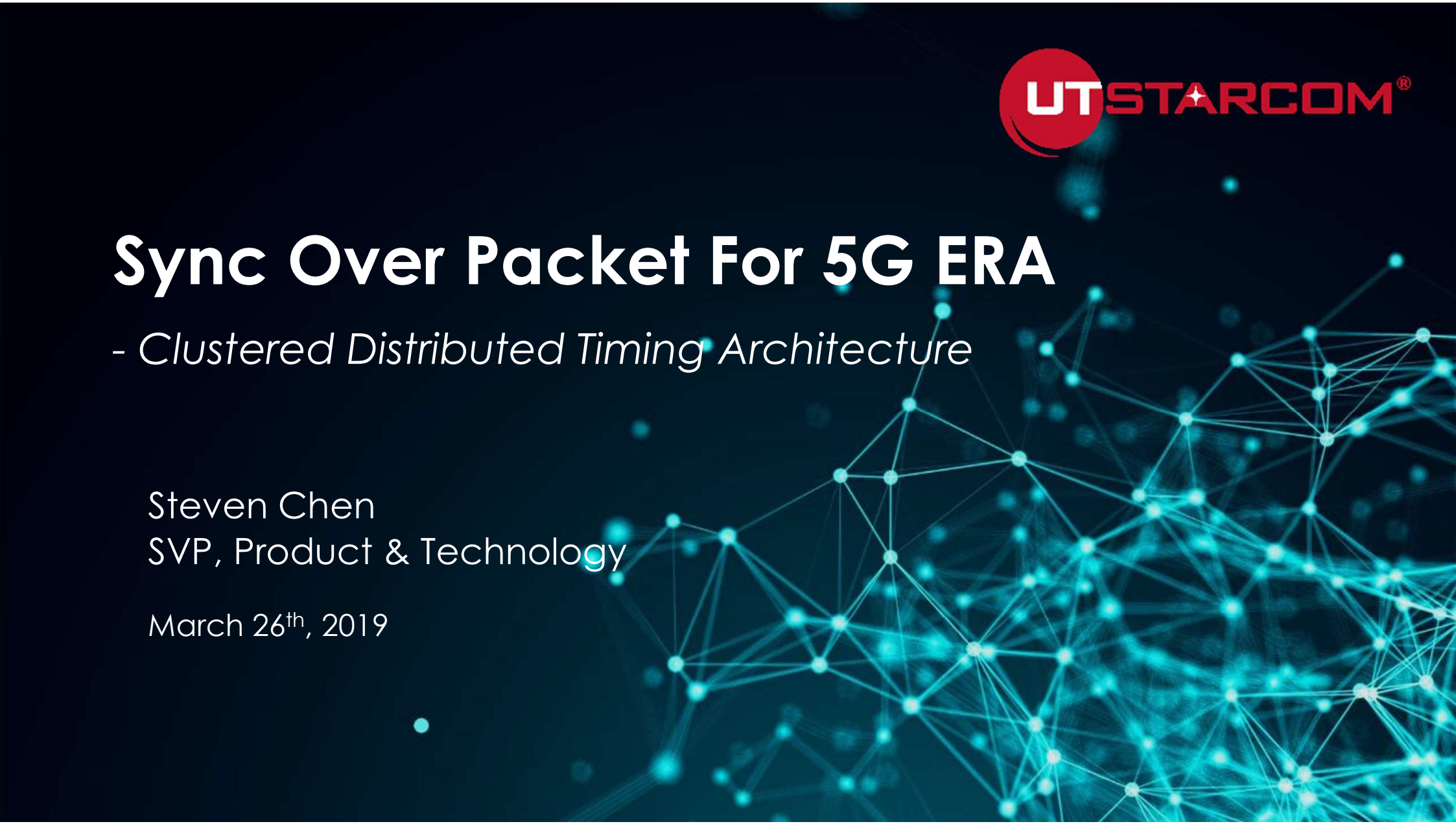


Sync Over Packet For 5G ERA

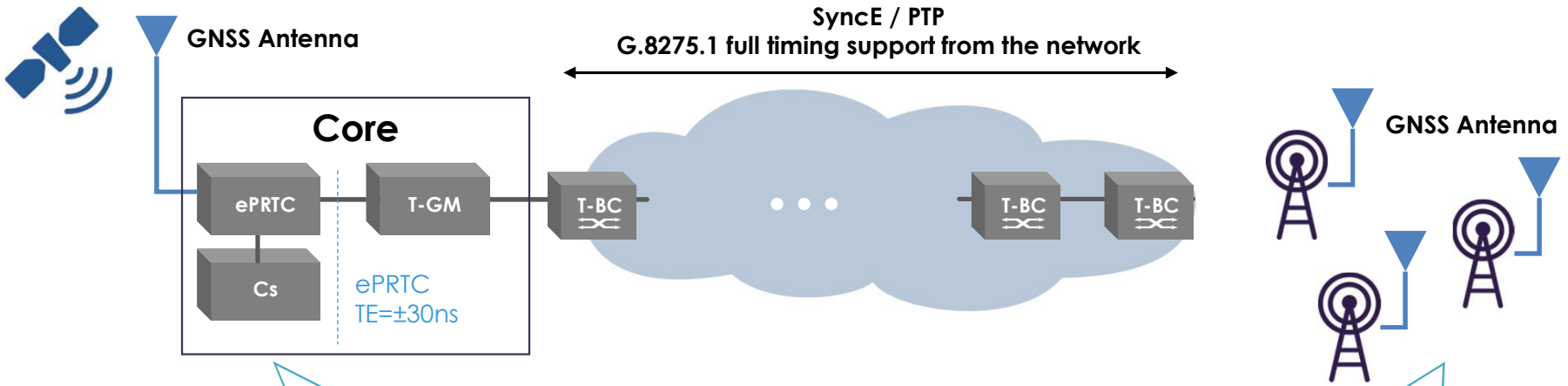
- Clustered Distributed Timing Architecture

Steven Chen
SVP, Product & Technology

March 26th, 2019

TIMING ARCHITECTURE

Traditional architecture for 3G/4G



Central ePRTC –
a primary timing source

OR

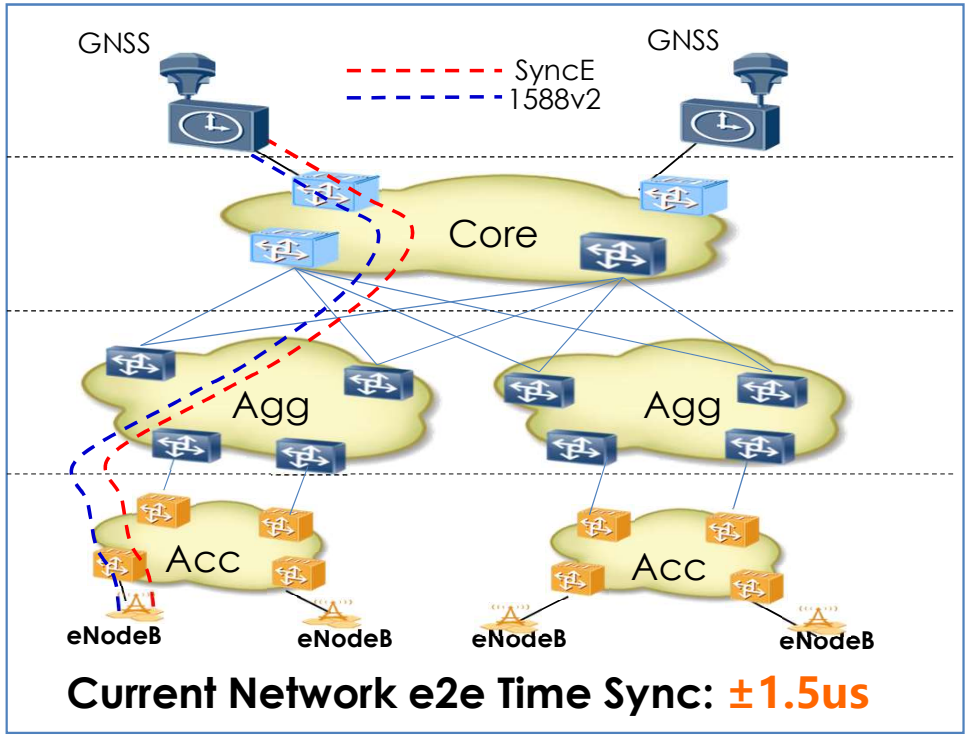
Distributed –
GNSS receiver @ every BS

- Requires full on-path support from the network with high accuracy T-BC
- Limited number of hops
- Transport network complexity

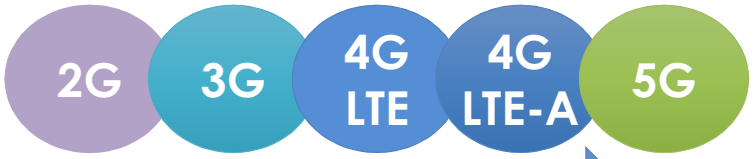
- Small cell challenge
- High cost
- Limits site acquisition options
- Adds to installation and maintenance complexity

5G TIME SYNC REQUIREMENTS

Increasing sync accuracy



Current Network e2e Time Sync: ±1.5us



Sync accuracy requirements

5G Sync Requirements

A. **Basic radio interfaces** ***(Whole Network):*** Ultra-short Frames, about **±390ns**

B. **Cooperations among stations** ***(Local):*** CoorapCA, CoMP etc., about **±130ns**

C. **5G new services** ***(Local):*** Base station positioning etc. about **±10ns**

Network Time Sync Budget

	PRTC	Transmission Network	Base Station
4G	250ns	1000ns（including holdover）, 30ns per hop, >20 hops	250ns
5G	50ns	Tracing 100ns, 5ns per hop >20 hops	50ns

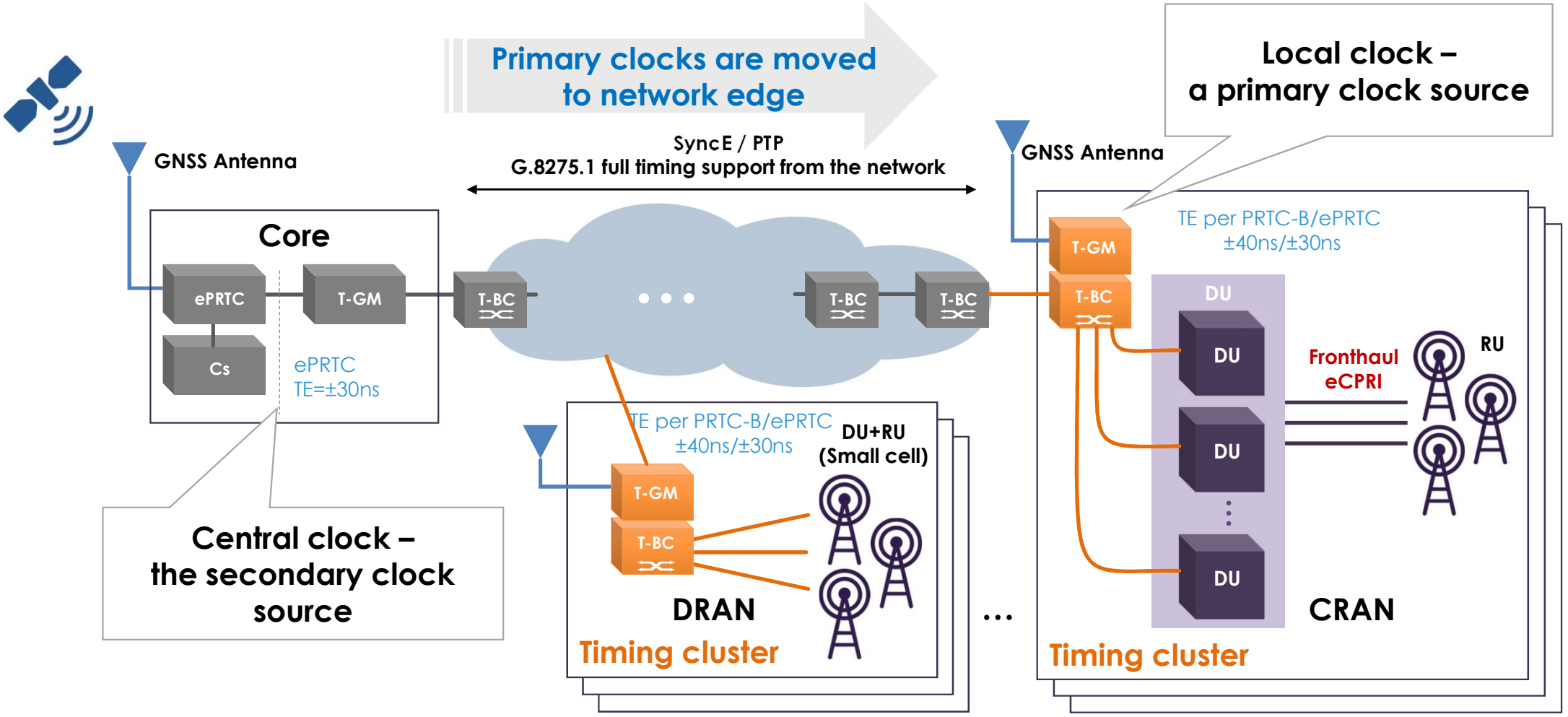
SYNCHRONIZATION CHALLENGES

High accuracy, low cost, new service & security

- **Provide required sync accuracy**
  - Heterogeneous networks, different performance of network devices, different technologies, complex to guarantee consistent sync performance
  - The best performance is while using on-path sync support in every node (TC/BC) – not always the case
- **Provide it cost efficiently**
- **Guarantee high availability**
- **Meet different sync requirements from vertical applications**
- **Meet different sync requirements for network slicing**
- **Against GNSS Jamming & Spoofing**

TIMING ARCHITECTURE

Clustered Distributed Timing Architecture



GM FOR CLUSTERED DISTRIBUTED ARCH.

Concurrent GNSS multi-system / multi-frequency

High-grade OCXO

Sync Ethernet

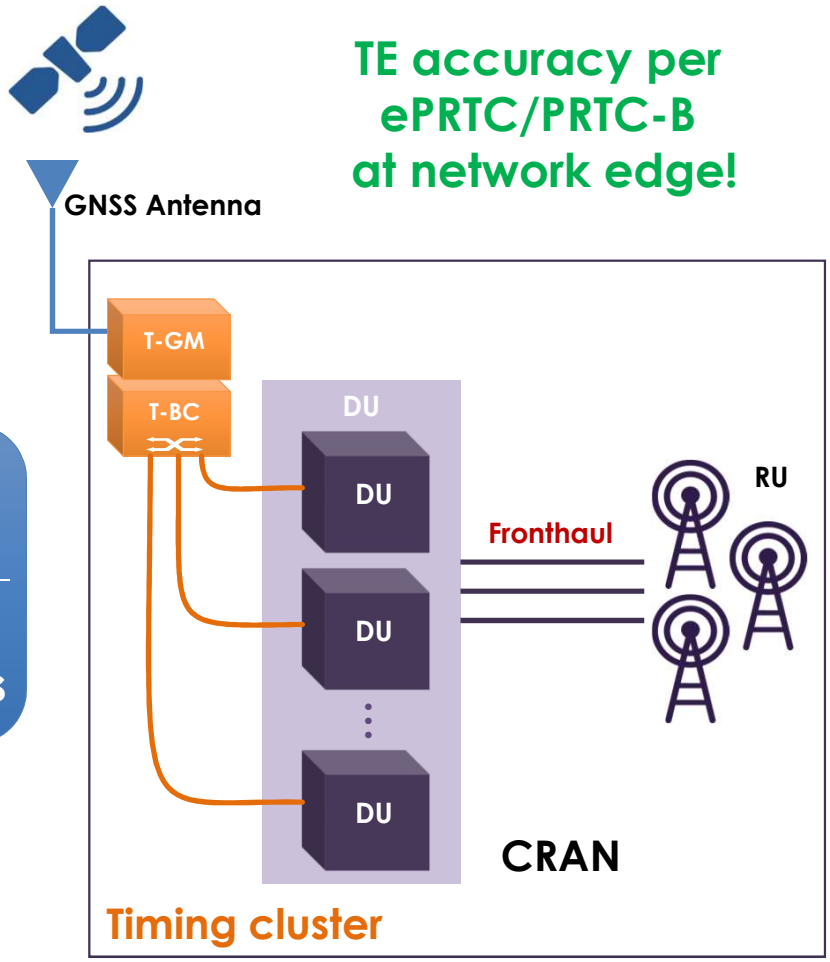
PTP IEEE 1588v2

Outdoor deployment

Performance monitoring and management

TE (locked):
≤ ±30ns/40ns

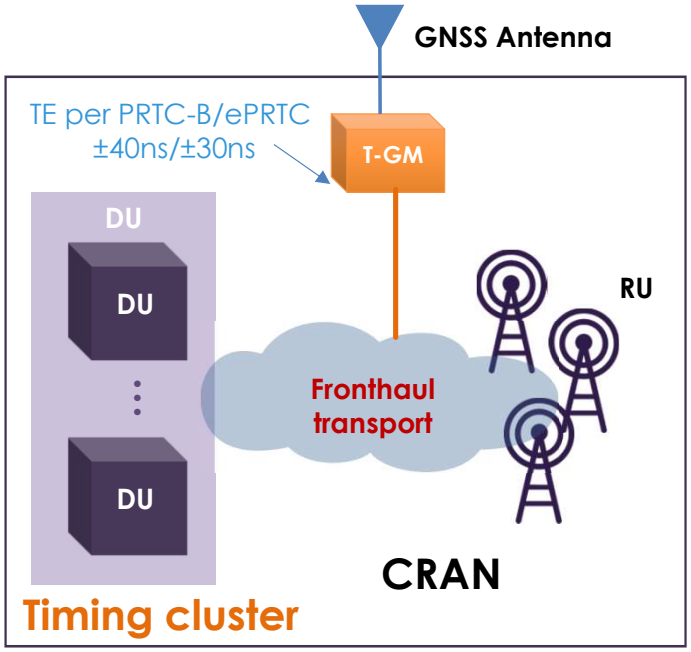
Holdover:
± 1.1us/24hours



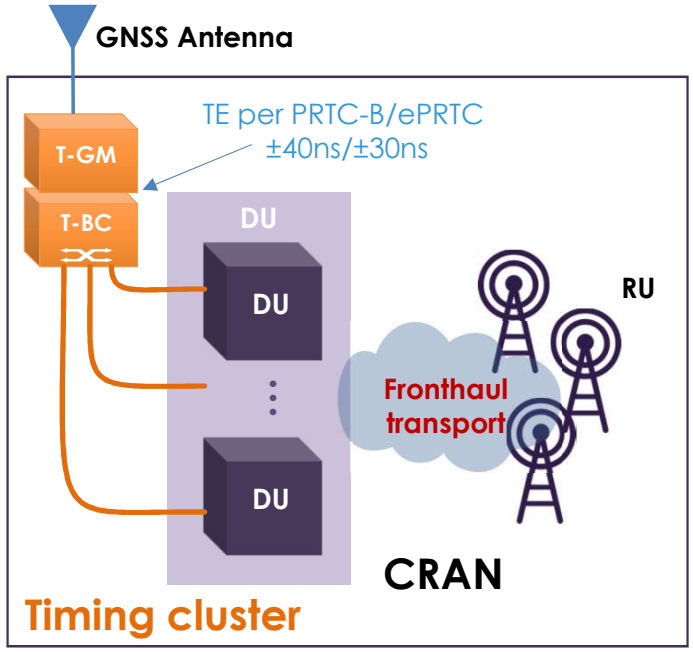
TE accuracy per ePRTC/PRTC-B at network edge!

TIMING ARCHITECTURE

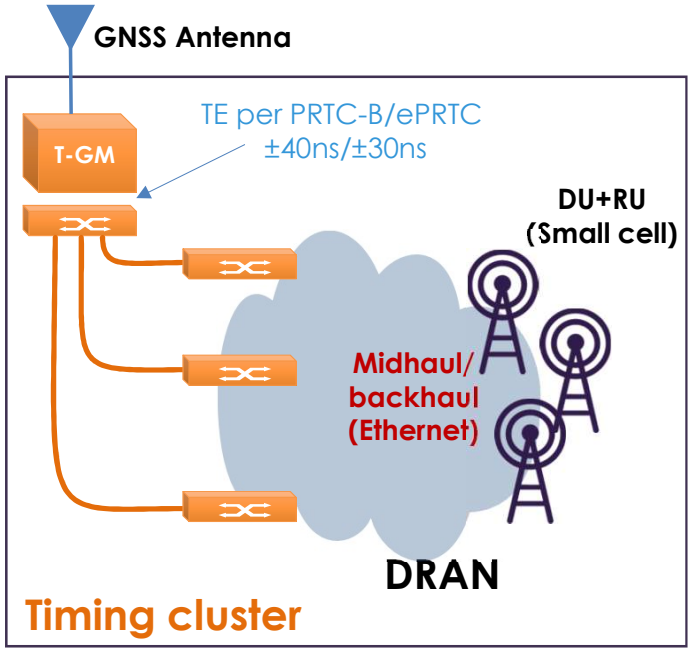
Clustered Distributed Timing Architecture – Some scenarios



- Max accuracy (x10-x100ns)



- Very high accuracy (x100ns)

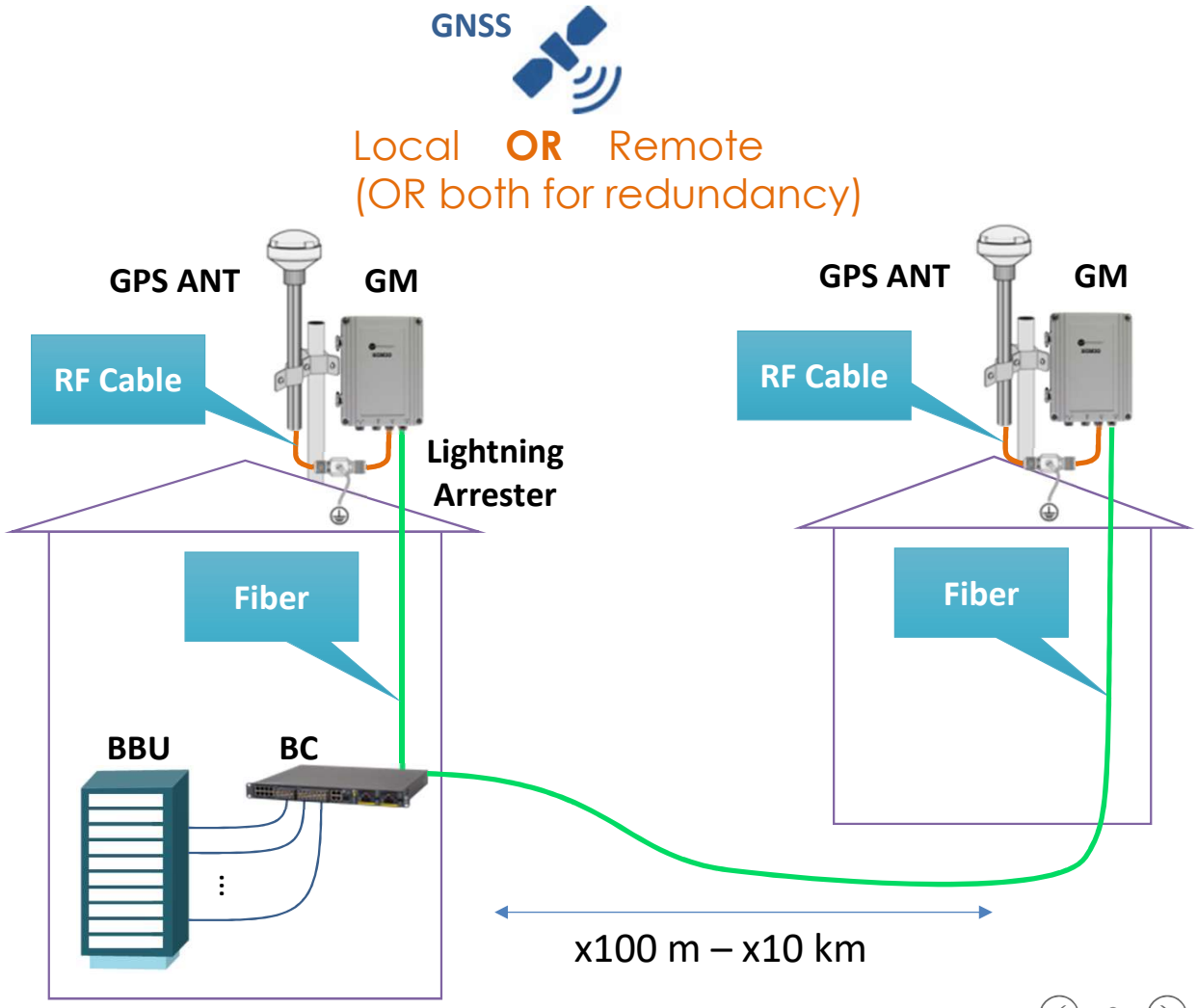


- High accuracy (x100ns…<±1.5μs)
- High cost efficiency
- Mass small cell deployment

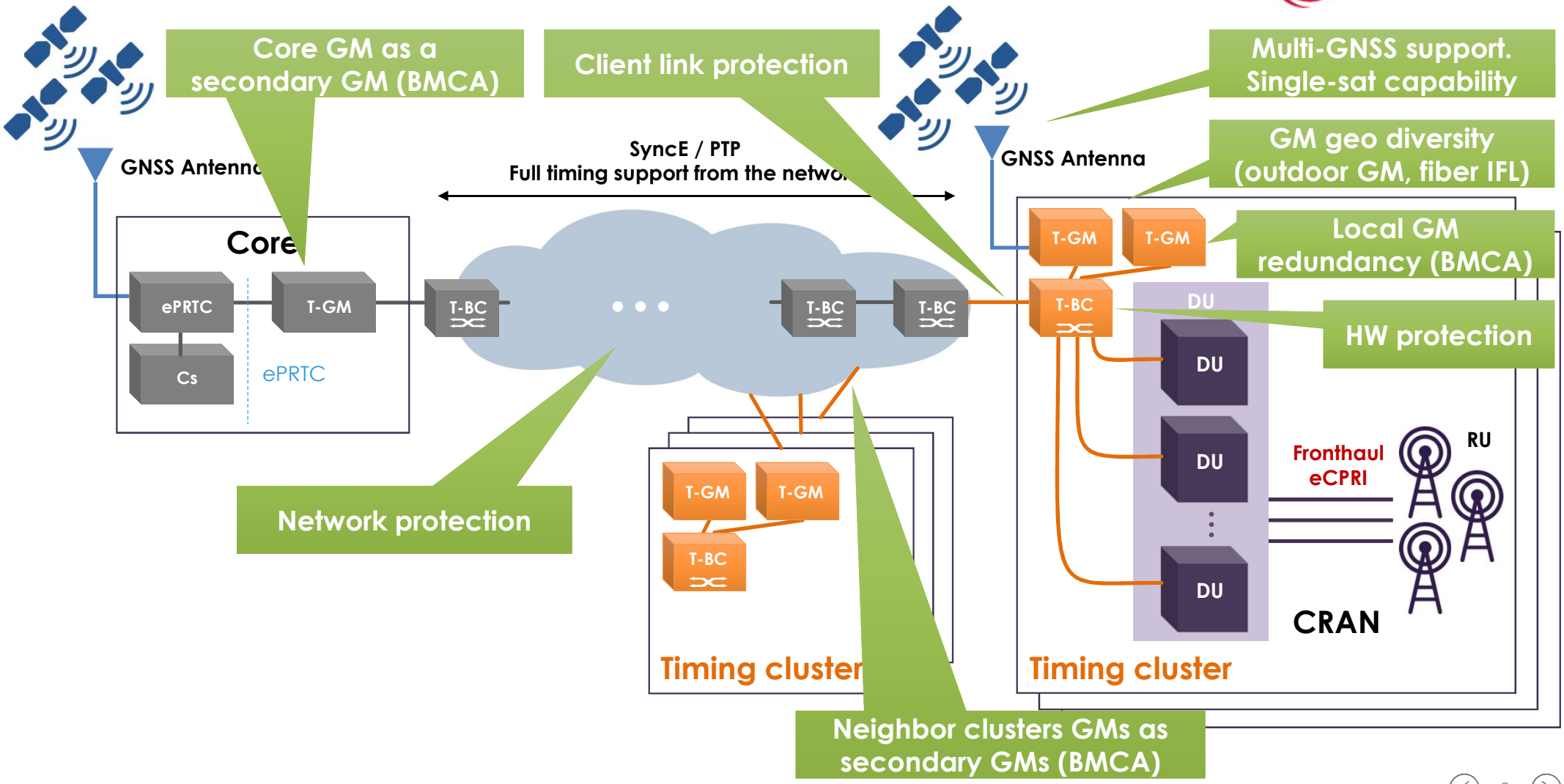
OUTDOOR DESIGN GRAND MASTER

Easy for Deployment

- Resolves issues and limitations of RF cable
- Short RF cable, predictable performance, easy delay compensation
- Easier site acquisition with fiber IFL
- Great flexibility in deployment options
- Reduced risks of damaging indoor equipment due to a lightning strike thanks to fiber IFL
- Improved availability with geographically distributed main and redundant GM
- Proven field deployment



HIGH SYNC AVAILABILITY



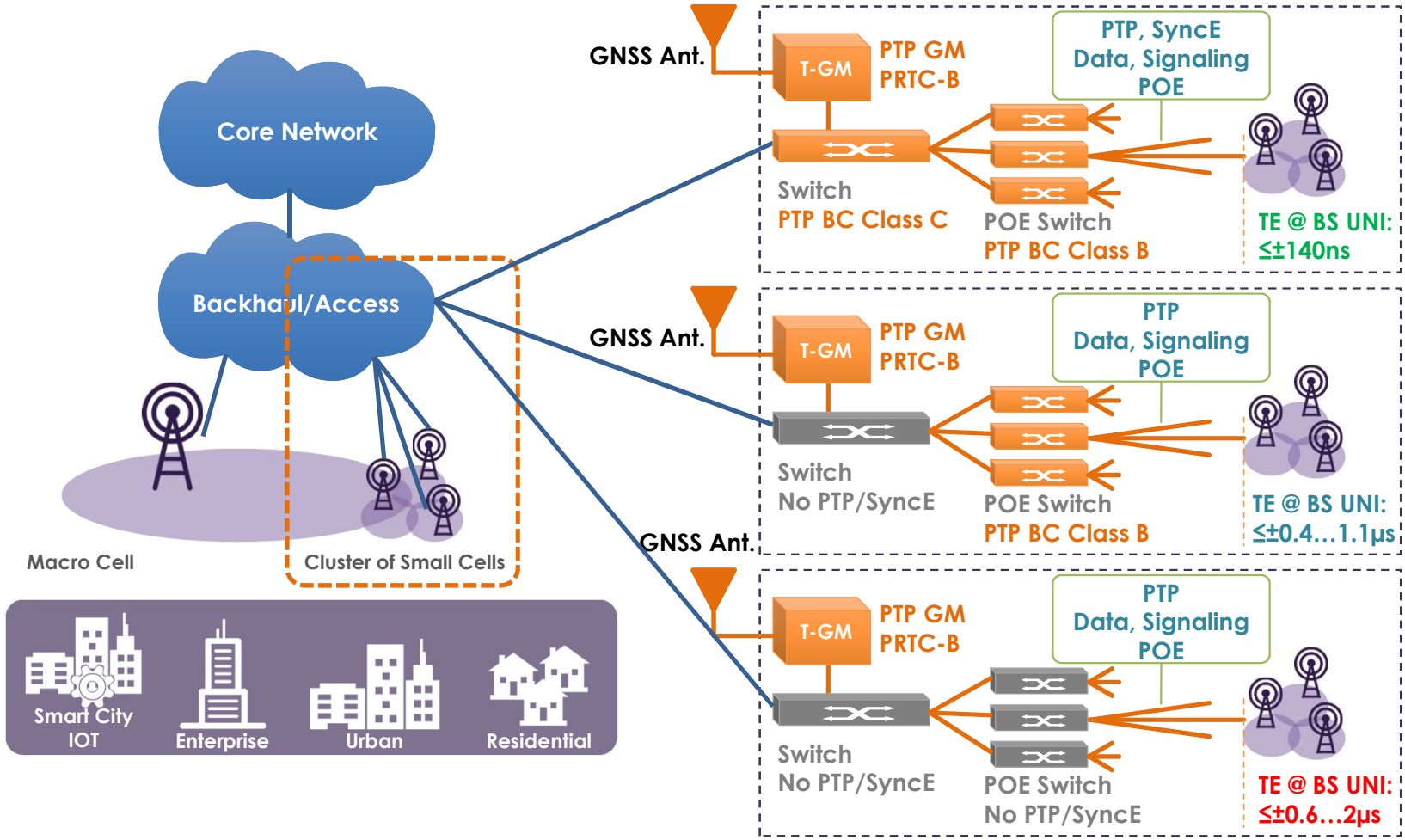
USE CASES

LTE Commercial Deployment

- Deployment of distributed sync scenario for LTE mobile network
- One of the largest mobile network operators (MNO) in Japan
- Hundreds of sets GM and BC to serve thousands of BBUs
- Enable instant implementation of precise clock/time solution
- Deployment flexibility due to separate BC & outdoor GM
- Centralized network management system (NMS)
- Customer satisfied with clock accuracy and operation experience
- Early adopter

USE CASES

4G/5G Small Cell

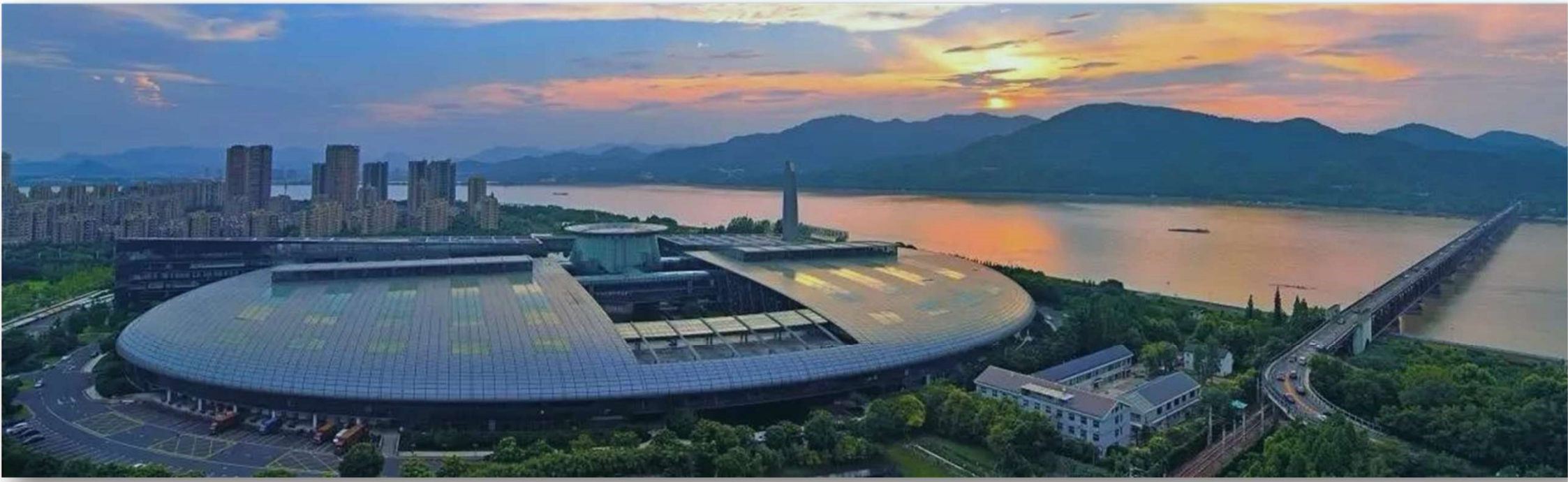


Scenario 1: Full timing support from the network.
PTP+SyncE.
POE to small cells.

Scenario 2: Partial timing support from the network.
PTP only.
POE to small cells.

Scenario 3: No timing support from the network.
PTP only.
POE to small cells.

THANK YOU!



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