fractional Frequency Deviation defined in ITU-T G.810.

FHM mode: Mode of Shared cell which is realized by FHM and several O-RUs. (See clause 13)

Hop: physical link between 2 s-plane nodes (where node can be O-DU, switch or O-RU) as defined in IEEE 802.1CM

LAA: Licensed-assisted access: Carrier aggregation with at least one secondary cell operating in the unlicensed spectrum.

LLS: Lower Layer Split: logical interface between O-DU and O-RU when using a lower layer (intra-PHY based) functional split.

LLS-U: Lower Layer Split User-plane: logical interface between O-DU and O-RU when using a lower layer functional split.

LLS-C: Lower Layer Split Control-plane: logical interface between O-DU and O-RU when using a lower layer functional split.

High-PHY: those portions of the PHY processing on the O-DU side of the fronthaul interface, including FEC encode/decode, scrambling, and modulation/demodulation.

Low-PHY: those portions of the PHY processing on the O-RU side of the fronthaul interface, including FFT/iFFT, digital beamforming, and PRACH extraction and filtering.

M-Plane: Management Plane: refers to non-real-time management operations between the O-DU and the O-RU

O-CU: O-RAN Control Unit – a logical node hosting PDCP, RRC, SDAP and other control functions