Common Public Radio Interface

P802.1CM/D1.0 Timing accuracy ballot comment

CPRI
Common Public Radio Interface

Timing accuracy requirements

CPRI requirements refinements rationales (1/3)

The previous requirements were based on the assumption that the RE radio contribution to the Time Alignment Error started at the output of the radio clock.

After discussions with IEEE 802.1 and inside CPRI, it appeared that the radio contribution shall include this recovery clock at the interface between the source of the time information from the network and the radio part of the RE.

Moreover for Category/Class C (P802.1CM/CPRI), CPRI suggests not to derive the network limits from the 3GPP requirements, RE internal error and PRTC/GM error, but to use the same network limits as described in chapter 7.3 of ITU-T G.8271.1, “Network limits for time synchronization in packet networks” for reference point C.

Timing accuracy requirements

CPRI requirements refinements rationales (2/3)

eCPRI Transport Network Requirements considers two interface conditions cases:

- Interface conditions for Case 1:
  - T-TSC is integrated in eRE, i.e. PTP termination is in eREs
  - Refer to “deployment case 1” in Figure 7-1 of [ITU-T G.8271.1]
- Interface conditions for Case 2
  - T-TSC is not integrated in eREs, i.e. PTP termination is in T-TSC at the edge of transport network
  - The phase/time reference is delivered from the T-TSC to the co-located eREs via a phase/time synchronization distribution interface (e.g. 1PPS and ToD)
  - Refer to “deployment case 2” in Figure 7-1 of [ITU-T G.8271.1]

Timing accuracy requirements

CPRI requirements refinements rationales (3/3)

For Interface conditions for Case 1, eCPRI Transport Network Requirements considers two sub-cases:

- the integrated T-TSC requirements are the same as standalone T-TSC Class B as defined in [ITU-T G.8273.2].
- the enhanced integrated T-TSC requirements assume a total maximum absolute time error of 15ns.

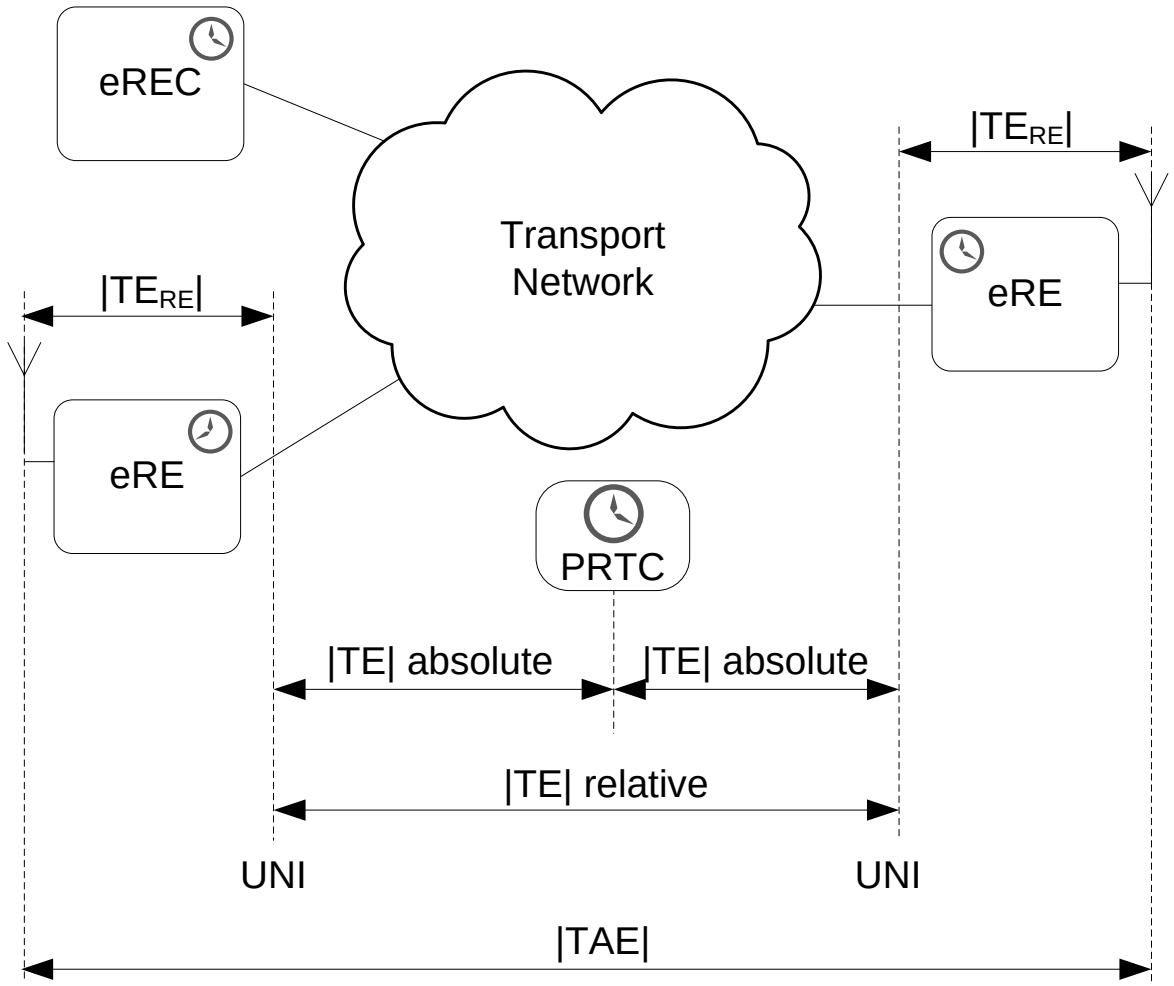
As a consequence the requirements have to be revised.

eCPRI Transport Network requirements (1/3)

Timing accuracy requirements

For category A+/A/B, the requirements are expressed as relative requirements between two UNIs, instead of relative to a common clock reference.

For category C, the requirement is expressed as an absolute requirement at the UNI as in ITU-T G.8271.1.



eCPRI Transport Network requirements (2/3)

Timing accuracy requirements

Category (note 1)	Time error requirements at UNI, |TE|			Typical applications and time alignment error (TAE) requirements at antenna ports of eREs (for information)	
	Case 1 (note 2)		Case 2 (note 3)	Typical applications	TAE
	Case 1.1 (note 4)	Case 1.2 (note 5)			
A+	N.A.	N.A.	20 ns (relative)	MIMO or TX diversity transmissions, at each carrier frequency	65 ns (note 6)
A	N.A.	60 ns (relative) (note 7)	70 ns (relative)	Intra-band contiguous carrier aggregation, with or without MIMO or TX diversity	130 ns (note 6)
B	100ns (relative) (note 7)	190 ns (relative) (note 7)	200 ns (relative)	Intra-band non-contiguous carrier aggregation, with or without MIMO or TX diversity, and Inter-band carrier aggregation, with or without MIMO or TX diversity	260 ns (note 6)
C (note 8)	1100 ns (absolute) (note 9)		1100 ns (absolute) (note 9)	3GPP LTE TDD	3 us (note 10)

eCPRI Transport Network requirements (3/3)

Timing accuracy requirements

Note 1) In most cases, the absolute time error requirements (Category C) are necessary in addition to the relative time error requirements (Category A+, A and B)
Note 2) Interface conditions for Case 1
•T-TSC is integrated in eRE, i.e. PTP termination is in eREs
•Refer to “deployment case 1” in Figure 7-1 of [ITU-T G.8271.1],

•Note 3) Interface conditions for Case 2

•T-TSC is not integrated in eREs, i.e. PTP termination is in T-TSC at the edge of transport network
•The phase/time reference is delivered from the T-TSC to the co-located eREs via a phase/time synchronization distribution interface (e.g. 1PPS and ToD)
•Refer to “deployment case 2” in Figure 7-1 of [ITU-T G.8271.1]

Note 4) In this case the integrated T-TSC requirements are the same as standalone T-TSC Class B as defined in [ITU-T G.8273.2].

Note 5) In this case the enhanced integrated T-TSC requirements assume a total maximum absolute time error of 15 ns.
Note 6) TAE, section 6.5.3.1 of [3GPP TS36.104]

Note 7) Network access link delay asymmetry error is included
Note 8) The same requirements as “class 4” listed in Table 1 of [ITU-T G.8271]

Note 9) The same value as the network limits at the reference point C described in chapter 7.3 of [ITU-T G.8271.1]

Note 10) Cell phase synchronization requirement for wide area BS (TDD), Table 7.4.2-1, section 7.4.2 of [3GPP TS36.133], |TE| at the antenna ports shall be less than TAE/2

P802.1CM/D1.0 sub-clause 6.3 comment

Case2 impact on P802.1CM Time synchronization requirements

$|TE_{RE}|$ = 30 ns Budget for internal RE timing error for Class A/B/C

$|TE_{RE}|$ = 22.5 ns Budget for internal RE timing error for Class A+

- Class A+: $|TE|_{relative}$ < ~~32.5~~ 65 ns – 2x$|TE_{RE}|$ = ~~12,5~~ 20 ns

  MIMO, Tx-diversity

- Class A: $|TE|_{relative}$ < ~~65~~ 130ns – 2x$|TE_{RE}|$ = ~~45~~ 70 ns

  CA Intra Contiguous.

- Class B: $|TE|_{relative}$ < ~~130~~ 260ns – 2x$|TE_{RE}|$ = ~~110~~ 200 ns

  CA Intra Non-Contiguous, CA Inter

- Class C: $|TE|_{absolute}$ < ~~1.5 µs - $|TE_{RE}|$ - max$|TE_{PRTC/GM}|$~~ 1.1 µs

  LTE TDD

P802.1CM/D1.0 sub-clause 6.3 comment

Case 1.1 and 1.2 impact on P802.1CM Time synchronization requirements

Case 1.1 assumptions and requirements have to be considered in P802.1CM/D1.0 sub-clause 6.3

Case 1.2 assumptions and requirements have to be considered in P802.1CM/D1.0 sub-clause 6.3

P802.1CM/D1.0 sub-clause 6.3 comment

Case 1.1 impact on P802.1CM/D1.0 Time synchronization requirements

$|TE_{RE}| = 20$ ns

$|cTE_{T\text{-}TSC}| = 20$ ns according to ITU-T G.8273.2 (T-BC Class B)

$|dTE_{T\text{-}TSC}| = 40$ ns according to ITU-T G.8273.2 (T-BC Class B)

- Class B: $|TE|_{relative} < 260ns - 2x|TE_{RE}| - 2x|cTE_{T\text{-}TSC}| - 2x|dTE_{T\text{-}TSC}| = 100$ ns

  CA Intra Non-Contiguous, CA Inter

- Class C: $|TE|_{absolute} < 1.1$ µs

  LTE TDD

P802.1CM/D1.0 sub-clause 6.3 comment

Case 1.2 impact on P802.1CM/D1.0 Time synchronization requirements

$|TE_{RE}|$ = 20 ns $|TE_{T\text{-}TSC}|$ = 15 ns Budget for internal RE timing error for Class A/B

- Class A: $|TE|_{relative} < 130ns – 2x|TE_{RE}| -2x |TE_{T\text{-}TSC}| = 60$ ns

  CA Intra Contiguous.

- Class B: $|TE|_{relative} < 260ns – 2x|TE_{RE}| -2x |TE_{T\text{-}TSC}| = 190$ ns

  CA Intra Non-Contiguous, CA Inter

- Class C: $|TE|_{absolute} < 1.1$ µs

  LTE TDD

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