Synchronization for 5G

EPIC Online Quantum Technology Meeting on
Atomic Clocks and Network Synchronization
6 October 2021

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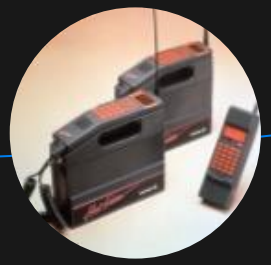
An industry driving change

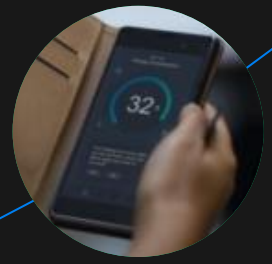
?

IoT

Mobile broadband

Voice





1980 1G

1990 2G

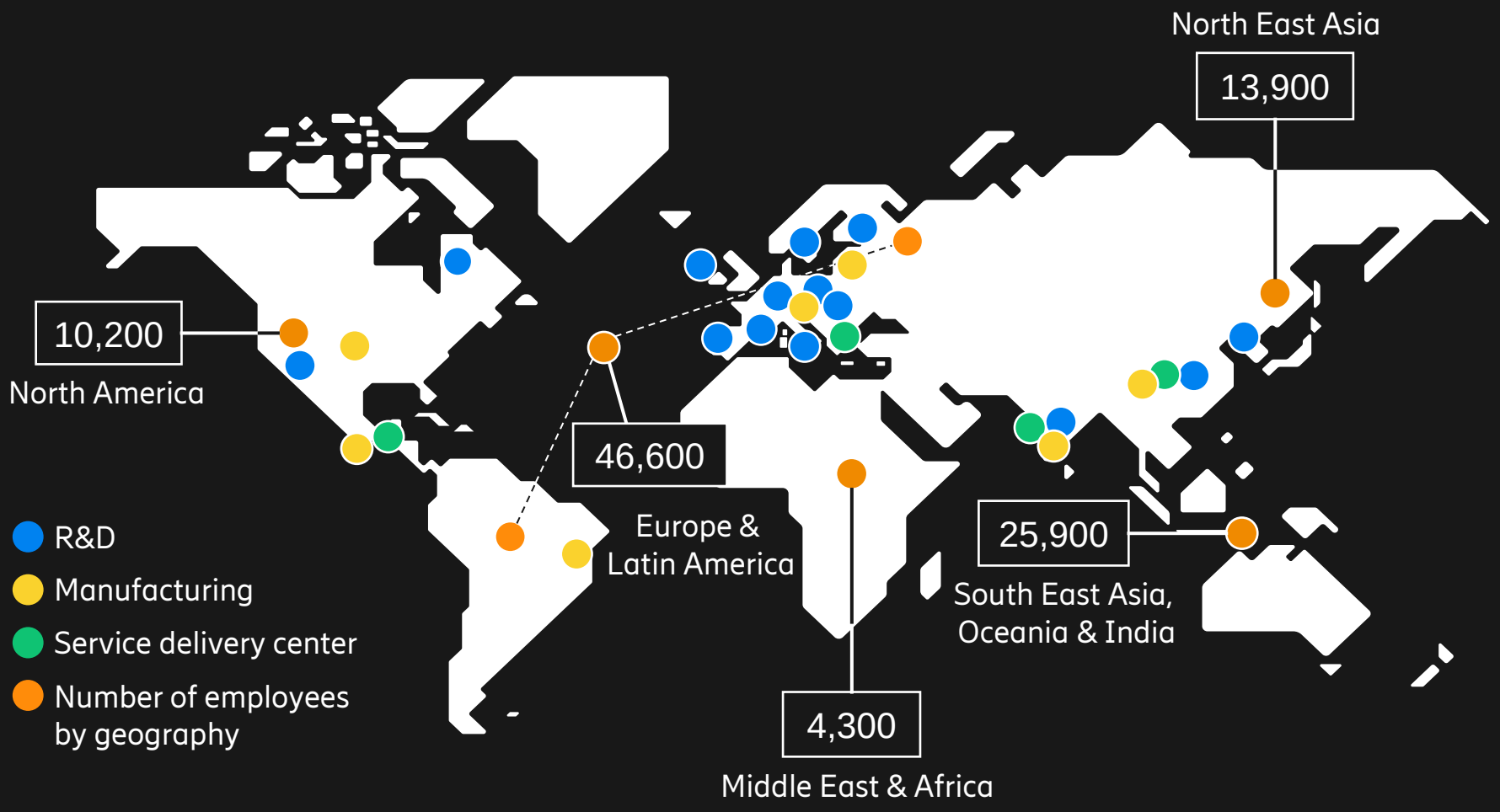
2000 3G

2010 4G

Now 5G

Ericsson at a glance

World leader in ICT and 5G serving customers in more than 180 countries



100,800
Highly skilled people worldwide

26,000
Dedicated to R&D

57,000
Patents

232
BSEK in sales

2030
Carbon neutral own operations

Data as of Dec 31st 2020

A foundation for innovation

Use Cases


Enhanced MBB


Smart Cities


Automotive / Transport


Energy & Utilities


Construction


Manufacturing


Agriculture


First responders


Logistics

... and more

Platform Values


Coverage & Capacity


Voice, Broadband & Applications


High speed & Low latency


Service orchestration & exposure


Wireless edge solutions


Private networks


Trusted execution environment


IoT solutions


Network slicing

5G digital infrastructure

Radio Access

Core Network

Communication Services

Operations Support Systems

Business Support Systems


Sustainable

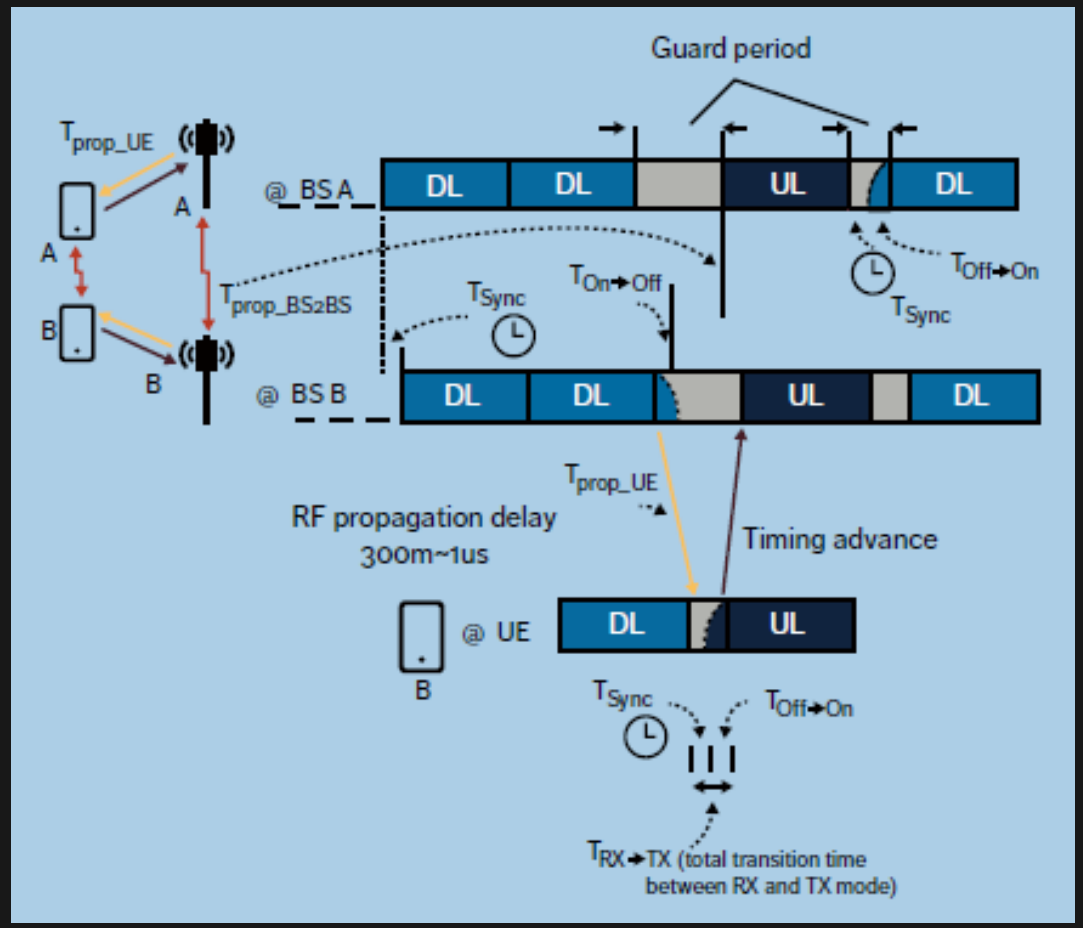

Reliable & Resilient


Cloud native


Secure

Data driven

Why Synchronization in 5G, TDD



TDD: Time Division Duplex

UTC: Universal Time Coordinated

Time Sync is required for preventing interferences in TDD

Typical target requirement is about 1 us with respect to an absolute timing reference (to meet 3 us Cell Phase Synchronization)

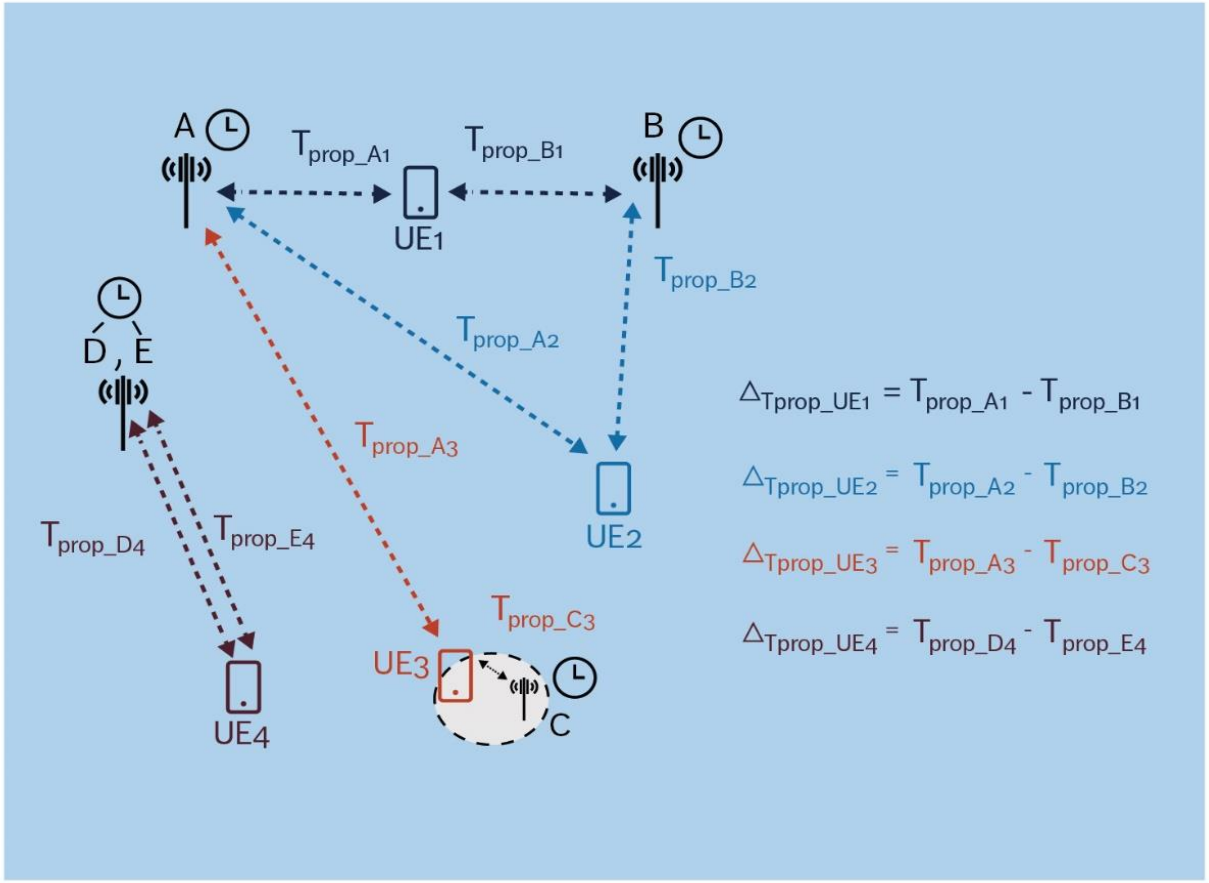
UTC Traceability required in case of non-isolated TDD deployments (3GPP TS 38.401):
Start of the radio frame shall be aligned with the start time of the UTC second.

Why Synchronization in 5G, CA / DC

Sync is required for combining radio signals in Carrier Aggregation, Dual Connectivity

Target requirement is 3 us Relative Time Error (TAE)
For Co-located Antennas more stringent requirements may apply (260 ns / 130 ns / 65 ns)

TAE: Timing Alignment Error



ΔT_{prop_UE1} and $\Delta T_{prop\_UE4} < \Delta T_{prop\_UE2} < \Delta T_{prop\_UE3}$

For same delay spread ➔ UE1 and UE4 can tolerate larger TAE than UE2 and UE3. For colocated D and E, $TAE_{D\text{-}E}$ generally < $TAE_{A\text{-}B}$

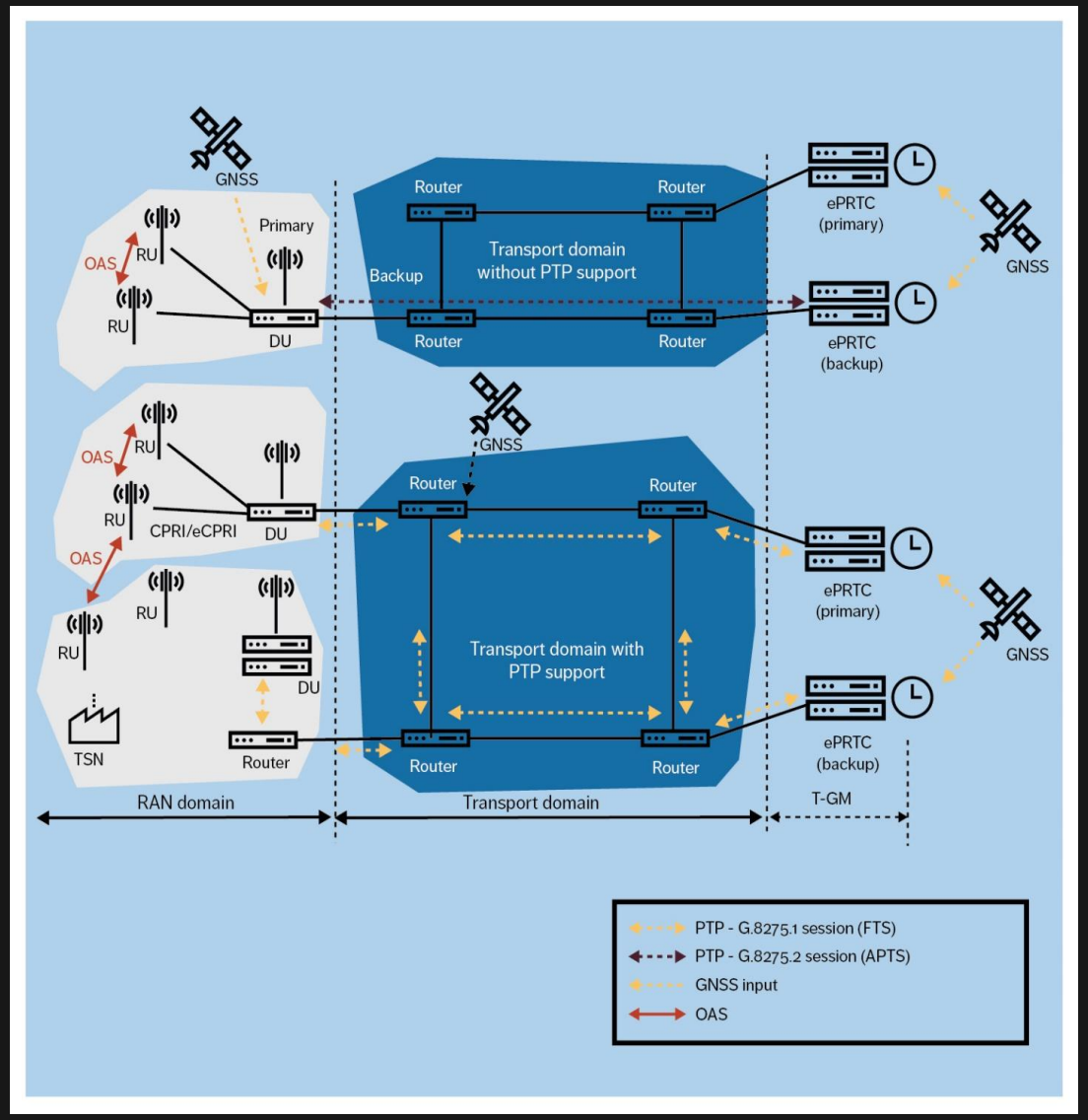
5G Sync, Solutions

An efficient and robust solution requires the support of a toolbox of sync methods:

- in the RAN Domain (GNSS, OAS)
- in the Transport domain (PTP , SyncE)

Atomic clock technology (Cesium) is a fundamental part of the solution in Telecom

- ePRC (ITU-T G.811.1) (i.e., 10^{-12}) is the state of the art for Telecom applications
- Can be used in combination with GNSS in case of centralized sync solutions (e.g., ePRTC, ITU-T G.8272.1, targeting 100 ns over 14 days after loss of GNSS)
- … and GNSS itself relies on atomic clocks



PTP: Precision Time Protocol
PRTC: Primary Reference Time Clock
ePRTC: enhanced PRTC
OAS (OTA): Over the Air Sync
DU: Distributed Unit
RU: Radio Unit
RAN: Radio Access Network
SyncE: synchronous Ethernet

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