

## IEEE 1914 NGFI WG

Synchronization options: ITU-T G.8275.1 and  
ITU-T G.8275.2

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# Current synchronization requirement

One of the following PTP profiles shall be used for NGFI network time distribution, with the optional exceptions that are listed henceforth:

ITU-T G.8275.1 PTP Telecom Profile for Phase/Time Synchronization with Full Timing Support from the Network.

ITU-T G.8275.2 PTP Telecom Profile for Phase/Time Synchronization with Partial Timing Support from the Network.

## Inclusive standard of all use cases

- Open architecture & interfaces, mix and match solutions from different vendors
- Compliance to NGFI tied to support of ITU-T G.8275.1 ?
  - A lot of cases where Fronthaul switches do not support Boundary Clocks (existing network, many switches with 100G interfaces, etc)
  - TIP vRAN project: "Producing a vRAN solution that can cope with non-ideal transport, enables an operator to exploit its existing infrastructure, and enables vRAN solutions to apply to a wider range of use cases."

# Examples

## eCPRI

- user plane over Ethernet or user plane over IP

## xRAN.org

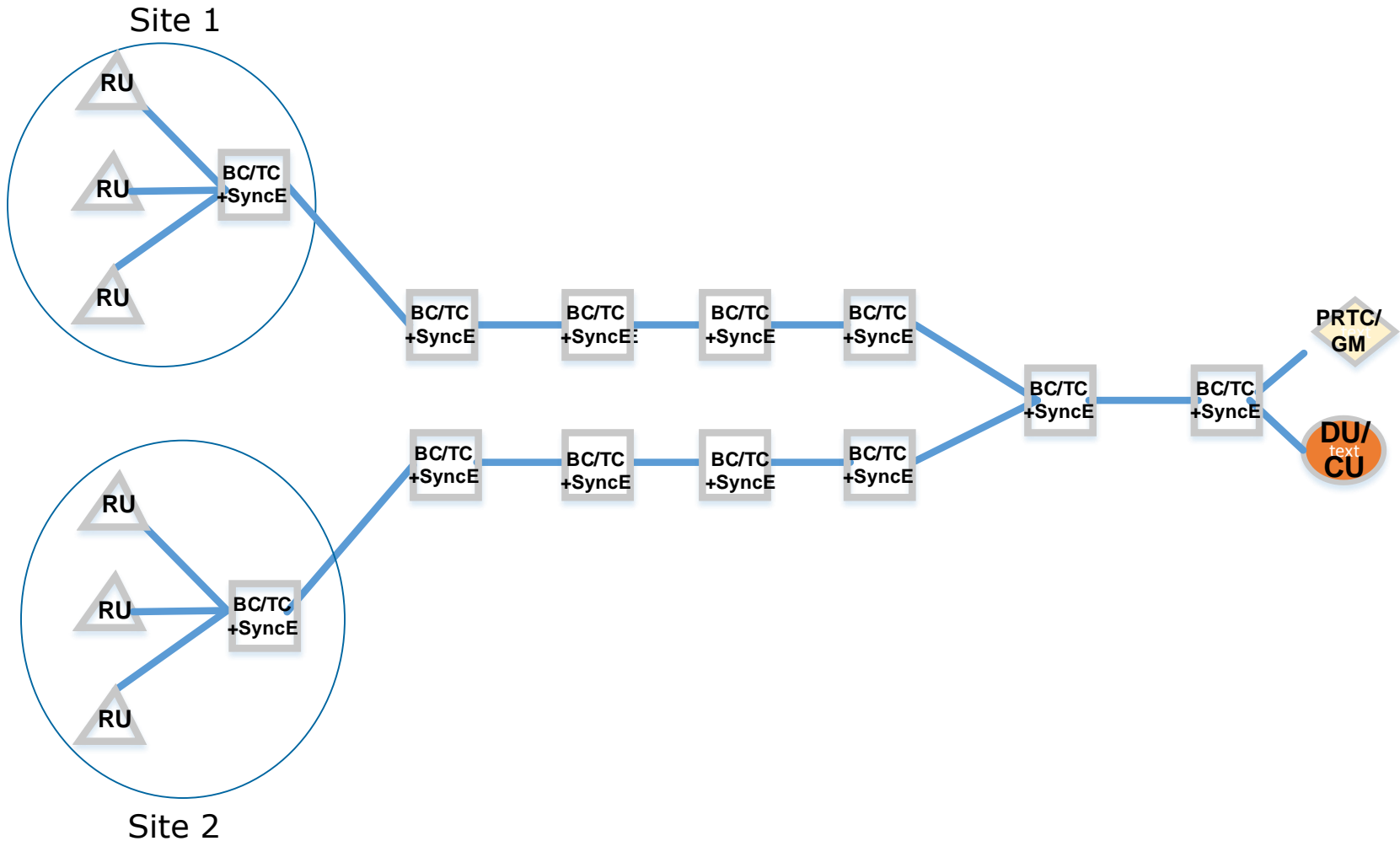
- Transport encapsulation types: eCPRI Ethertype or the IEEE1914.3 Ethertype shall be used

# Synchronization applications

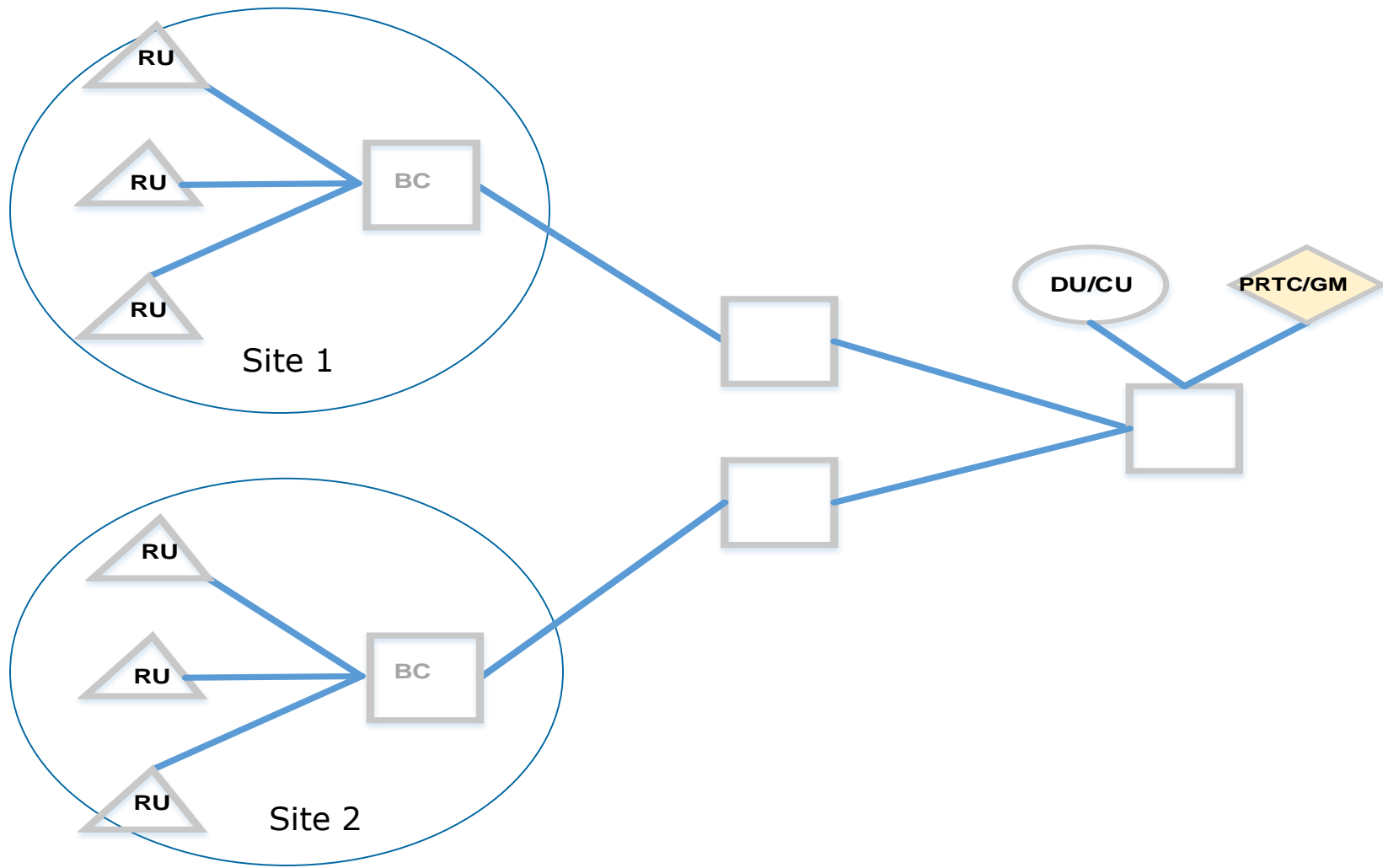
Synchronization requirements depend on carriers applications

- LTE (FDD)
- LTE (TDD)
- LTE-eICIC
- LTE-A (CoMP, MBFSN)
- *Intra-band non-contiguous CA*
- *Intra-band contiguous CA*
- *MIMO or TX Diversity*

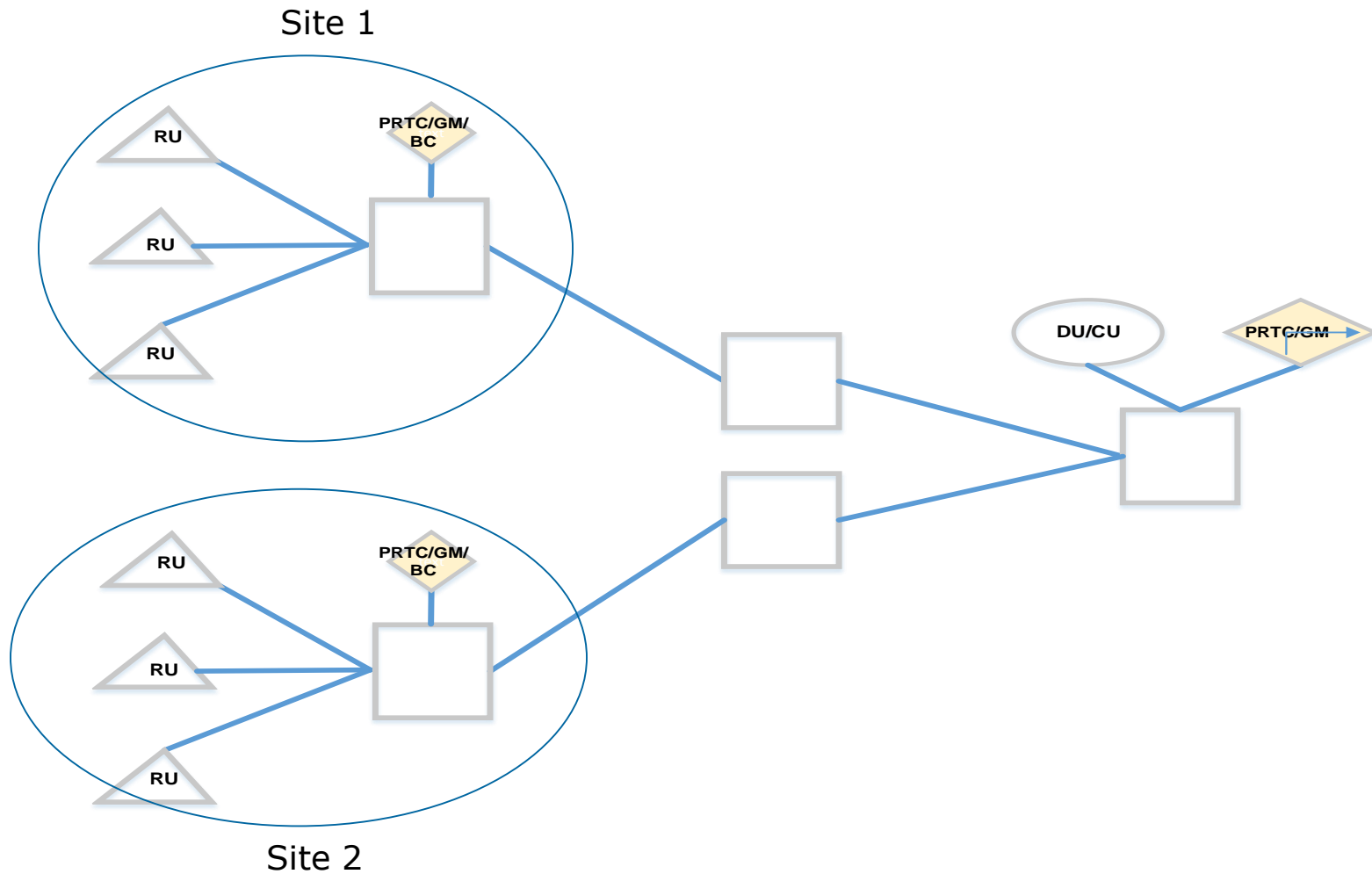
# ITU-T G.8275.1 use case



# ITU-T G.8275.2 use case



# Co-located Master use case



# 3GPP synchronization requirements

Applications	Time/Phase requirements	
LTE (FDD)	N/A	Call initiation
LTE (TDD)	+/-1.5 usec	Time slot alignment

Typical applications (for information)	Time error requirements (Note 1)	Specification
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MIMO or TX diversity transmissions, at each carrier frequency	$\pm 65$ ns	3GPP 36.104 V13.1.0 section 6.5.3.1



# Liaison with CPRI on TAE

CPRI\_1000\_1910

**Title:** CPRI TWG response to Liaison on the “Category A+” TAE Requirement

**To:** Jinri Huang, Chair, IEEE 1914 ([huangjinri@chinamobile.com](mailto:huangjinri@chinamobile.com))

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John Messenger, Vice-Chair, IEEE 802.1 ([J.L.Messenger@ieee.org](mailto:J.L.Messenger@ieee.org))  
Jessy Rouyer, Secretary, IEEE 802.1 ([jessy.rouyer@nokia.com](mailto:jessy.rouyer@nokia.com))

**Source:** CPRI Technical Working Group

**Date:** 2018-12-04

**Contact Person:**

**Name:** Olivier Klein (Chairman CPRI Technical Working Group)

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# Liaison with CPRI on TAE

## 1 Response

CPRI cooperation appreciates receiving the liaison statement from IEEE 1914 Next Generation Fronthaul Interface (NGFI) Working Group. We have reviewed with interest your comments and suggestion. Please find below our feedback.

*As part of IEEE P1914.1 work at our September 2018 meeting, we discussed Time Alignment Error requirements at the radios in a fronthaul network. Considering recent industry progress in this area, we concluded that the “Category A+” requirement of 65 ns (Multiple-Input and Multiple-Output or transmit diversity radio access technologies) applies to co-located transmitter groups in the same Remote Unit and that the network is not involved in the synchronization of these transmitter groups. Therefore, we are planning to not cover this in IEEE P1914.1.*

CPRI TWG considers this conclusion not entirely accurate. While it is true that in most of cases, the “Category A+” requirement of 65 ns (Multiple-Input and Multiple-Output or transmit diversity radio access technologies) would apply to co-located transmitter groups in the same Remote Unit, co-located transmitter groups in different Remote units for MIMO or TX-diversity transmission may exist as a lower priority, yet possible deployment scenario. Nevertheless, CPRI TWG recognizes that there are issues in supporting this lower priority case given that:

# Liaison with CPRI on TAE

- It requires a non-standard T-TSC (i.e. beyond Class A, B or even C – and perhaps D) with narrow-band filtering in the NE to achieve the 3GPP frequency accuracy at the air interface. With a standard ITU-T T-TSC, the RE end application clock in the radio unit would have to support very narrow-band filtering to eliminate noise from the NE and this would require a high-cost oscillator with high temperature stability to be able to achieve the required timing accuracy.
- It requires a non-standard interface (e.g. 1PPS but not necessarily only 1PPS) and so would only be supportable as part of a proprietary solution.

Therefore, inter-vendor interoperability would be very difficult to achieve.

*In the interest of alignment, we would recommend that this topic be revisited in the context of the collaboration between IEEE 802.1 and CPRI Cooperation as we believe the "Category A+" requirement should be removed from IEEE Std 802.1CM.*

# Liaison with CPRI on TAE

CPRI Cooperation does not aim for inter-vendor interoperability in its own specifications and does not plan to provide additional details that would be required to achieve such interoperability in this lower priority case. Therefore, after revisiting the topic, and considering both the unavailability of the standard T-TSC that Category A+ would require and IEEE 802.1CM focus on standard-based interoperable solutions, CPRI TWG takes the opportunity of this liaison response to inform IEEE 802.1 that CPRI TWG no longer considers Category A+ as a requirement for IEEE 802.1CM. Additionally, CPRI is considering adding further clarifications to a future edition of the requirement document [1] concerning constraints associated with Category A+.

# IEEE 802.1CM-2018

## 6.4.1.1 Category A+

Category A+ is only applicable to Case 2. The maximum relative TE can be determined as shown by Equation (6-1):

$$\max |TE|_{relative} = 65 \text{ ns} - 2 \times |TE_{eRE/RE}| = 20 \text{ ns} \quad (6-1)$$

where  $|TE_{eRE/RE}|$  is the budget for all respective internal eRE/RE TE.

Equation (6-1) is derived from 6.5.3.1 of 3GPP TS 36.104-2018 [B 1]. The maximum Time Alignment Error is 65 ns. 20 ns budget remains for the maximum relative TE of the bridged network as  $|TE_{eRE/RE}|$  is 22.5 ns (see Table 6-1).

Category A+ requirement is relevant, e.g., for Multiple-Input and Multiple-Output or transmit diversity radio access technologies (used between two cooperating eRE/REs).

# Relative and intra-site vs inter-site

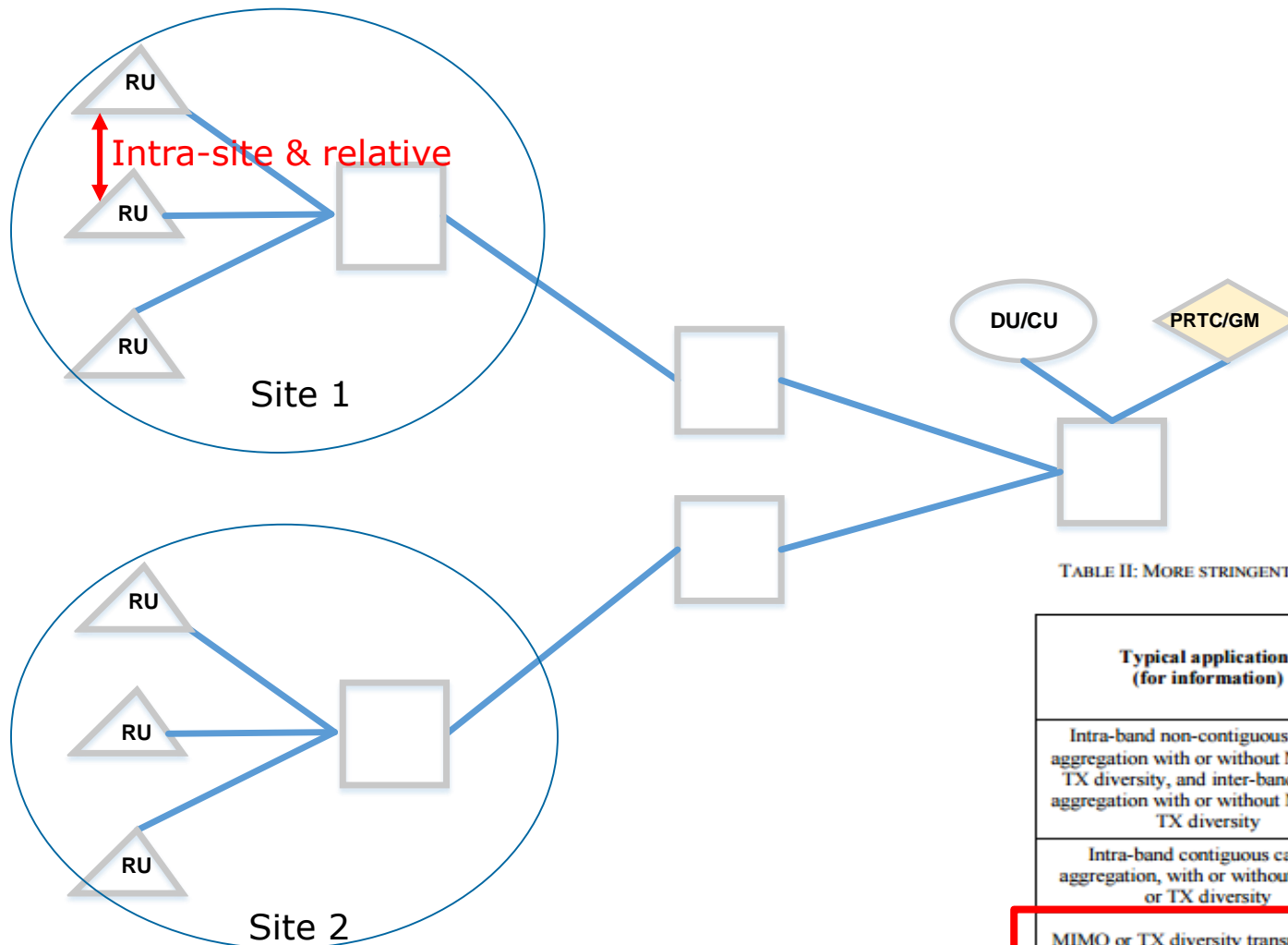


TABLE II: MORE STRINGENT REQUIREMENT SET BY 3GPP FOR FUTURE NETWORKS.

Typical applications (for information)	Time error requirements (Note 1)	Specification
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	$\pm 260$ ns	3GPP 36.104 V13.1.0 section 6.5.3.1
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# 3GPP TSG-RAN WG4 Meeting #87 Ericsson R4-1807182 Busan, South Korea, 21<sup>st</sup>-25<sup>th</sup> May 2018

~~3GPP TSG-RAN WG4 Meeting #87~~

~~R4-1807182~~

~~Busan, South Korea, 21<sup>st</sup>-25<sup>th</sup> May 2018~~~~3GPP TSG-RAN WG4 Meeting #XX~~ ~~R4-XXXXX~~

~~XXXX, XXX, XXXX May 2018~~

**Source:** Ericsson  
**Title:** Input to WF on NR BS TAE for inter-BS for MIMO, TX diversity and continuous CA  
**Agenda item:** ~~XXXXX~~7.7.2.7.1  
**Document for:** Discussion

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## 1 Introduction

In latest RAN4 meeting, there has been questions regarding existing specified requirements for TX diversity, MIMO and continuous CA in [1]. The questions are expressed in [2] and relates to whether existing requirements shall be interpreted for intra-site or inter-site deployments.

In this contribution, we provide answers to questions in [2] for TX diversity, MIMO and continuous CA and describe our view for an inter-site TAE specification.

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## 2 Background

Extract from [2] below.

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### Agreements(1/2)

- Following table shows the common RAN4 understanding of current TAE requirement applicability. (Discussion is required for yellow parts)

Configurations	TAE requirement	
	Intra-BS	Inter-BS
MIMO or Tx div.	65ns	??
intra-band C CA	260ns (FR1), 130ns (FR2)	??

- In RAN4#87 meeting, encouraged companies provide their understanding and view on following questions/action points.
  - If the current TAE requirements (65ns for MIMO/Div. for both FR1/FR2, 260ns for intra-band C CA for FR1, and 130ns for intra-band C CA for FR2) are also applicable for inter-BS case?
  - If the answer in 1. is "NO", if RAN4 needs to specify separate TAE requirement for inter-BS case? If needed how RAN4 should derive the required TAE value?
- In RAN4#87 meeting, RAN4 shall decide/have consensus on at least above 1 question, and agree the clarification CR to TS38.104 if needed.

The questions are related to deployment conditions for the in [1] specified TAE=65ns for TX diversity and MIMO and 130/260ns for contiguous CA



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# 3GPP TSG-RAN WG4 Meeting #87 Ericsson R4-1807182 Busan, South Korea, 21<sup>st</sup>-25<sup>th</sup> May 2018

*“RAN thanks ITU-T Study Group 15 for their LS/r on the initiation of work to support IMT-2020/5G in the Transport Network. In that document, ITU-T SG15 asked if it is correct to expect that in the case of MIMO or Tx diversity transmissions, and intra-band contiguous carrier aggregation, that the antennas typically be co-located (same site).”*

*“In 3GPP RAN, the above-mentioned features are specified to be applied intra-gNB, where the gNB is a logical node. A gNB is then typically implemented within a “base station” that is deployed at a “site”. Although base station antennas of the same “site” can be deployed at different locations within that site, e.g. different corners of a roof, it is correct to assume that the distribution of the reference timing signal would not be required between sites; an intra-site timing distribution would suffice.”*

**Observation- 1: According to earlier clarification in LS to ITU-T Study Group 15 [3] the specified TX diversity, MIMO and continuous CA requirements shall be interpreted as intra site requirements.**

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# 3GPP TSG-RAN WG4 Meeting #87 Ericsson R4-1807182 Busan, South Korea, 21<sup>st</sup>-25<sup>th</sup> May 2018

## 5 Conclusion

In this contribution, we discussed and answers questions in [2] whether existing TX diversity, MIMO and contiguous CA requirement are to be interpreted as intra- site only or also valid for inter-site deployments. We also discuss around the difficulty trying to define a proper TAE for inter site deployments of those services.

Based on our understanding as explained in this paper, we observe the following:

**Observation- 1:** *According to earlier clarification in LS to ITU-T Study Group 15 [3] the specified TX diversity, MIMO and continuous CA requirements shall be interpreted as intra site requirements.*

**Observation- 2:** *The presence of a related MRTD could serve as an indication if a requirement also is valid inter site with non-co-located ARPs. However, a clarification to existing requirements could be beneficial.*

**Observation -3:** *An infinite amount of combinations for TAE,  $\Delta T_{prop}$  and  $T_{channel}$  will fulfil the MRTD equation for the discussed services in an inter-site deployment. None of the parameters can be considered fixed. Taking the multitude of conditions and considerations that impacts the TAE in a complete MRTD budget, it would not be possible nor wise to trying to specify this as a single figure for an inter-site deployment. A figure might not even be sufficient in some cases and over-specified in others.*

Based on our observations we suggest the following proposals:

**Proposal1:** *The specified TX diversity MIMO and continuous CA requirements shall be interpreted as intra site requirements and a clarification in [1] could be beneficial.*

**Proposal2:** *For reasons mentioned and highlighted in observation 3 it is neither possible or beneficial specifying a TAE for TX diversity, MIMO and continuous CA in an inter-site deployment i.e. proposal is following LTE and not specify this in NR.*

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## 4 Inter site requirements

For inter site, a reasonable large  $\Delta T_{prop}$  needs to be allocated to prevent limiting the service to a small area.

Maintaining the specified 65ns at the receiver for an inter site for distributed ARP deployment would even with an unrealistic ideal TAE=0 \* still only allow  $\sim\pm 10m$  service area from a symmetric midpoint due to  $\Delta T_{prop}$  see Figure 1.

\*Note: Trying would drive product, installation and maintenance cost and since lack of holdover margin result in reduced service availability

One could conclude that for 65ns even with an unrealistic ideal TAE, the actual service area would be very limited due to the small allowed  $\Delta T_{prop}$  which of course also would be an issue for mobility.

A TAE  $\neq 0$  will simply offset and move the timing centre point closer to the base station with the “late” timing, at this new centre point there will be a  $\Delta T_{prop}$  and related pathloss difference/asymmetry. A path loss difference normally causes a received power difference that normally should be limited i.e. both a timing window and power window must be considered for the service.

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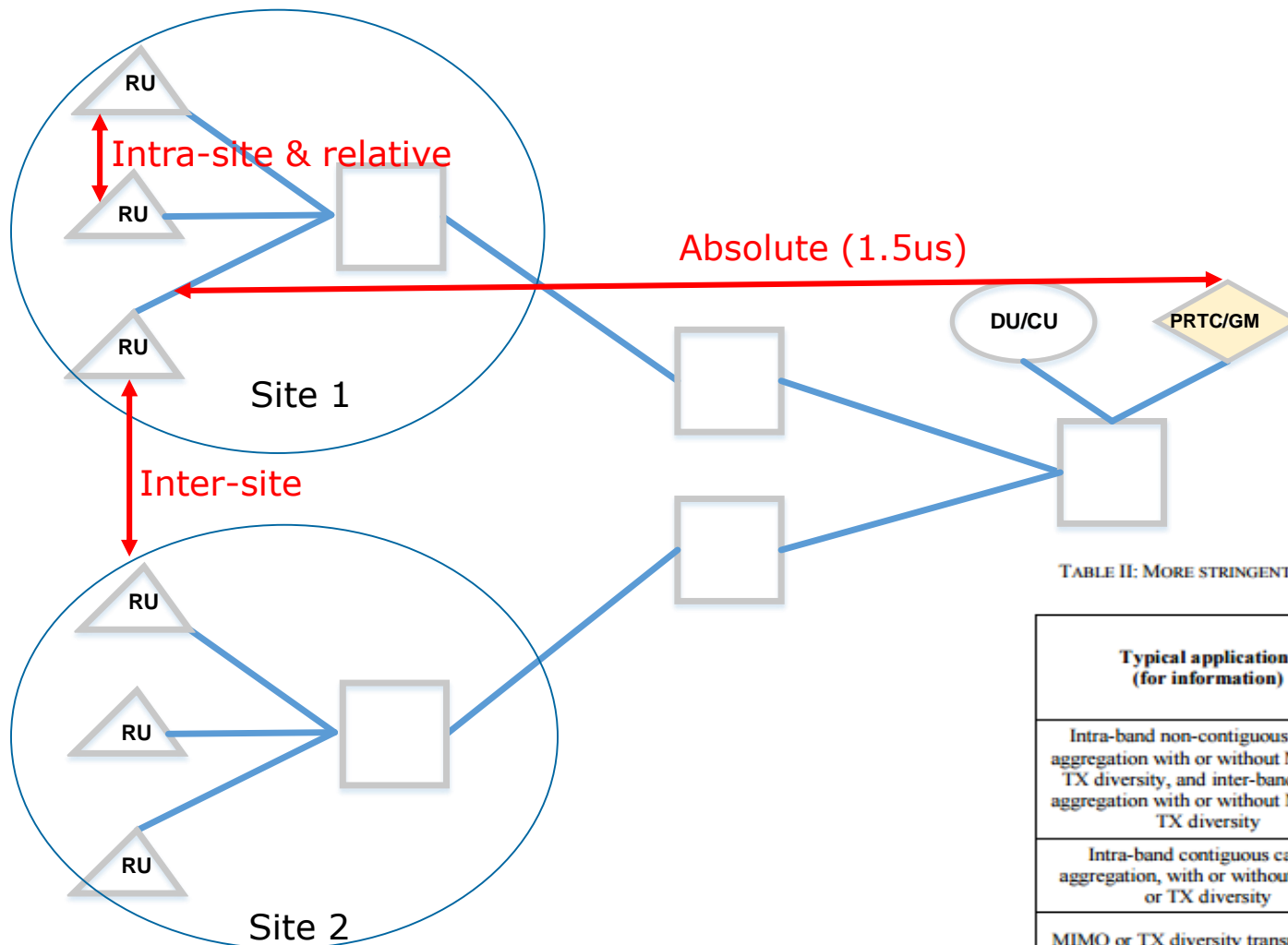


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# eCPRI Specification v1.1(2008-01-10)

## 3.4. Synchronization Plane

The eCPRI nodes shall recover the synchronization and timing from a synchronization reference source, and the air interface of the eRE shall meet the 3GPP synchronization and timing requirements. The synchronization information will not be transmitted via the eCPRI specific protocol. The details of this information flow are out of the scope of the eCPRI specification. This information flow can use existing protocols (e.g. SyncE, PTP) but any other solution is not precluded.

The synchronization information flow will be considered as time-critical and will utilize a small part of the total bandwidth between eCPRI nodes.

# Conclusion

Most case of Fronthaul deployment are small networks

Latency constraint

Recommendation to keep current IEEE 1914.1 sync requirements as they are inclusive of larger number of use cases

Neutral and open approach

Add a note stating that ITU-T G8275.1 protects against PDV when it is a source of performance degradation

Further studies are needed on ITU-T G.8275.1 & G8275.2 perf aspects (Clock)

- Examples: PDV impact at 100G, PTP interoperability on 100G links, PTP performance on 100G links, asymmetry on 100G (timestamping, PHYs, fibers, etc)