Intro

High Accuracy Time Distribution in Telecom

Why and Where?

Francisco Girela
Americas White Rabbit Tech Responsible

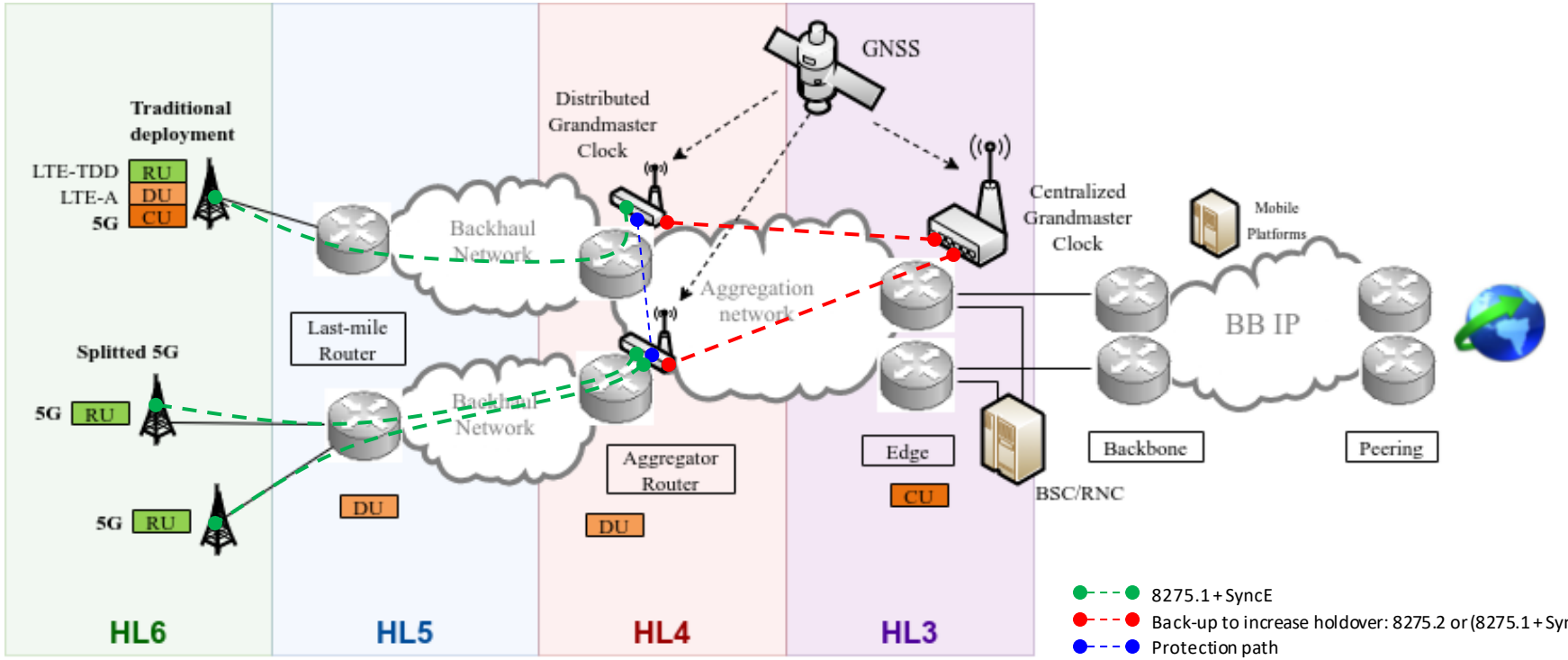
WSTS 2022

WORKSHOP ON SYNCHRONIZATION AND TIMING SYSTEMS
MAY 9-12, 2022 | DENVER, CO

Introduction

Typical Network Architecture

Distributed Grandmaster Clocks



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

Introduction

New 5G Requirements

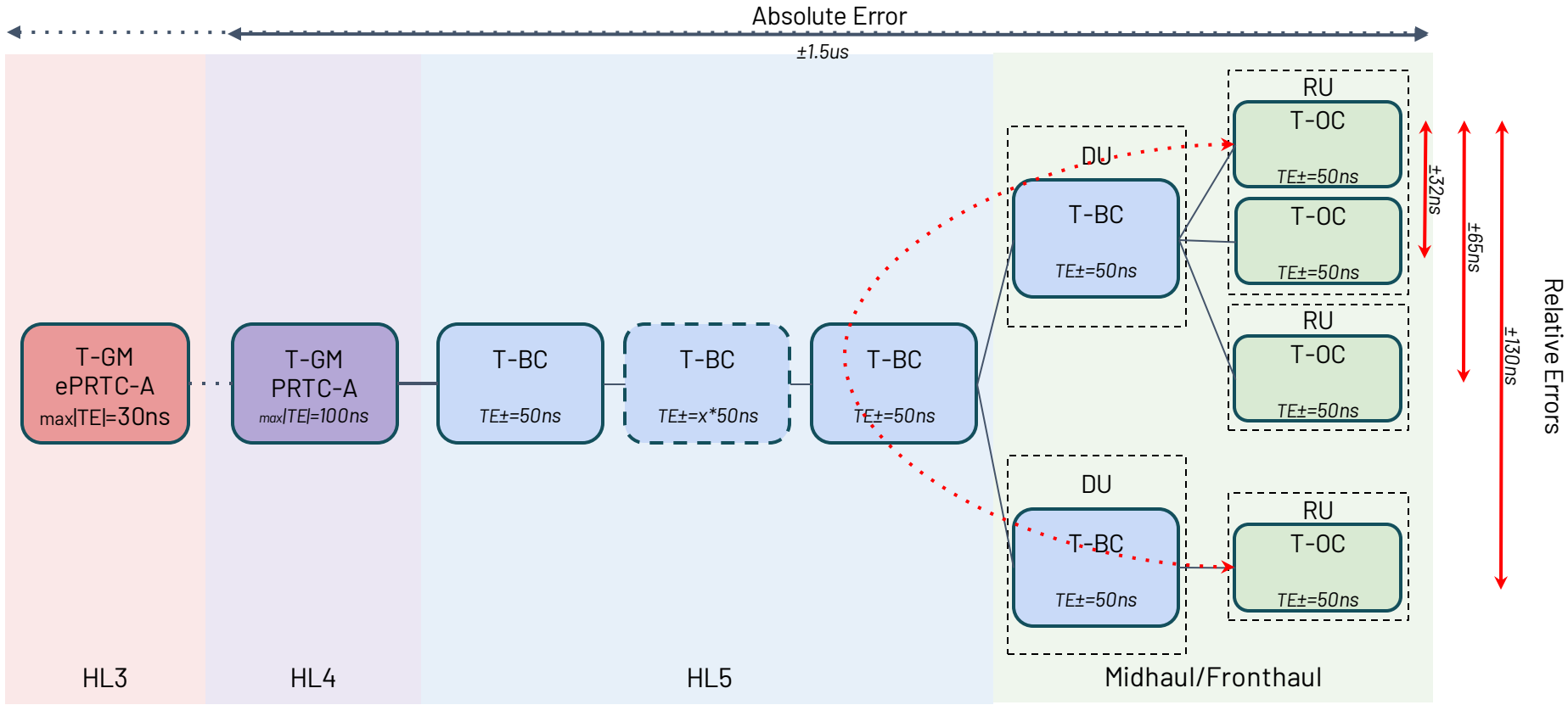
Allowing new applications

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*

Introduction

Relative VS Absolute

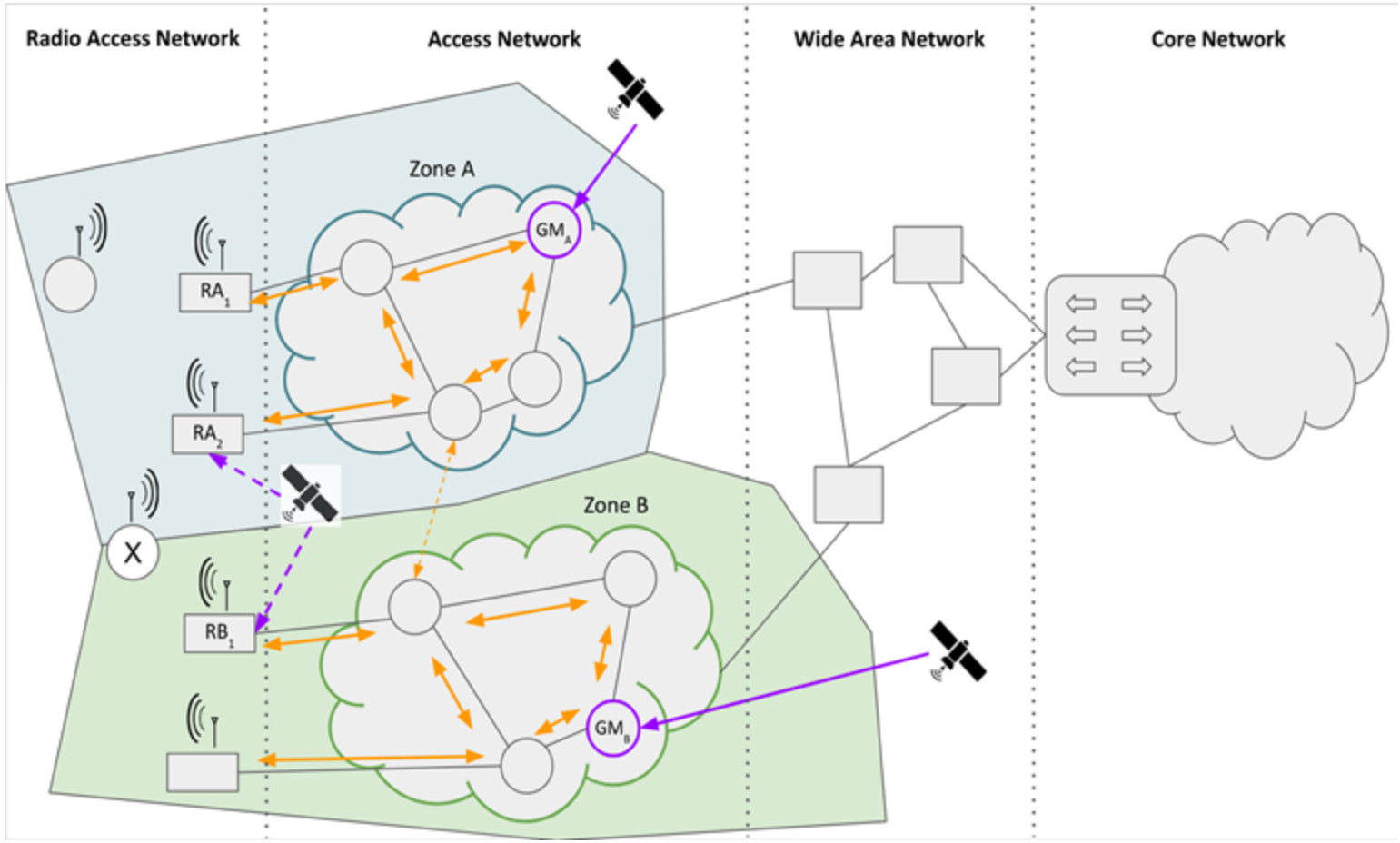
Where?



Introduction

Border Areas

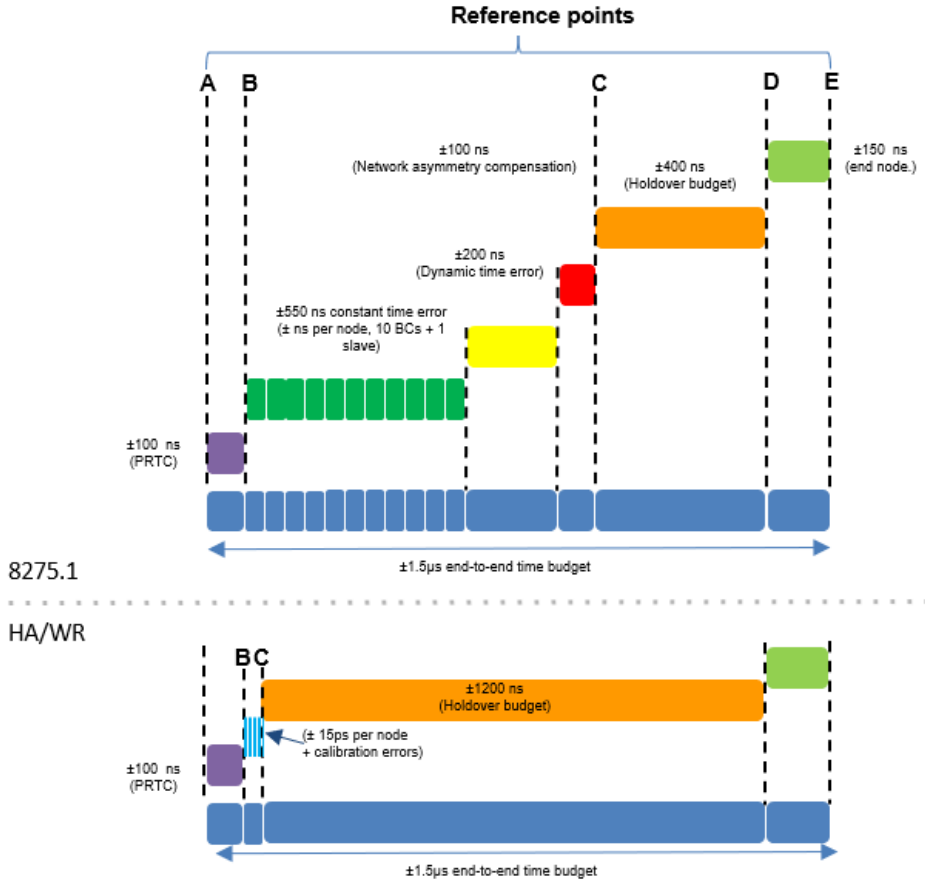
When relative becomes absolute



HA/WR vs PTP

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

HA/WR vs PTP

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 asymmetry)	✗	✓
Support all features of IEEE-2019	⚠	✓
Timing & 10G/40G/100G data traffic on the same network	+	✗
Compatible with many vendors	✓	⚠

orolia

HA/WR &

PTP

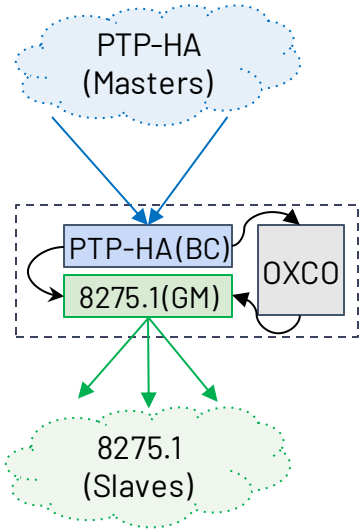
Interoperability

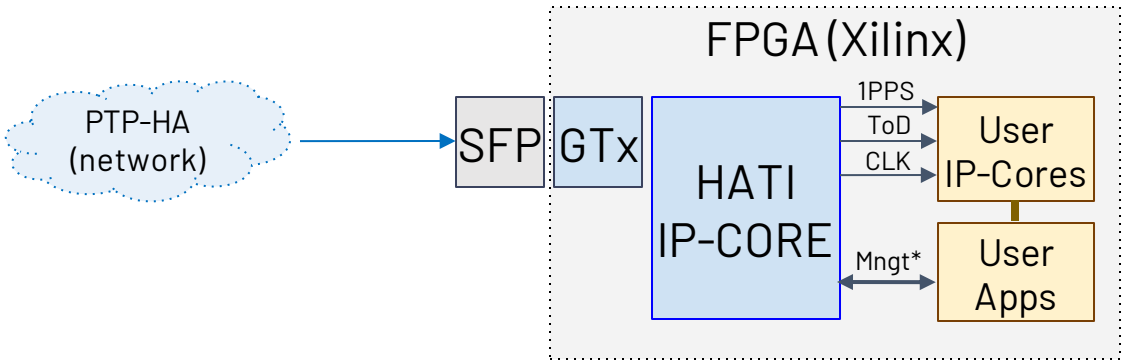
When PTP-HA meets third party devices

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





HA/WR &

PTP

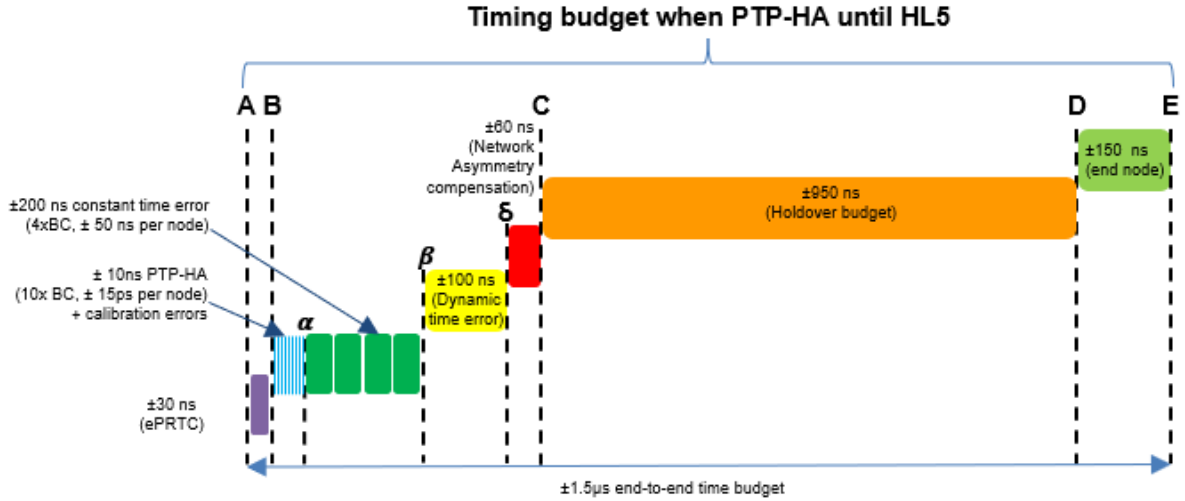
Bring ePRTC specification nears final-node

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

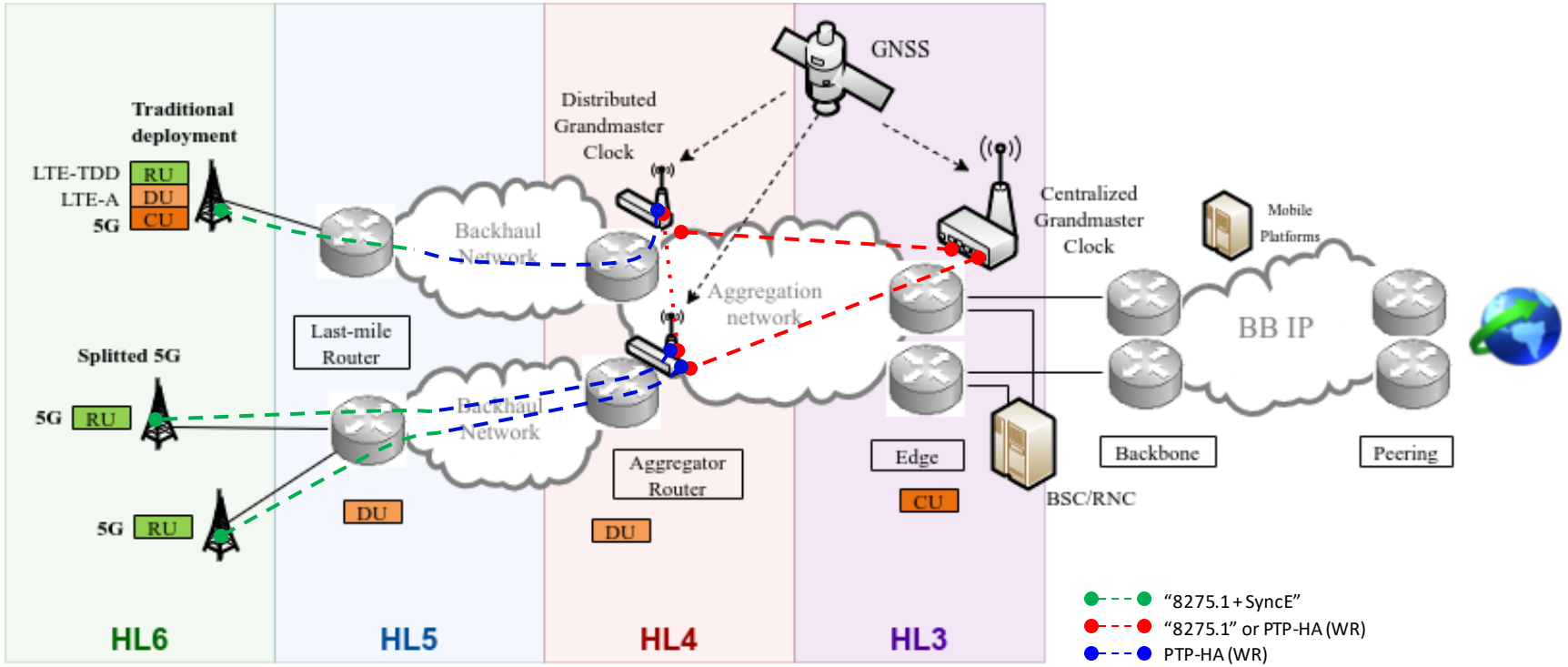


HA/WR &

PTP

Typical network architecture (II)

Bringing ePRTC specifications near final node



cnPRTC

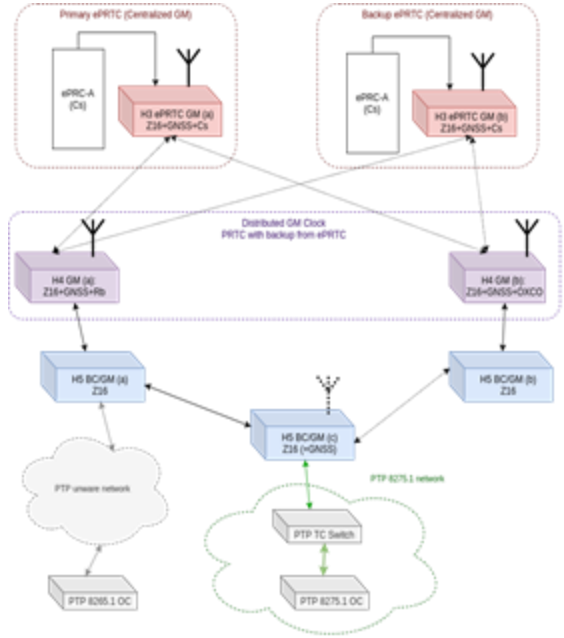
Combining GNSS & PTP-HA

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.



orolia

cnPRTC

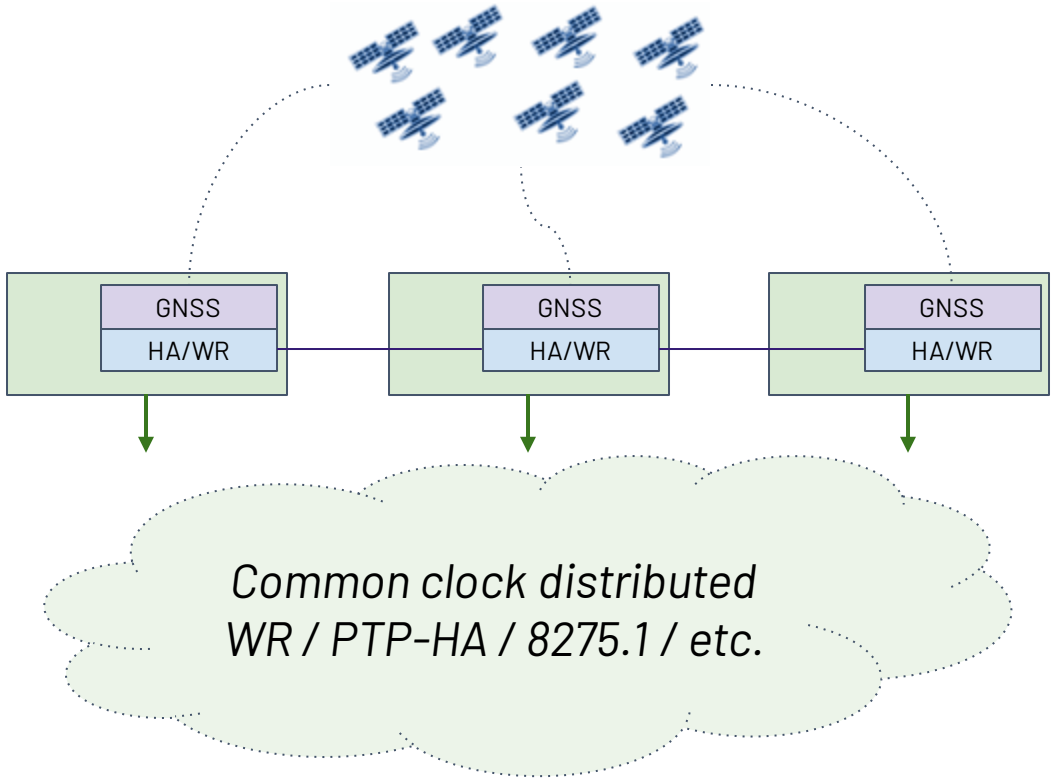
Linked GNSS

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

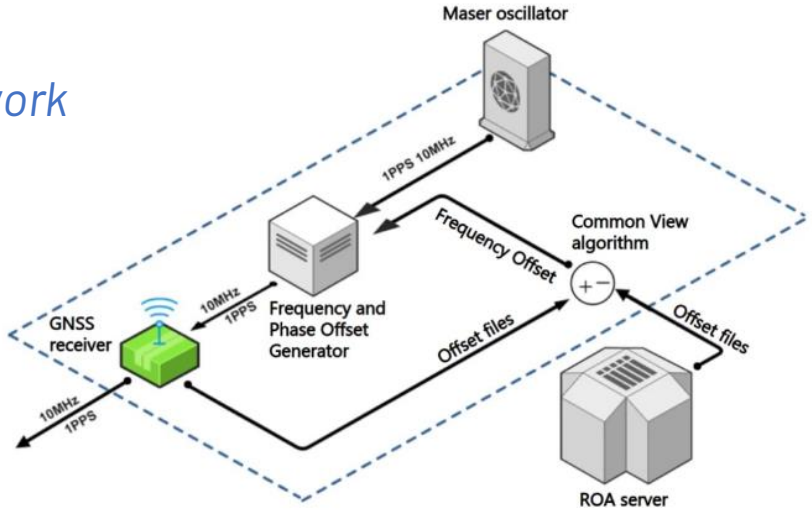


orolia

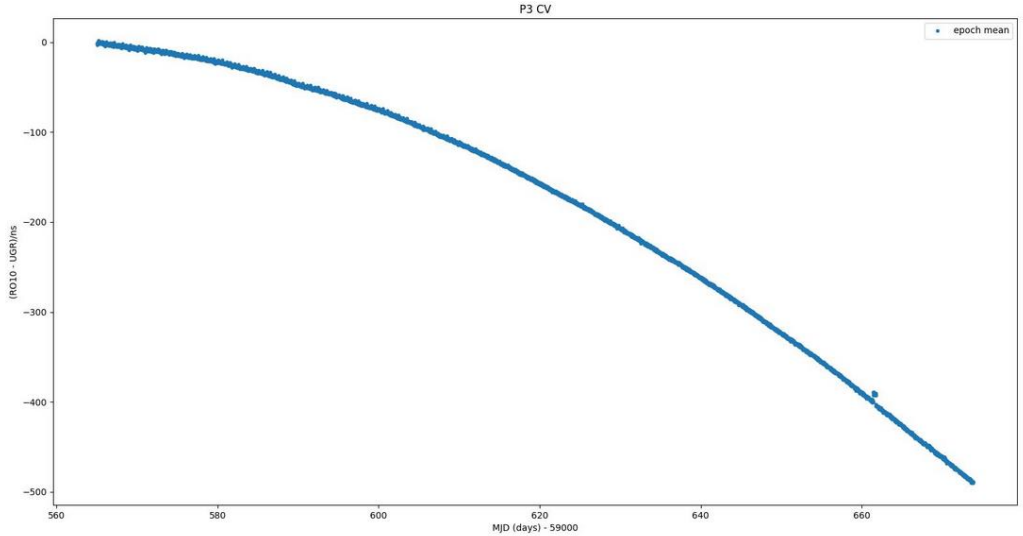
cnPRTC

Resilient time generation

Traceability and failover for the core network



- Traceability to a NMI.
  - <5 ns
- Holdover:
  - <100 ns after 1 month
  - <350 ns after 3 months



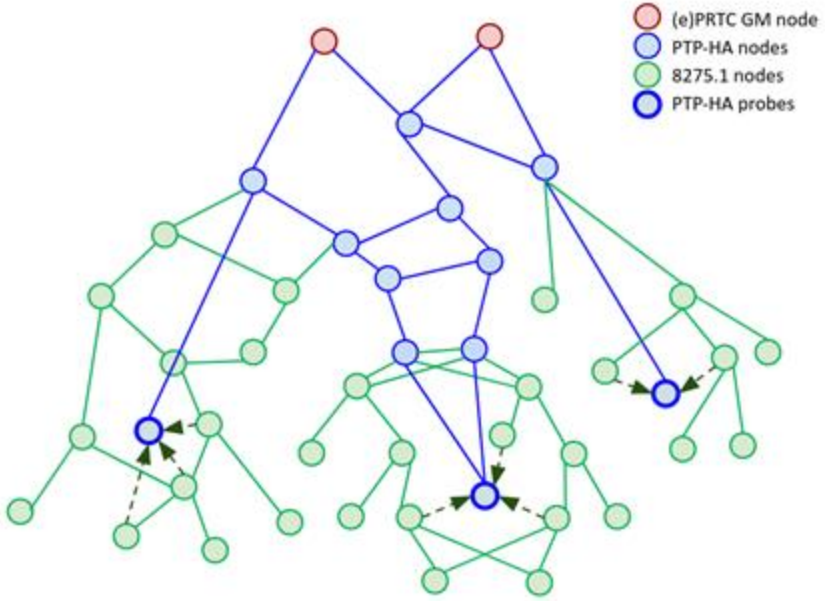
HA/WR

survey

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.



Summary

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

WSTS 2022

Acknowledgements

Projects and Partners

UNIVERSIDAD DE GRANADA

ROOT
Rolling Out GNSMA 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.

This project receives funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 951886 (CLONETS-DS).

orolia

Q&A

Thank you!

Francisco Girela
Americas White Rabbit Tech Responsible

WSTS 2022

WORKSHOP ON SYNCHRONIZATION AND TIMING SYSTEMS
MAY 9-12, 2022 | DENVER, CO