Towards 6G Networks: Wireless X-HAUL Evolution

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The radical transformation of cellular networks towards the 6G era will:

▶ Unveil a new use case for the X-Haul networks:

- Inter-DU communication for O-RAN Cell-Free mMIMO Networks.

▶ Demand the introduction of innovative X-Haul features.

- Advanced synchronisation capabilities and optimised distribution of frequency, phase and time over packet-based networks.

▶ Communication by jointly precoded transmission from many distributed antennas, called Cell-Free massive Multiple-Input Multiple-Output (CF mMIMO), is a promising concept for beyond 5G systems enhancing network coverage and capacity.

▶ Inter-DU interface is a non-standard, novel interface.

▶ Inter-DU communication allows to extend the CF mMIMO to Radio Units connected to multiple DUs, further extending the gain provided by the CF mMIMO architecture.

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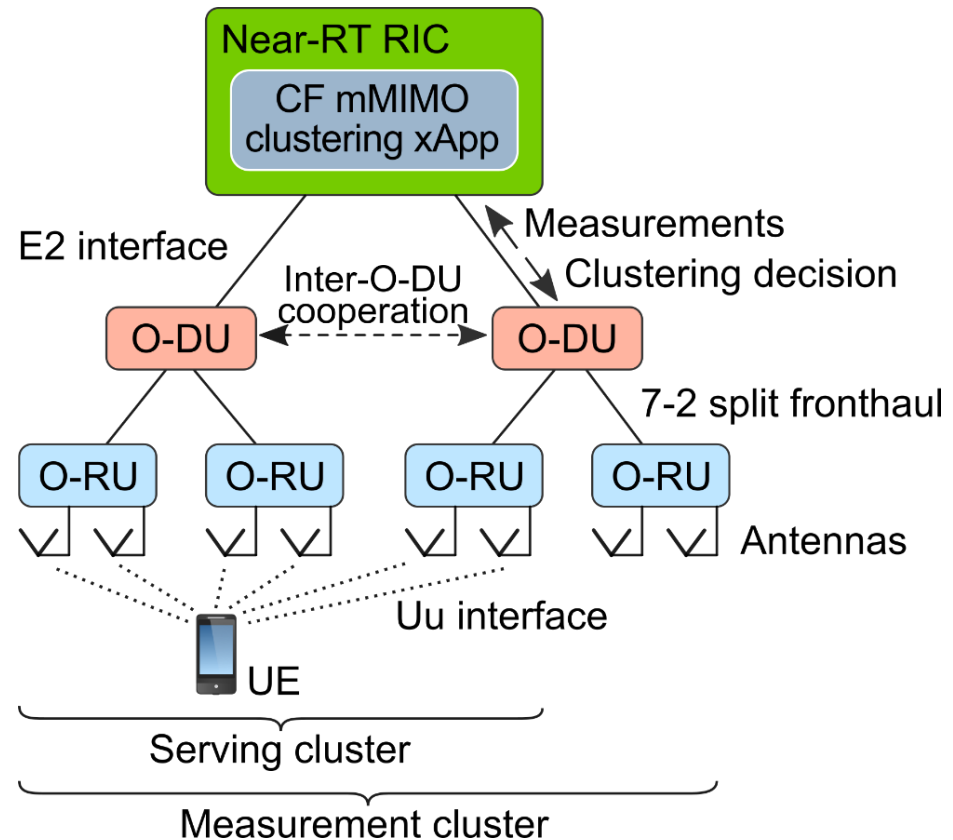
▶ Prove that an efficient Inter-O-DU communication based on containers is feasible with the use of a high-data rate, low-latency mmWave link.

The integration Setup
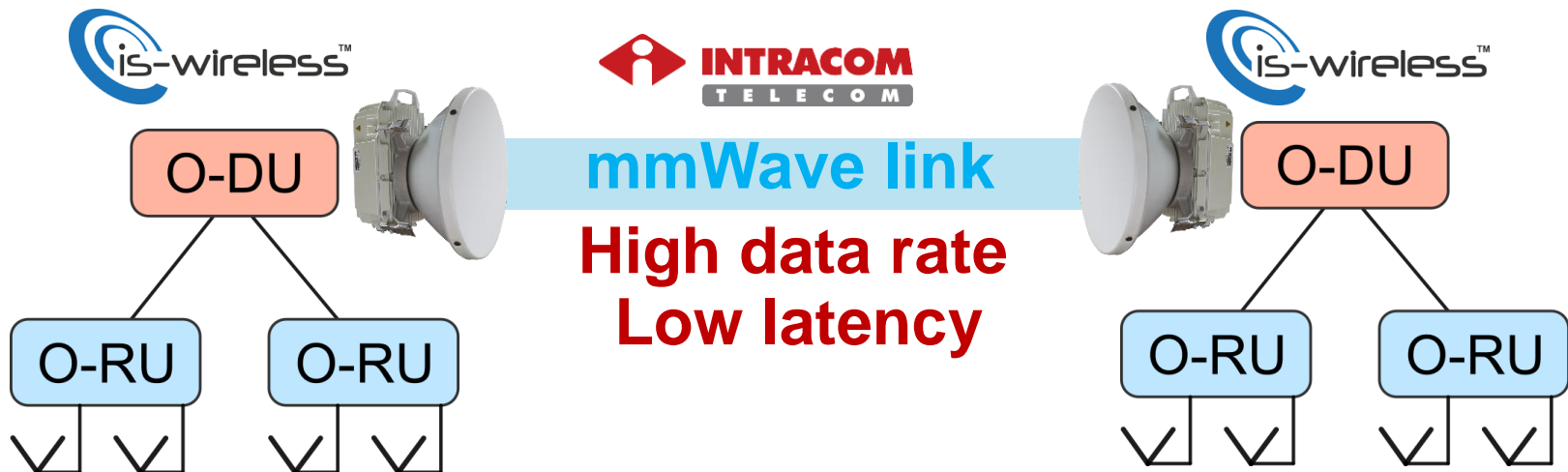
- ▶ Two ISW O-DUs are installed on the same physical server.

- ▶ Each O-DU is associated with a different network interface.

- ▶ Data from O-DU-1 are sent to O-DU-2 through:

  - ● Fibre optic cable, fed by 10Gbps optical SFP+ modules.

  - ● Intracom Telecom's mmWave (E-band) link and fibre optic cables fed by 10 Gbps optical SFP+ modules.

- ▶ Measurements:

  - ● Delay between DUs (instantaneous, average, P10, P50 and P90).

   - ▪ Grafana dashboard to visualize data.

Integration setup

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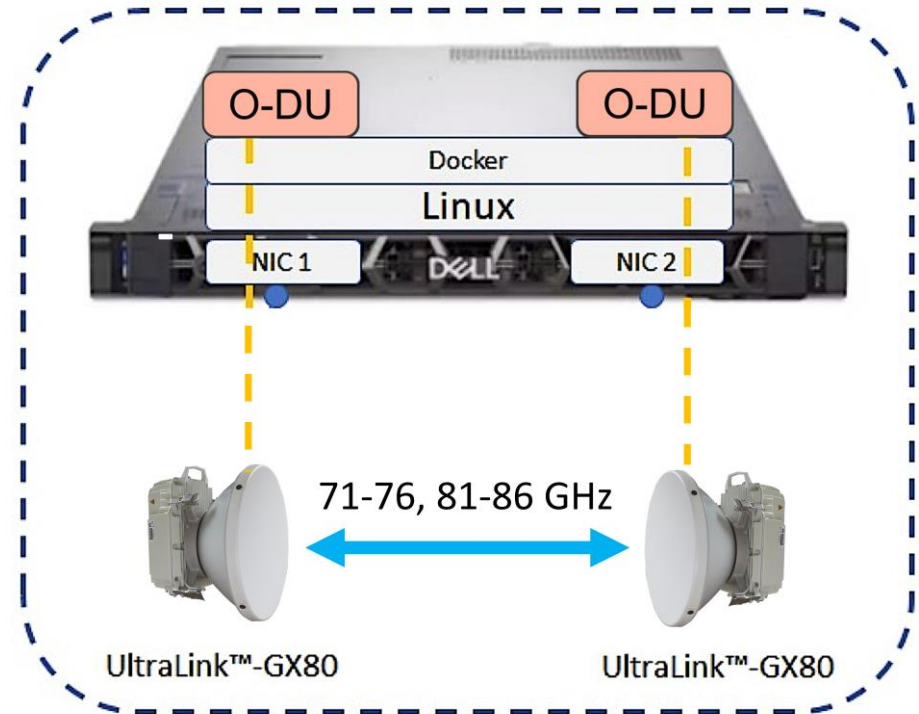
▶ **O-DU-to-O-DU communication** through the mmWave link together with containers' environment, results in a delay of 280 μs (P90) which is less than the typical 5G slot duration of 500 μs.

▶ The setup with the mmWave link introduces an additional delay of 62 μs compared with the fibre connection
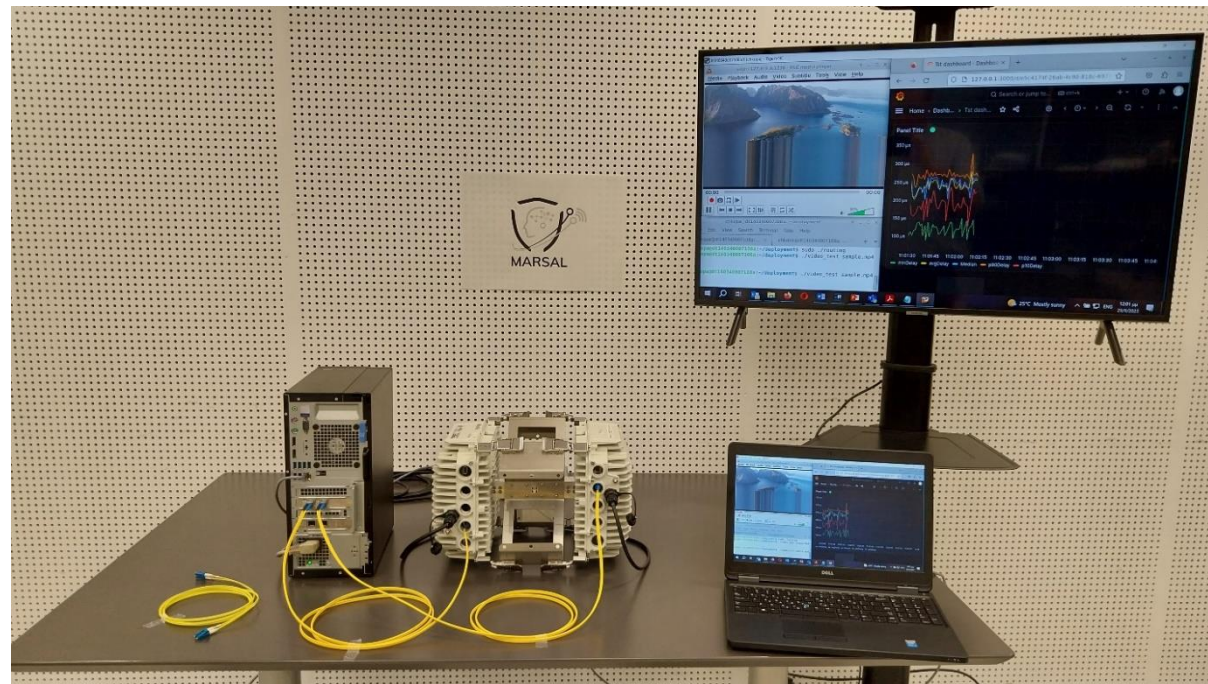
Intracom Telecom testbed

▶ With the evolution towards CoMP and cell-free, there are tighter constraints on synchronisation, with requirements for coherency (phase synchronisation) between RUs.

- Need of evolution of synchronisation distribution over the transport network.

▶ Within ITU-T and IEEE, two protocols were defined that provide synchronisation over Ethernet interfaces and can be achieved by either:

- ITU-T Synchronous Ethernet (SyncE)

- IEEE 1588-2008 Precision Time Protocol version 2 (PTPv2)

  - Class B is required for most of today's 5G and O-RAN deployments.

 - For B5G networks and cell-free, PTP Clock performance should be Class C or better.
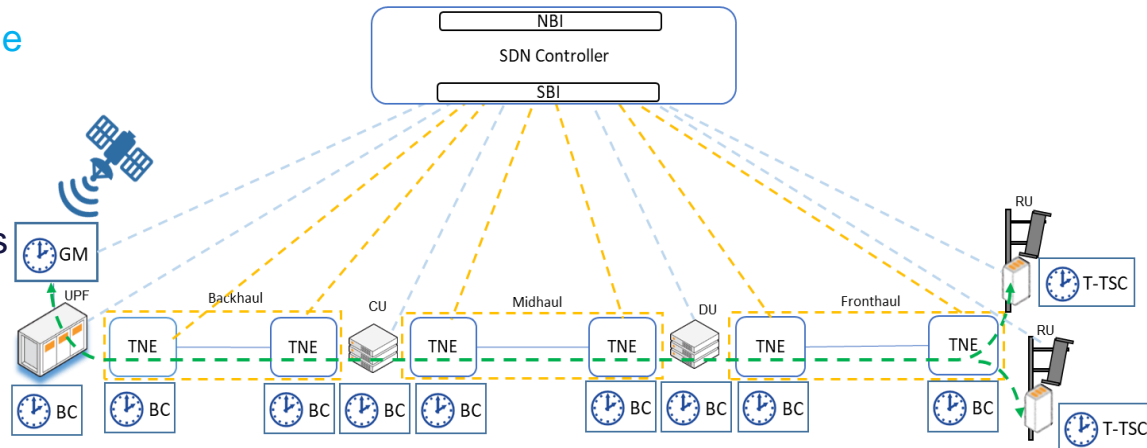
SDN-enabled end-to-end synchronization support in O-RAN compliant architecture

Advanced Synchronisation Solution

- **Reference product:**
  - UltraLink™-GX80

- **The new timing solution is based on employing:**

  - Hardware accelerated (FPGA-based) techniques for IEEE 1588 packets-processing and timestamping.

  - Implementation of innovative frame-based synchronisation algorithms.

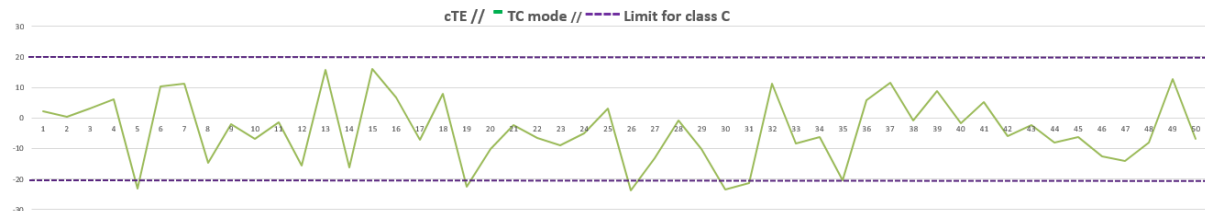 - Implementation of innovative coding schemes
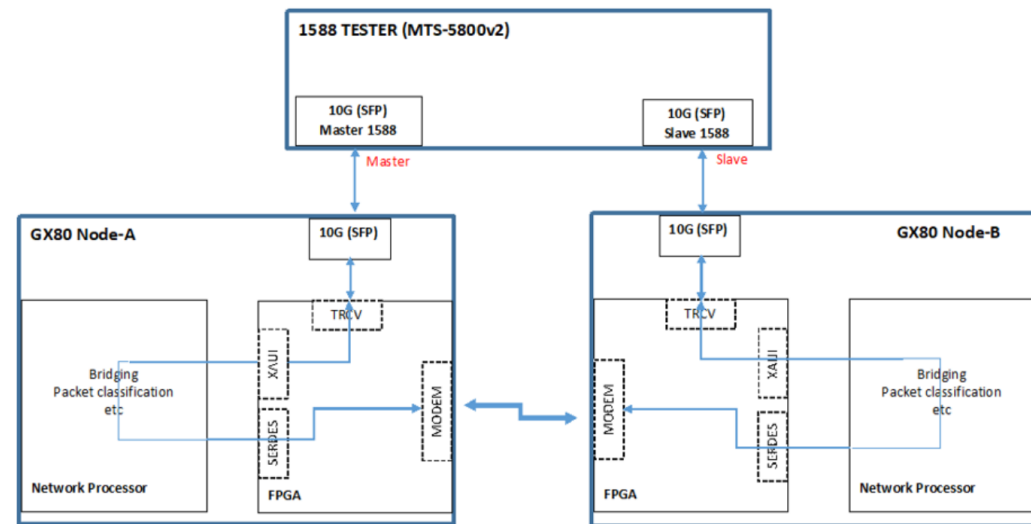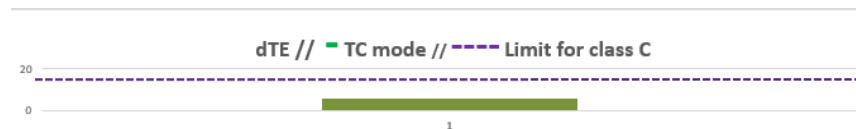

Block diagram of an UltraLink™-GX80 link

- The UltraLink-GX80 TC mode solution was fully qualified as class C.

  - Hence a successful candidate for next-generation cell-free wireless transport.
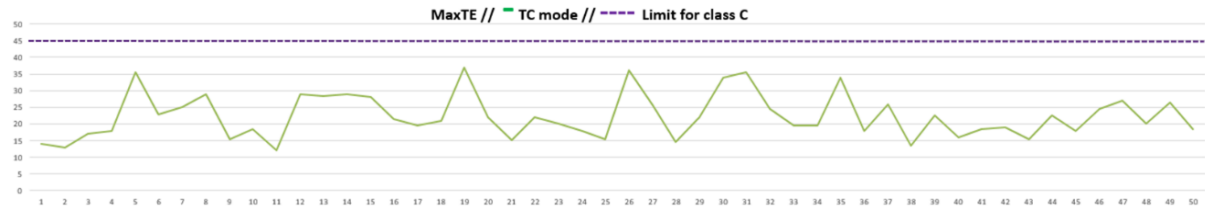
Maximum Time Error graph

Constant Time Error graph

Dynamic Time Error graph

thank
you

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