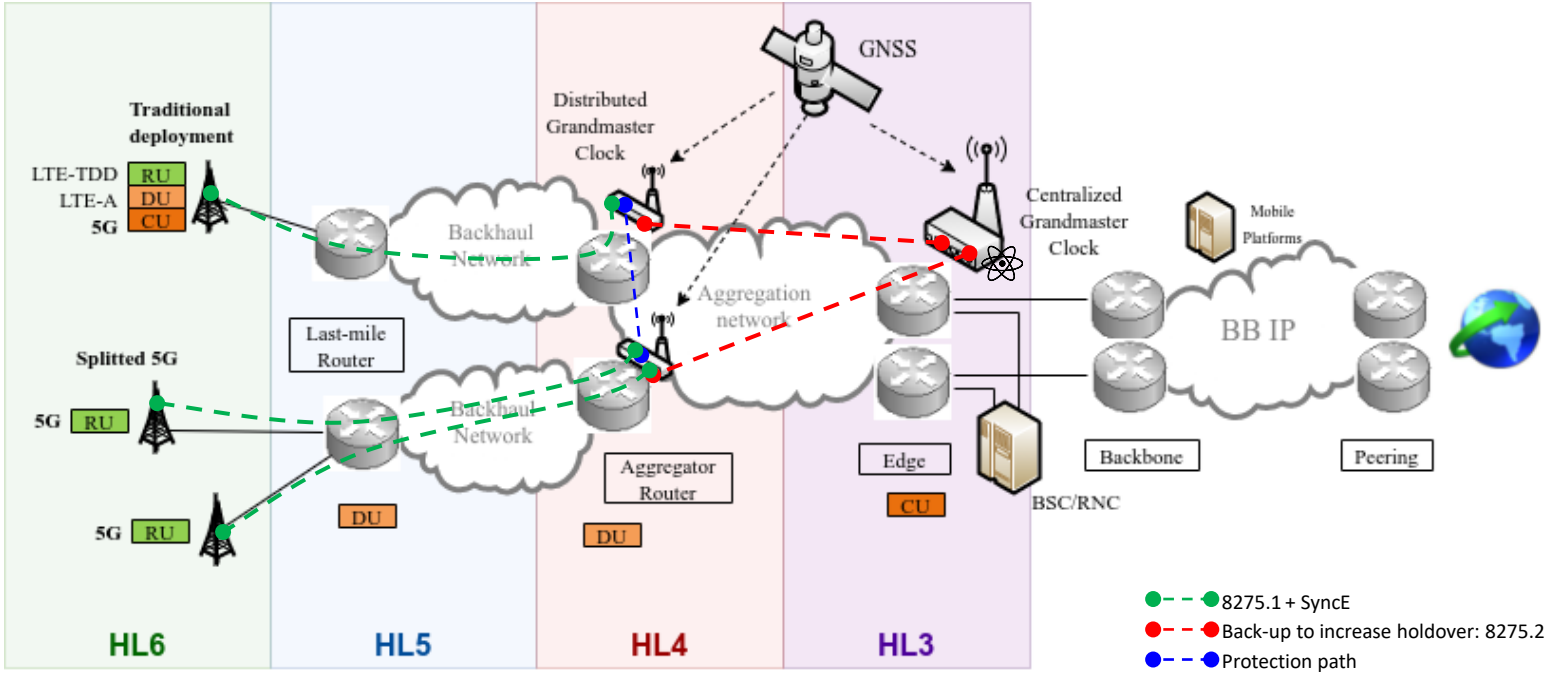
SEVEN Solutions

High Accuracy Time Distribution in Telecom

Why and Where?

Typical network architecture

Distributed Grandmaster clocks



Based on *I. De Francesca (Telefonica) @ ESA NAVISP thematic open calls «PNT in 5G», 21/10/2020*

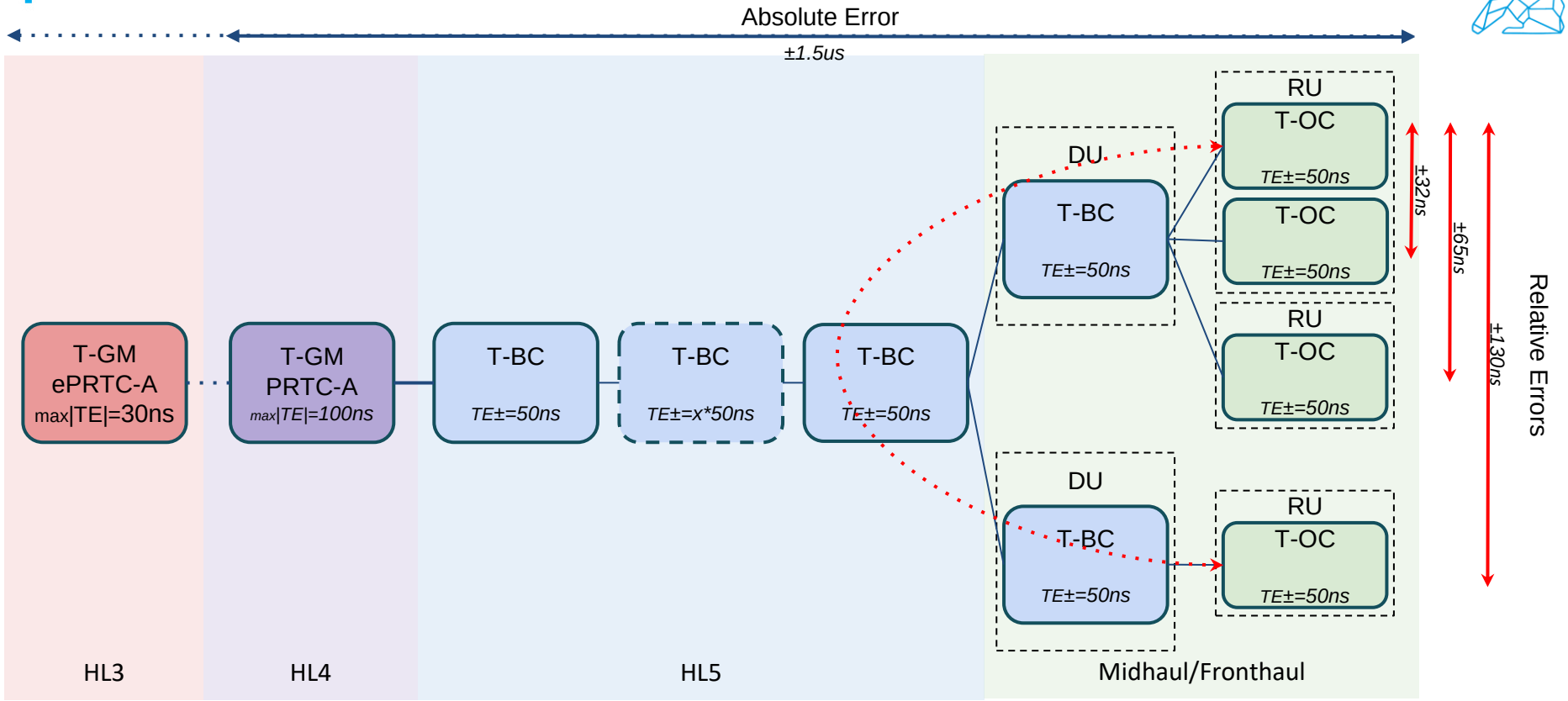
New 5G requirements

Allowing new applications

Tech / Application	Time-error	
RU-GMC (DU-GMC)	+/- 1.5 µsec (+/- 1.1 µsec)	*Absolute*
Intra-band non-contiguous CA	+/- 130 nsec	*Relative*
Inter-band CA	+/- 130 nsec	*Relative*
Coordinated Multi-Point (CoMP)	+/- 130 nsec	*Relative*
Intra-band contiguous Carrier Aggregation (CA)	+/- 65 nsec	*Relative*
MIMO / Transmit Diversity (Cat A+)	+/- 32 nsec	*Relative*
High-Accuracy Positioning Services (same DU)	10 nsec	*Relative*
Self-driving / Autonomous car	< 5 nsec	*Relative*

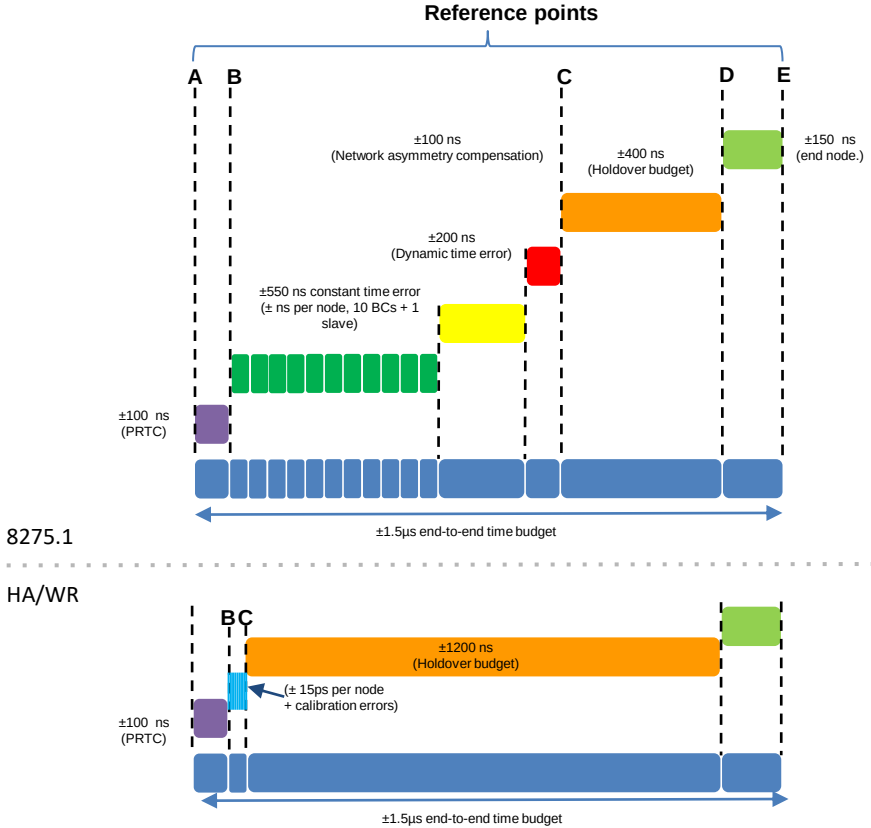
Relative VS Absolute

Where?



8275.1 vs HA/WR : Timing budget

Reducing timing budget at each hop allow to increase reliability



~[6-8] hours in HO

~[20-25] hours in HO

ITU-T 8275.1 vs PTP-HA (WR)

What are the key differences….

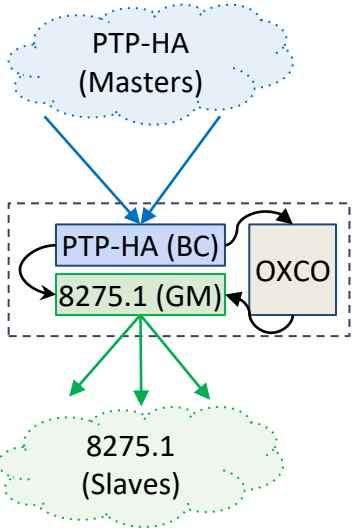
	8275.1	WR/HA
Does not need specific Hardware for each node	✗	✗
Needs L1-sync frequency synthonization	✓	✓
Independant Phase & Frequency	✓	✗
Phase-tracking	✗	✓
Precision for each hop	±16ns	±15ps
Enhanced calibration (PHY and link asymetrie)	✗	✓
Support all features of IEEE-2019	⚠	✓
Timing & 10G/40G/100G data traffic on the same network	+	✗
Compatible with many vendors	✓	⚠

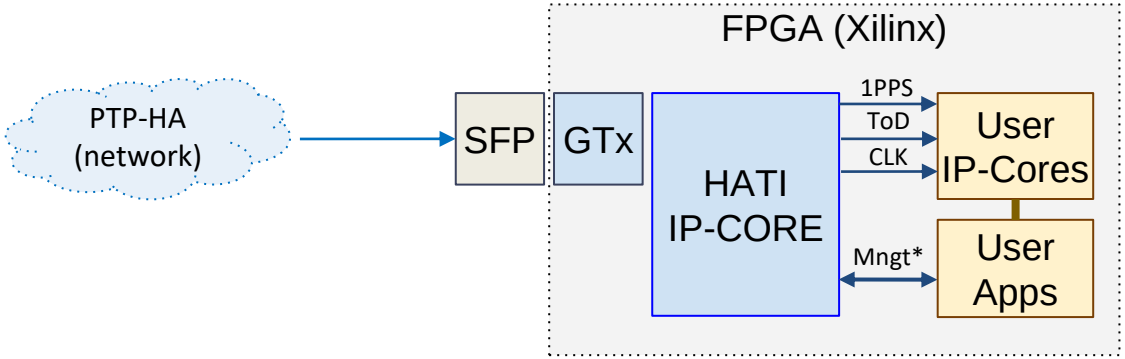
Interoperability

When PTP-HA meets third party devices

WR-PTP requires a specific hardware to track the phase. How to benefit from its performance in other hardware?

- PTP-HA in upper layer fully compatible to act as a 8275.1+SyncE GM (forwarding PTP clock Quality)
- Integrating using HATI (High Accuracy Timing IP) IP-CORE into FPGA of 3rd party devices





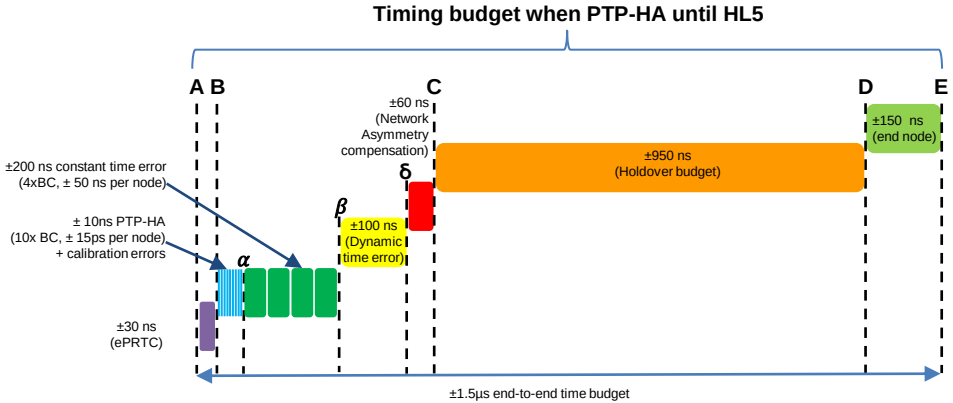
Bring ePRTC specification nears final-node

The trade-off between accuracy/reliability VS price

Using PTP-HA from ePRTC (HL3) until:

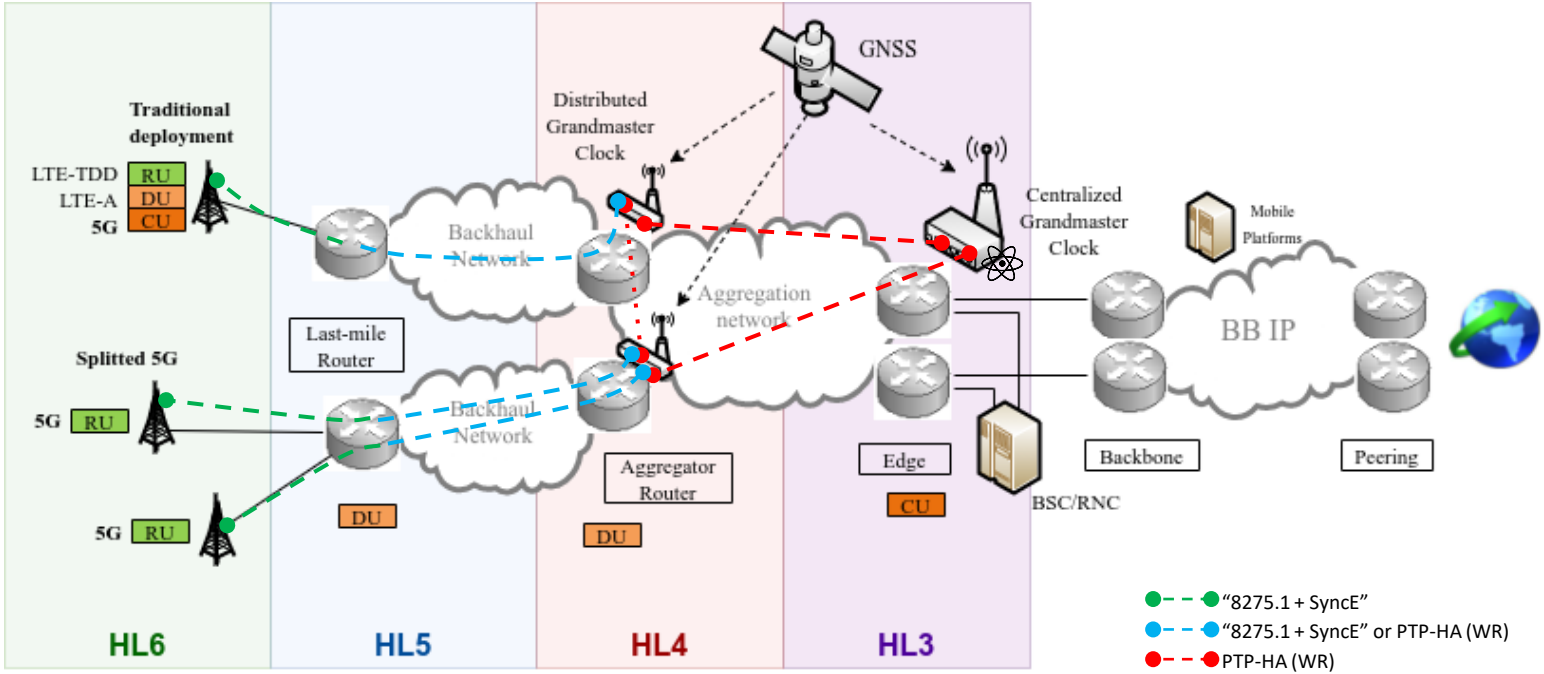
- HL5 levels (Only last hop using 8275.1)
- HL4 levels (PRTC ⇛ ePRTC)
- HL3 levels (linked GNSS ⇛ cnPRTC)

ePRTC is the best way to protect against long-lasting solar flare events



Typical network architecture (II)

Bringing ePRTC specifications near final node



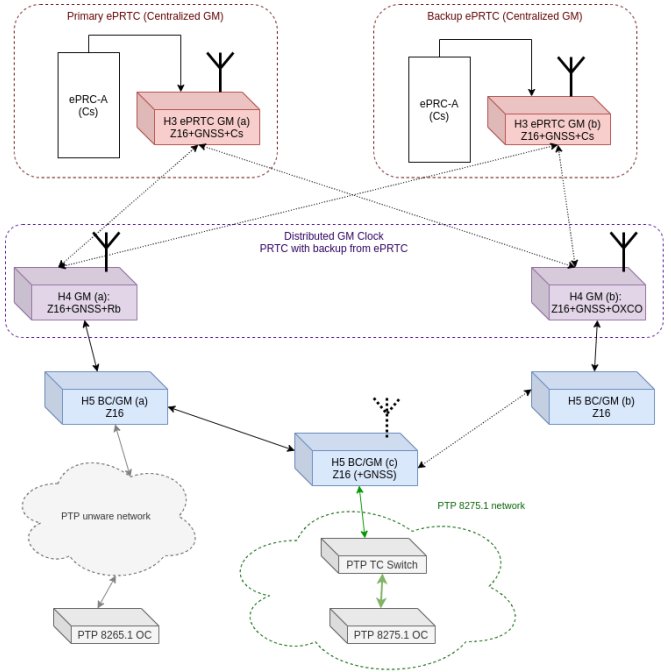
Combining GNSS & PTP-HA

*ROOT project: **R**olling **O**ut **O**SNMA for the secure synchronization of **T**elecom networks*

To ensure failing-over the next timing source the GNSS receiver should implements best-in-class algorithms to handle a **fast** and reliable Spoofing/Jamming detection.

- Multi-band & multi-constellation
  - Ionosphere variation
- GNSS OSNMA Authentication
- Interference detection algorithms

The objective of ROOT project is to simulate spoofing/jamming attacks on a reference 5G architecture at Telefonica Labs.



ROOT
Rolling Out OSNMA for the securesynchronization of Telecom networks

https://www.gnss-root.eu/

This work was developed within the ROOT project (www.gnss-root.eu) funded by the European GNSS Agency under the European Union's Horizon 2020 – G.A. n. 101004261.

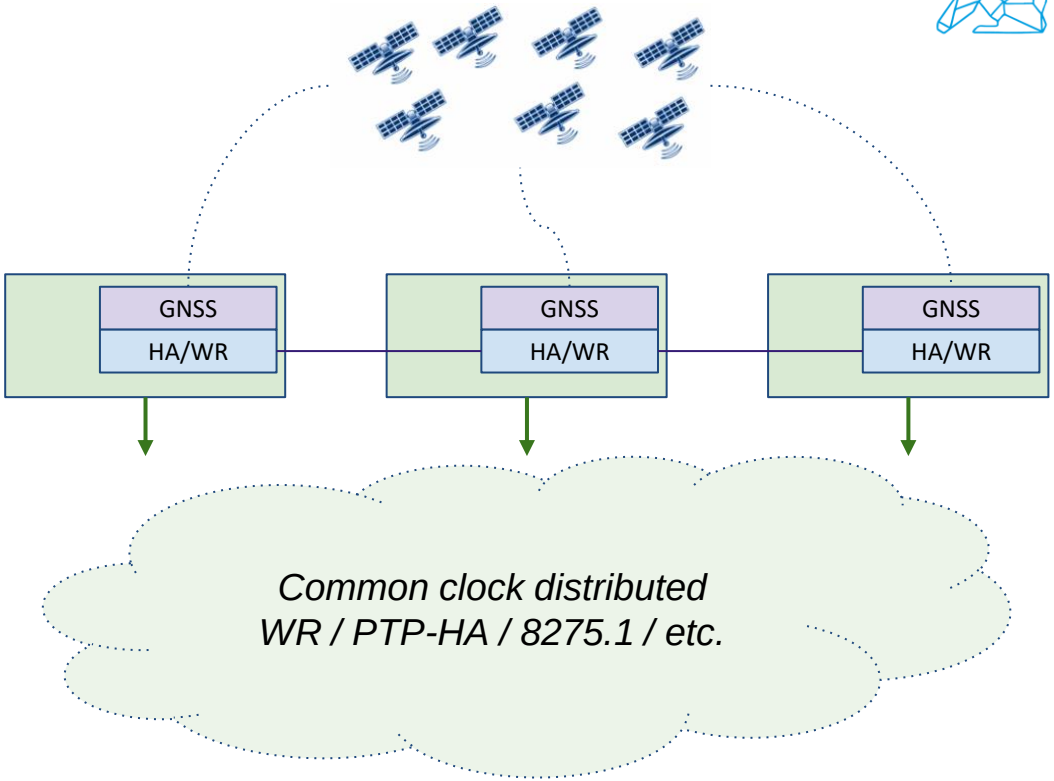
Linked GNSS

Combining PTP-HA and GNSS to get the best of both worlds

- Fiber calibration correction algorithm to improve accuracy
- GNSS calibration and accuracy improved based on common view

↓

Addressed both PTP and GNSS potential vulnerabilities

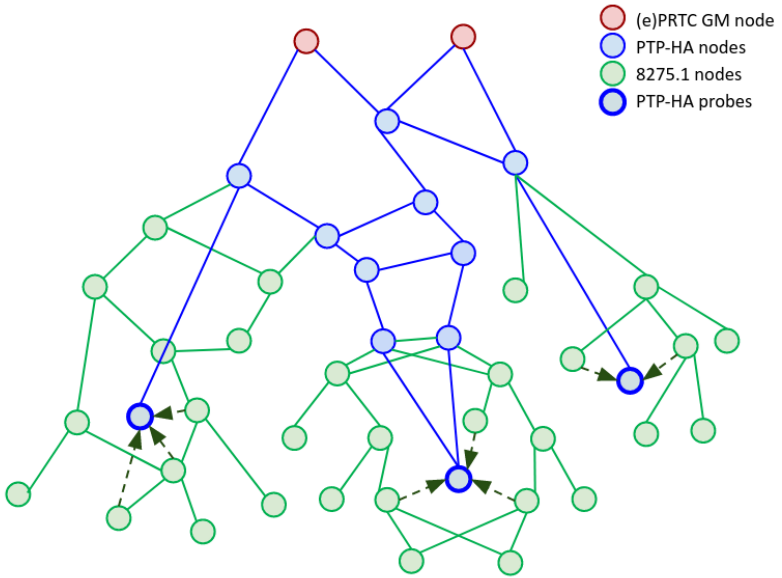


Supervision & Monitoring

Monitoring multiple PTP sources by devices synchronized through PTP-HA

- Finally PTP-HA can be used in critical places to supervise the synchronization through standard ITU-T 8275.1 as its performance are at least 10 times better than PTP+Sync-e

- Ultra Reliable Low Latency Communications (URLLC) are an emerging trend in 5G technology. Even if those does not directly needs PTP-HA performance, it seems that monitoring their performance to nanoseconds level seems appropriate.



Wrap-up: Key Benefits

Sub-nanosecond accuracy through PTP-HA (WR) allow to....

Increase Holdover budget

By consuming little timing-budget at each hops, PTP-HA allows more time in holdover without compromising the total timing budget (1.5us)

Linking GNSS

The accuracy of PTP-HA allows to connect and compare GNSS receiver between them to detect abnormal behaviour

Supervising ITU-T PTP

Real-time multi-source timing comparison benefiting from the accuracy of PTP-HA. Improved traceability, resiliency and guaranteed assured PNT

Future proof solution

Targeting sub-nanosecond to distribute timing through 5G RAN allow to target future applications such as positioning

SEVEN
Solutions

Seven Solutions

Border areas

When relative becomes absolute