

cm-baosh-synchronization-comments- on-D0-4-0916

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Agenda

- **Questions on the timing requirements :**
 - Current timing requirements to TSN
 - Question -1
 - Question -2
- **Proposals on the timing requirements :**
 - Proposal-1
 - Proposal- 2

Current timing requirements in TSN

<http://www.ieee802.org/1/files/public/docs2016/cm-CPRI-functional-decomposition-requirements-0516-v01.pdf>

802-1CM-d0-4.pdf

Synchronization timing accuracy

Class A+¹⁾: $|TE| < 10 \text{ ns}$

Class A¹⁾: $|TE| < 45 \text{ ns}$

Class B¹⁾: $|TE| < 110 \text{ ns}$

Class C²⁾: $|TE| < 1.36 \mu\text{s}$

- Class A+, A and B: The timing accuracy of the slave clock **in the RE** compared to a common GM clock.
(No REC need to fulfill Class A+, A or B)
- Class C : The timing accuracy of the slave clock **in the RE or REC** compared to any GM clock.

1) Category A+

The maximum absolute Time Error [B5] $\leq 10 \text{ ns}$ with respect to a common point in the synchronization chain (e.g. the common grandmaster clock or the nearest common boundary clock in case of PTP).

Meeting Category A+ requirement is optional.

Category A+ is, e.g., for Multiple-Input and Multiple-Output (MIMO) and transmit diversity radio access technologies.

2) Category A

The maximum absolute Time Error $\leq 45 \text{ ns}$ with respect to a common point in the synchronization chain (e.g. the common grandmaster clock or the nearest common boundary clock in case of PTP).

Meeting Category A requirement is mandatory.

Category A is for intra-band contiguous carrier aggregation radio access technology.

3) Category B

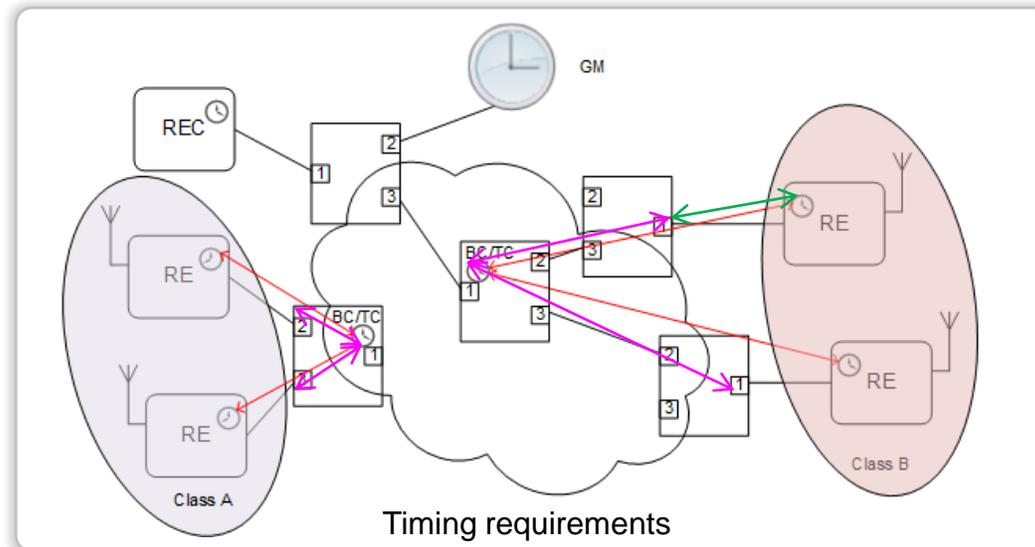
The maximum absolute Time Error $\leq 110 \text{ ns}$, with respect to a common point in the synchronization chain (e.g. the common grandmaster clock or the nearest common boundary clock in case of PTP).

Meeting Category B requirement is mandatory.

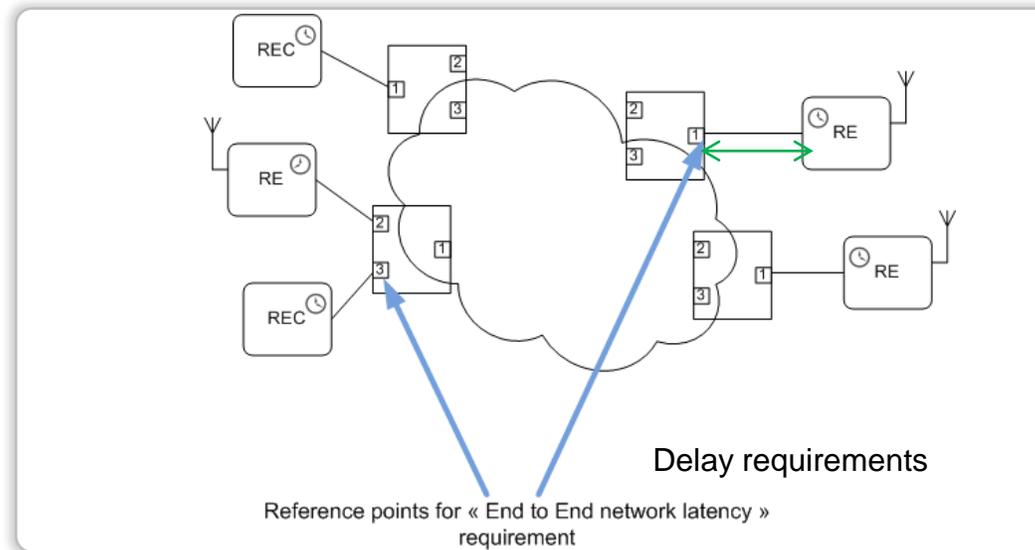
Category B is for intra-band non-contiguous and inter-band carrier aggregation radio access technologies.

Question -1

- For Class A+, A and B: The timing error of the slave clock in the RE compared to the nearest common BC or TC (between the REs that running a feature that require the specific class)..
- Question:
 - Whether the timing error between the RE and the fronthaul boundary node connecting with this RE (as shown in green) should be included in the timing error requirement path ?
 - If yes, then, when the timing requirements can not be satisfied, who is responsible for the failure ? the fronthaul network? Or the wireless system?



- According to the latency requirements(100us), the paths of the delay requirement are all located between the two boundary points of the network, which does not include the path between RE and fronthaul boundary node (as shown in green) .
- We should add some figures to the specification to describe the delay and timing requirements boundary. And especially for the timing requirements , we should figure out who is responsible for the timing error budget allocation between network and RE/REC.



Question -2

- For Class C, the time/phase accuracy for RE's time relative to an external absolute time
 - $\leq 1.36 \mu\text{s}$ (- wireless internal budget $\sim 40 \text{ ns}$ – GM 100 ns)

Synchronization timing error

Class A+¹⁾: $|\text{TE}| < 10 \text{ ns}$
Class A¹⁾: $|\text{TE}| < 45 \text{ ns}$
Class B¹⁾: $|\text{TE}| < 110 \text{ ns}$
Class C²⁾: $|\text{TE}| < 1.36 \mu\text{s}$
Class D³⁾: $|\text{TE}| < \text{TBD}$

Synchronization frequency error

-4)

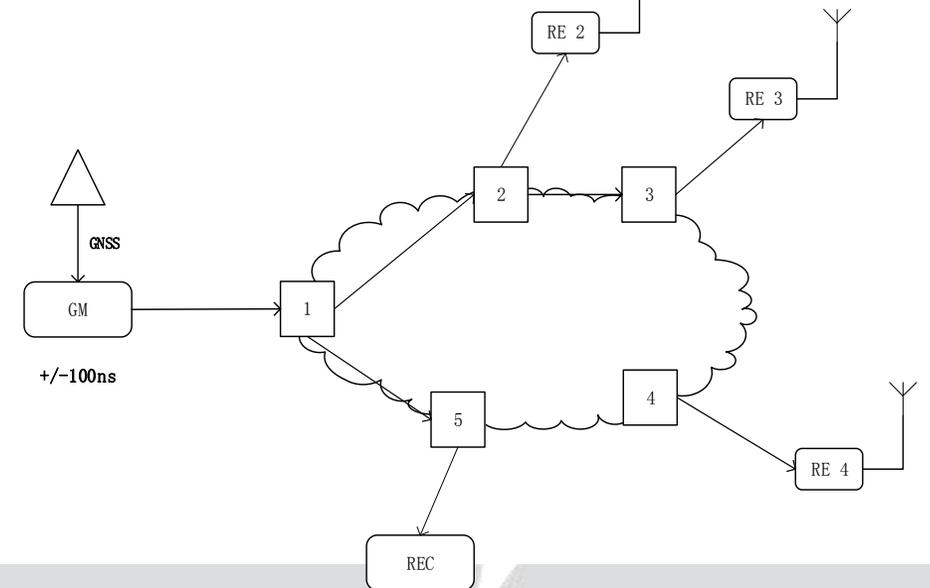
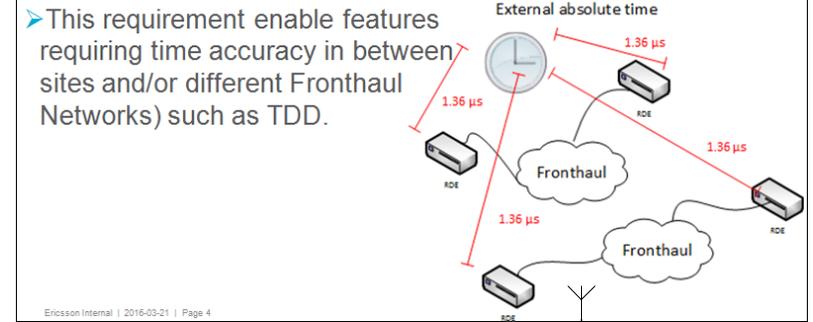
4) Category C

The maximum absolute Time Error $\leq 1.36 \mu\text{s}$, where the timing accuracy of the slave clock in the RE is compared to any grandmaster clock whose Time Error $\leq 100 \text{ ns}$. Meeting Category C requirement is mandatory. Category C is for time division duplex radio access technology.

- Time error 100ns for GM is based on ITU-T G.8272 recommendation.
- However, ITU-T is considering an enhanced GM clock in G.8272.1 (e.g., $\pm 30 \text{ ns}$), the error of GM is improving.
- We think that the error for GM is not in the CPRI or .1CM work scope, it's better to keep this to ITU-T. Then timing error requirements of class C and D should be amended.

Synchronization – Requirements 2

- The time/phase accuracy for RDE's time relative to an external absolute time:
 - $\leq 1.36 \mu\text{s}$ (- internal budget $\sim 40 \text{ ns}$ – GM 100 ns)

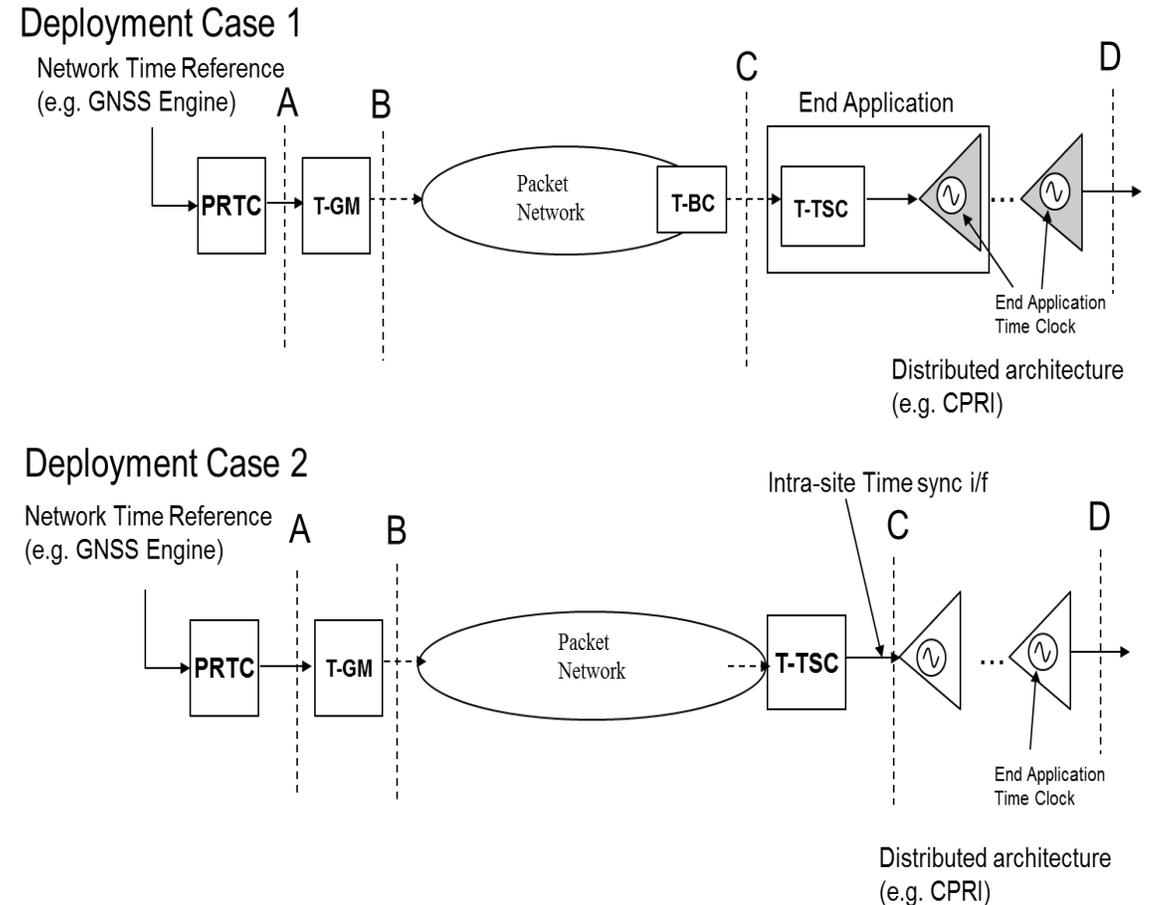


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Network Level Reference Models and Reference Points

- The requirements summarized on slide 5, for classes A+, A, B, and C are not very clear on exactly where in the network the requirements apply
- Network-level specifications developed in ITU-T Q13/15 clearly show reference points in the network where the specifications apply (i.e., they show a reference model)
- For example, the reference model for backhaul in G.8271.1 is shown on the right:



Network Level Reference Models and Reference Points (Cont.)

- In the reference model for backhaul on slide 7, the end application clock is not specified by ITU-T (it is specified by 3GPP)
- For eCPRI, the end application clock is part of the RE or REC, and is specified by the CPRI group
- Therefore, the requirements in 802.1CM should be specified at the equivalent of reference point C of the figure on the slide 7, but for a reference model for eCPRI rather than for backhaul
 - This is between the final network node and RE or REC
 - If the Time Telecom Slave Clock (T-TSC) is collocated with the RE or REC, this point is in between the final Telecom Boundary Clock (T-BC) and T-TSC
 - If the T-TSC is separate from the RE (or REC), this point is in between the T-TSC and RE (or REC)

Proposal – 1

- For the case of eCPRI, clearly show a reference model with a figure, with the relevant reference points indicated
- The time accuracy requirements for eCPRI should be at a reference point between the network and RE or REC (analogous to reference point C in the backhaul reference model)
- The reference can apply to all four timing requirements classes
- With the reference model, indicate that the relevant timing budget allocation will be defined by ITU-T
 - Work is beginning in ITU-T SG 15, Q13

Proposal – 2

- **As indicated in slide 5, the requirement of 1.36 μs for class C assumes that the budget for the GM (actually, Primary Reference Time Clock (PRTC)) is 100 ns, as specified in ITU-T G.8272**
- **But, it also is indicated in slide 5 that ITU-T SG 15, Q13 is working on a specification for an enhanced PRTC (ePRTC), which will be in ITU-T G.8272.1**
 - Max|TE| for the ePRTC will be 30 ns
 - If the GM is receiving timing from an ePRTC, the budget for the rest of the network, i.e., other than the ePRTC, is 1.43 μs (i.e., 1460 ns – 30 ns)
- **Whether the GM is timed by a PRTC or ePRTC is outside the scope of 802.1CM**
- **Therefore, it would be better to simply specify the overall maximum time error of the RE or REC relative to the source of timing of the network, i.e., the PRTC or ePRTC**
 - This requirement should be 1.46 μs
 - If an ePRTC is used, the rest of the network has more budget than if a PRTC is used
 - This should not be a concern of 802.1CM



Thank you

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