

EVOLUTION OF SYNC STANDARDS- ADDRESSING REAL DEPLOYMENT NEEDS

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- › Background
- › Deployment issues
- › Status with PTS / APTS; what is missing
- › Other Initiatives
- › Conclusions



TIME SYNC NEEDS



- › Mobile networks sync needs have traditionally been driving most of the activities in the standardization bodies
 - TDD, eICIC, CoMP, Dual Connectivity ...
 - Generally in the microsecond range, 5G may need much tighter requirement



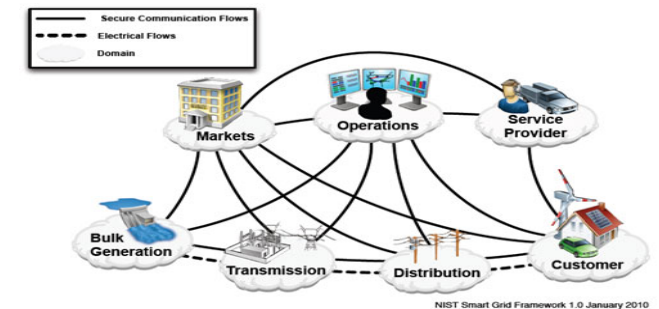
- › Emerging needs

- Financial, Power, Intelligent Transportation Systems
- Most stringent requirements are in the microseconds, however great variation (up to ms)



- › Originally only in North America and China.

- › The need is spreading also in other parts of the world
- › Increased interest as moving towards 5G



TIME SYNC MASTERS AND DISTRIBUTION



- › Solutions: GNSS, PTP, Others ...
- › Status ?

– Traditional approach: GNSS

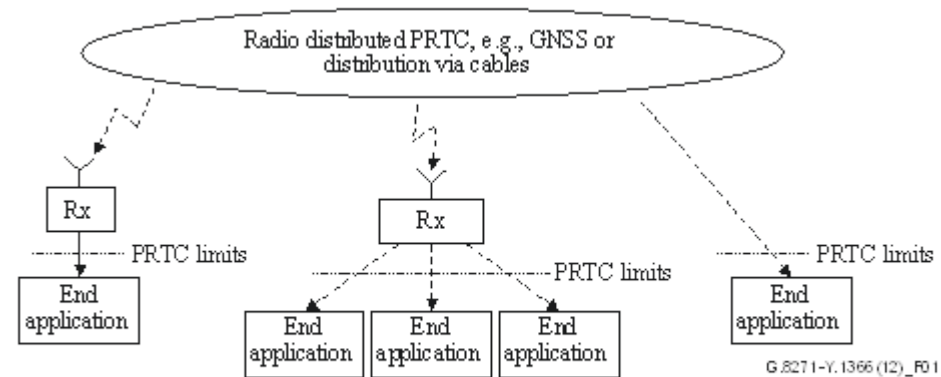
- › Need to complement with other solutions (vulnerability, visibility of the sky)

– PTP as main approach to distributed accurate time sync :

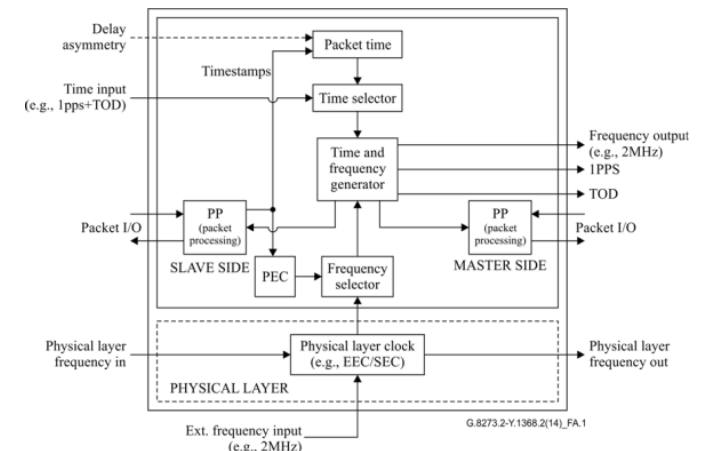
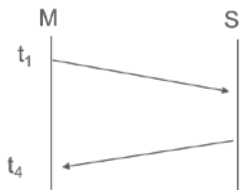
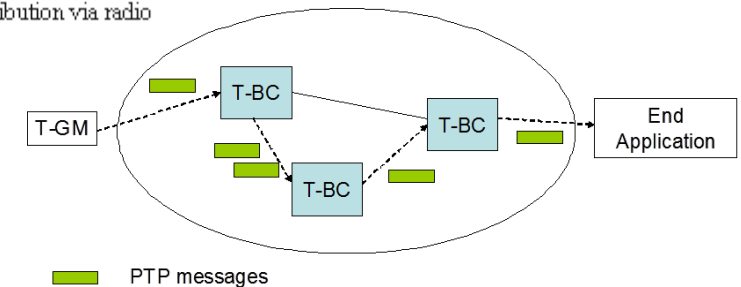
- › Full support and Partial timing support
- › Fundamental assumption for symmetric path
 - Need to control variable and static asymmetries;
- › With SyncE (fully standardized) / without SyncE (under study)

› SyncE

- It provides only frequency, but it can be used to complement PTP
 - › e.g. enhanced stability and/or enhanced time sync holdover
- Need for «full support»



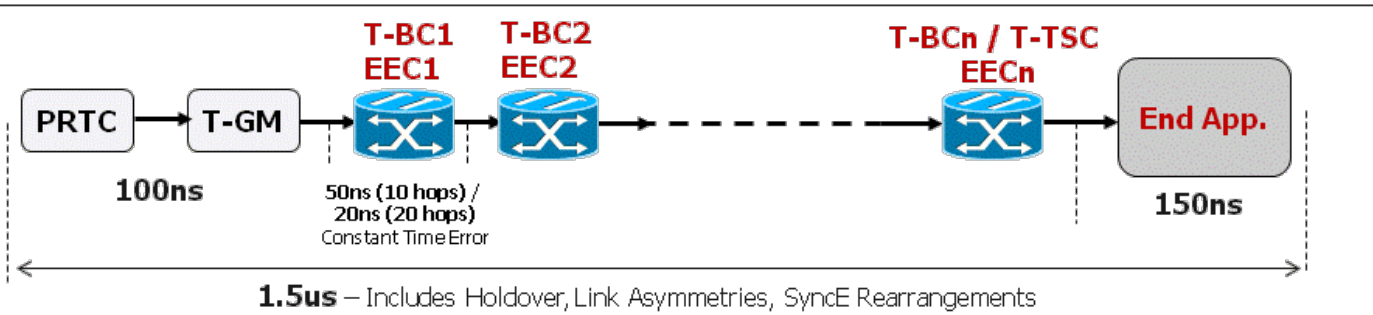
-----> Time or phase synchronization distribution via cable
 - - - - -> Time or phase synchronization distribution via radio



WHY PTP WITH FULL TIMING SUPPORT (FTS) ?



- › Packet-based method with *timing support from the network*
 - All the network nodes on the path of the synchronization flow implement BC or TC
- › Work focused on this approach first
 - Need to remove dependency from traffic conditions; analogous to SDH analysis
 - › Chain of equipment with well defined performance. Possible to predict worst case at the output of the chain
 - Expected higher performance
 - Note: static assymetries due to link still relevant ...

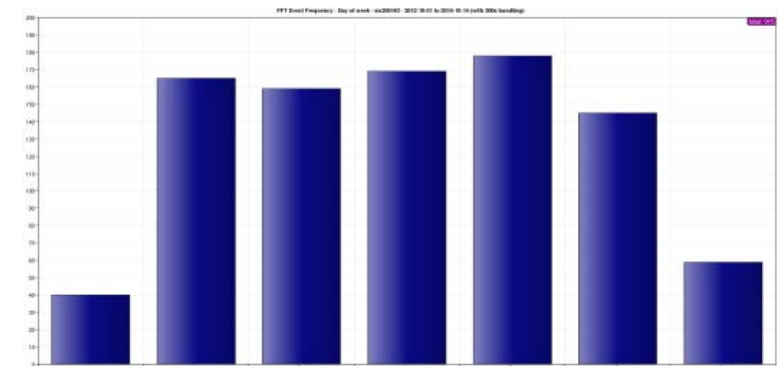


Budget Component	Failure scenario a)	Failure scenario b)	Long Holdover periods (e.g., 1 day)
PRTC (ce_{ref})	100 ns	100 ns	100 ns
Holdover and Rearrangements in the network (TE_{HO})	NA	400 ns	2'400 ns
Random and error due to synchronous Ethernet rearrangements (dTE')	200 ns	200 ns	200 ns
Node Constant including intrasite (ce_{ptp_clock})	550 ns (Note 1)	550 ns (Note 1)	550 ns (Note 1)
	420 ns (Note 2)	420 ns (Note 2)	420 ns (Note 2)
Link Asymmetries (ce_{link_asym}) (Note 3)	250 ns	100 ns	100 ns
	380 ns	230 ns	230 ns
Rearrangements and short Holdover in the End Application (TE_{REA})	250 ns	NA	NA
End application (TE_{EA})	150 ns	150 ns	150 ns
Total (TE_D)	1'500 ns	1'500 ns	3'500 ns (Note 4)

GNSS VULNERABILITY



- › In addition to traditional concerns of installation and visibility of sky, recent increased concerns in terms of vulnerability
- › The use of GNSS jammers are increasing
- › Jamming events and failure from last January reported at this conference
- › *Important to define back up alternatives and add redundancy to GNSS*



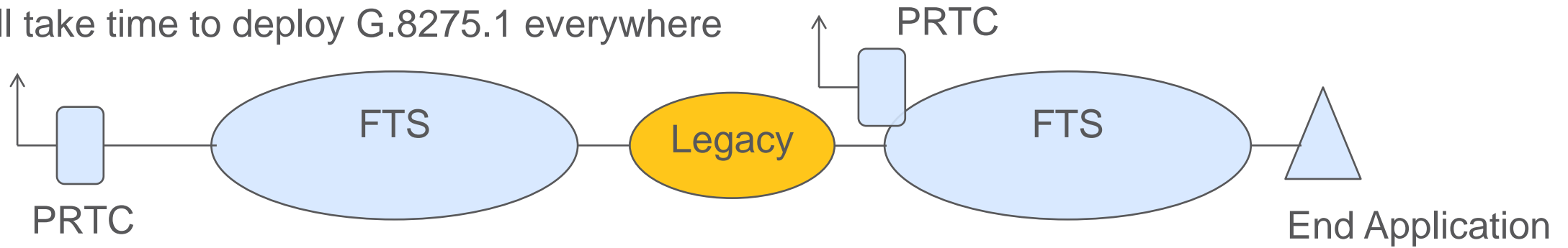
GPS Jamming Events by day
From C. Curry, ITSF 2014

1588 EVERYWHERE ?



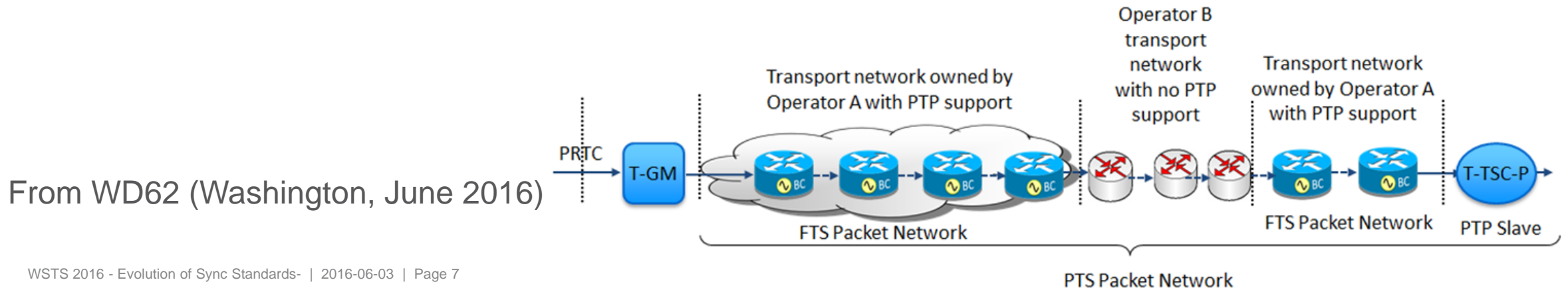
- › Operators will have to address legacy deployments (with no PTP support) for quite some time

- It will take time to deploy G.8275.1 everywhere



- › Interworking between operators will need to be addressed

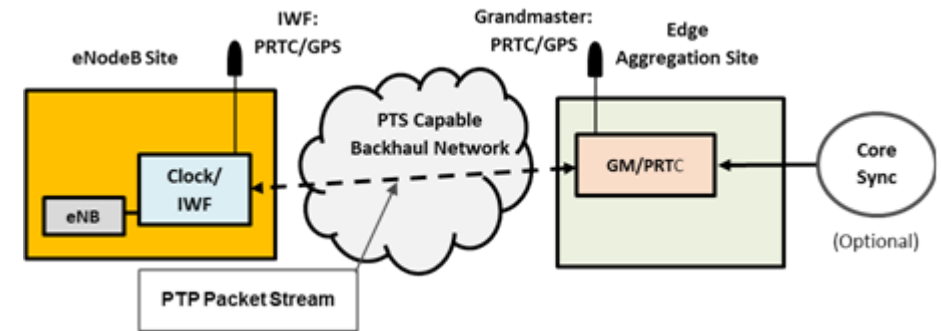
- A full timing support in general implies a single administrative domain (use of TC in this application is still being questioned)



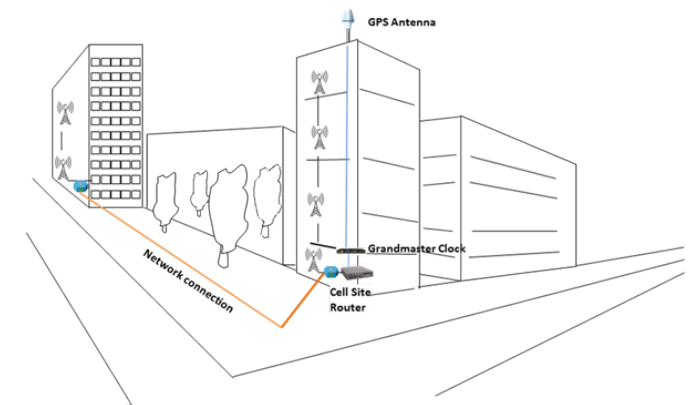
PTS / APTS : REQUESTS FROM OPERATORS



- › Contribution from Sprint and other operators in 2012 triggered the start of work on partial timing support
 - Assisted Partial Time Support (APTS) as main use case (GPS back-up)
- › AT&T contribution to address a partial timing support, but in a small network
 - The proposal focused on indoor (mall, campus, stadium) applications
- › Ongoing Debate on pure Partial Time Support (PTS):
 - However other operators are also interested in GPS back-up (APTS) no issue with static asymmetry in this case



From WD25 (Q13, Kansas City, 2013)



From WD20 (Q13, Sophia Antipolis, 2013)

PTS / APTS STATUS, 1



- › Profile (8275.2) just consented (February 2016)
- › Long debate on simple vs. more sophisticated BMCA solution (allowing for BCs)
- › Main Characteristics of the profile
 - IP Unicast
 - BMCA similar to 8275.1
 - Possibility to exchange messages irrespective of the port state
- › Some aspect still missing in 8275.2 and in general in the APTS /PTS studies, see also next slide :
 - Guidelines on the use of BCs
 - Performance aspects
 - Clock requirements
 - Details on Grand Master redundancy

PTS / APTS STATUS, CONT.



› Network Limits :

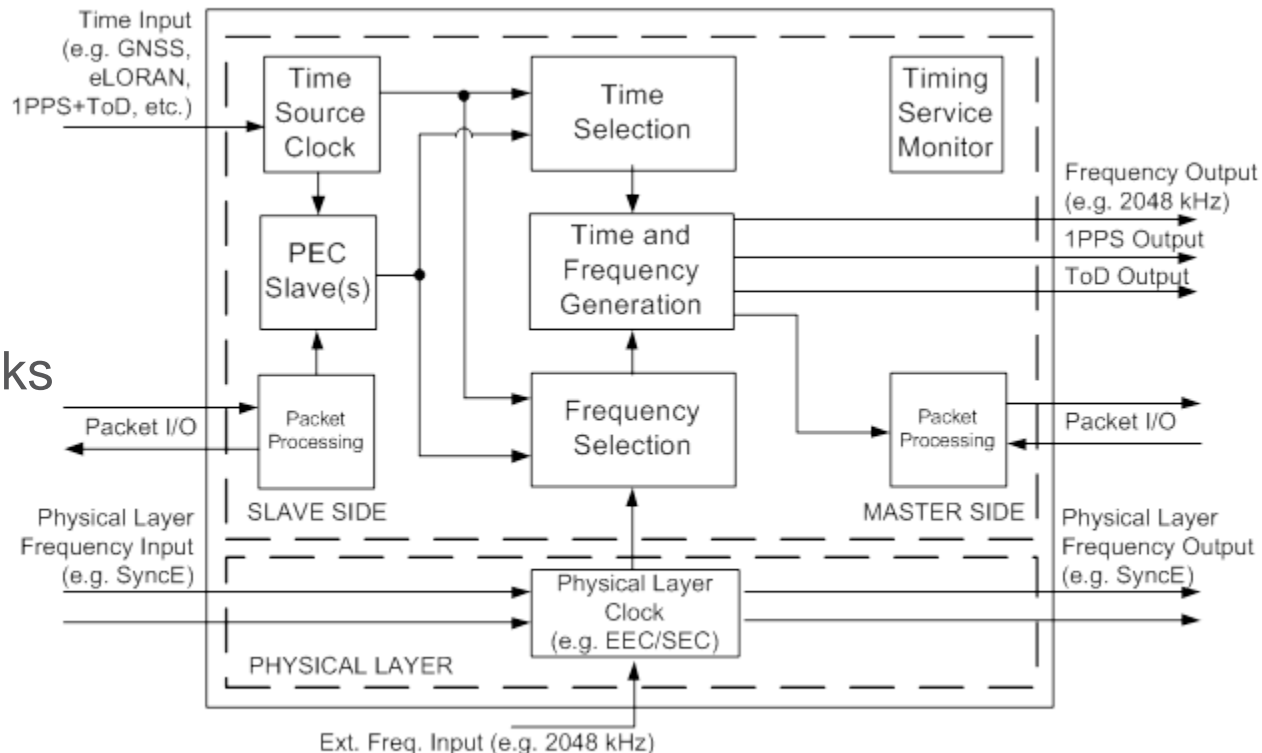
- Initial agreements on metrics and network limits/budgeting

› Clock Requirements

- G.8273.4 will include all requirements for partial timing support telecom boundary clocks and telecom time slave clocks

› HRM (Hypothetical Reference Model)

- HRM needs to be defined and simulations will be required to be able to define the characteristics of the clocks (e.g. T-BCs)



PTS / APTS VS. FTS

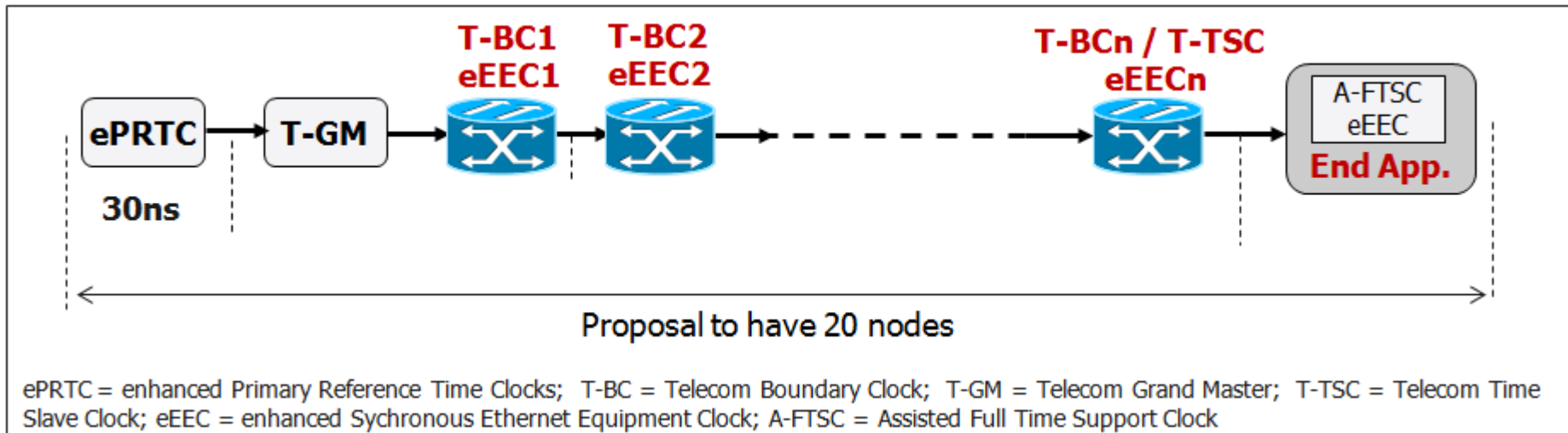


- › APTS (and PTS) is not equivalent to FTS
 - Applicable to different use cases
- › FTS provides a predictable performance (network limits, clock requirements, well defined network)
- › APTS: only as back up to GNSS
 - Static asymmetry is not an issue
 - Control of dynamic noise and variable asymmetry requires careful planning
- › PTS: major issue, no control of static asymmetry. Other means are needed (at installation?). Similar problems in terms of Control of dynamic noise and variable asymmetry
 - Performance is still under study

ASSISTED FTS ?



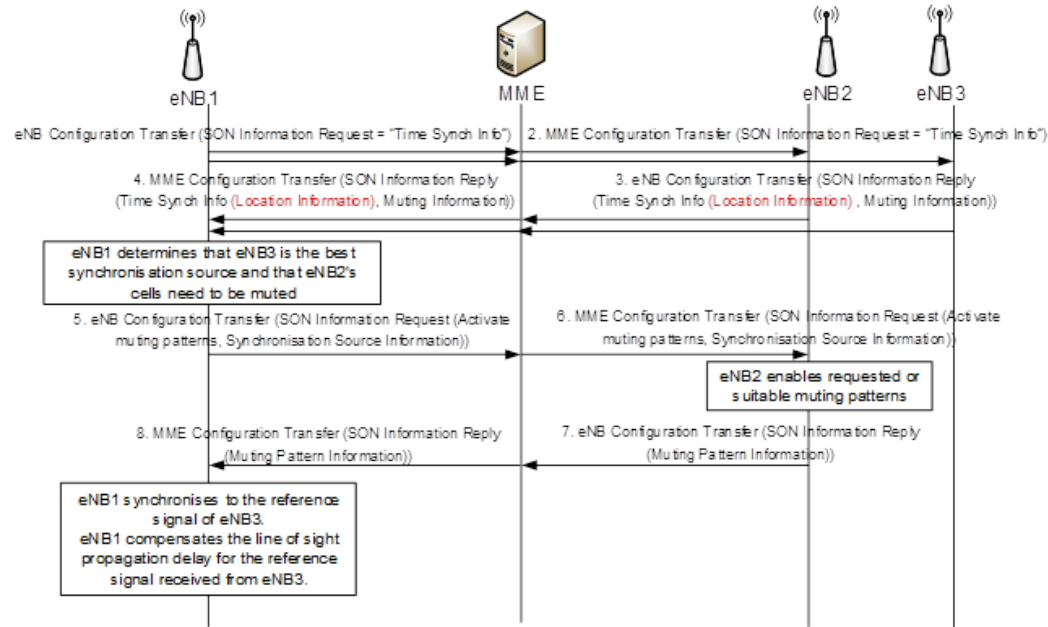
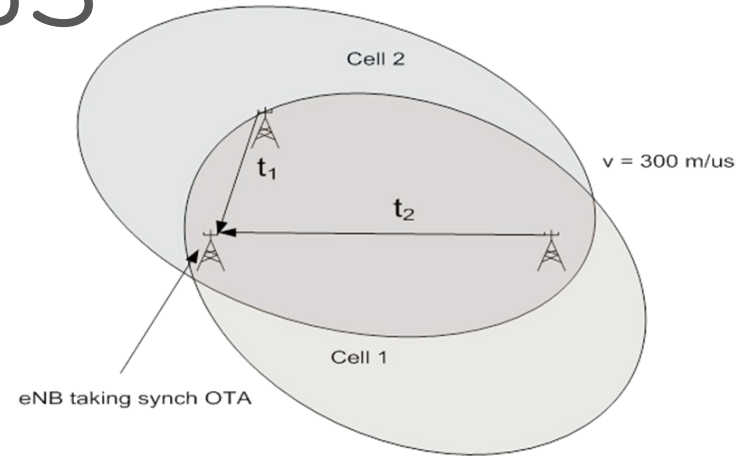
- › Recent proposal for assisted FTS (DT)
- › A new Class of Telecom Boundary clock (T-BC class C), enhanced Synchronous Ethernet and enhanced PRTC to be used for this application
- › FTS with GNSS to achieve even better accuracy
 - Can be used for GNSS backup with a $\max|TE|$ of 100ns



OTHER INITIATIVES: RIBS



- › RIBS (Radio Interface Based Synchronization) being standardized at 3GPP
 - synchronization over the radio interface (“Network listening”, originally to address TDD femtocells needs, TR 36.922)
 - signaling messages specified in TS 36.413 and TS 32.592
- › To address the case when the network does not allow accurate timing distribution
 - Internet-grade backhaul
 - partial timing support / legacy deployments



- › TR 36.898, Network Assistance for Network Synchronization with Solutions to improve the performance being evaluated:
 - Solution #1: Network based solution using detection of UE transmission
 - Solution # 2: OTA Synchronisation with Propagation Delay Compensation
 - Solution # 3: OTA Synchronisation with Propagation Delay Compensation Based on Timing Advance
 - Solution # 4: Propagation Delay Compensation for RIBS Based on Location Information Exchange

OTHER INITIATIVES: MEF, IEEE, ...



› MEF/BBF:

- TR221,
- MEF 22.2.1, Implementation Agreement on Mobile Backhaul Phase 3 Amendment 1
- addressing request from operators to define well specified functions and related performance at the relevant network interfaces
- Generally relying on ITU-T sync solutions (e.g. Telecom Profile)

› IEEE 802.1CM: fronthaul sync

- Ongoing discussions with initial set of requirements (from CPRI) and potential solutions (e.g. Telecom PTP profile with a specific HRM)

- › Other industries may have specific PTP profiles, e.g. Power profile

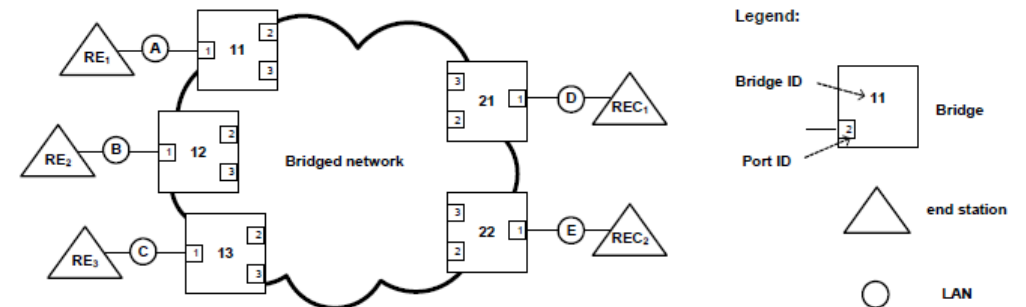
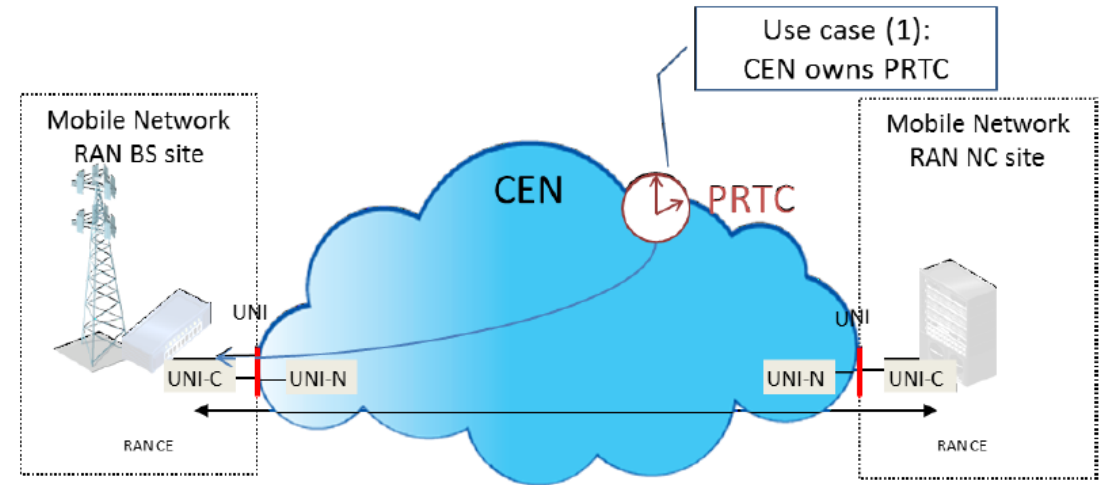


Figure 5-2—Fronthaul network

CONCLUSIONS



- › Emerging and increased needs for time sync
- › Work in the standards important for interoperability and performance, and for the success of a specific technology
- › Important to get input from network Operators
 - Often different needs and requests have to be accommodated
- › Network migration, legacy deployments, interworking between different operators network need to be addressed
- › Assisted partial timing support as an example of meeting the needs of specific geographical areas, but finding applications worldwide
- › Important to understand the fundamental differences between FTS and PTS / APTS
 - They are not equivalent. Applicable to different applications / networks
- › Not a single solution fits it all ...

REFERENCES



- › Packet Timing in ITU-T: ITU-T G.826x series, G.827x series,
- › ITU-T general definitions: G.810, G.8260
- › PTP: IEEE 1588-2008
- › RIBS: 3GPP TR 36.898, Study on Network Based Synchronization for LTE