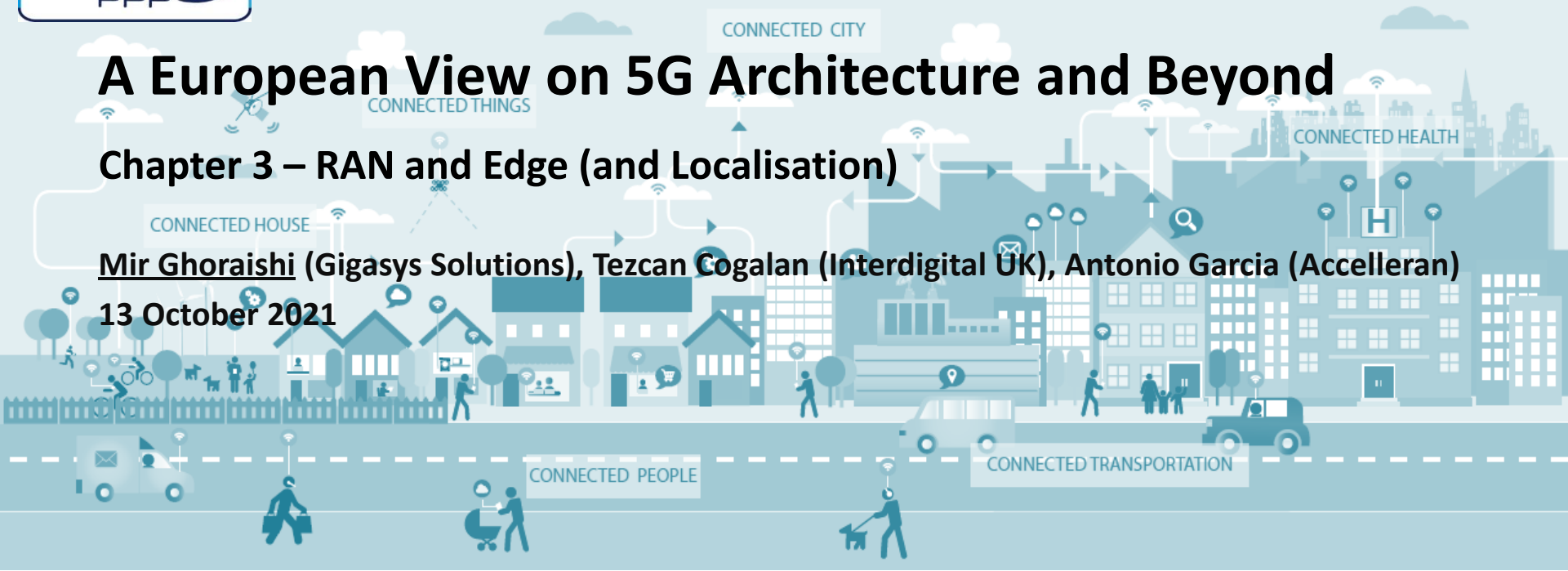
White Paper V4.0

A European View on 5G Architecture and Beyond

Chapter 3 – RAN and Edge (and Localisation)



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Motivation

- Phase II of the 5G PPP focused on the underlying technology including service creation → architecture white paper V3.0
- Phase III of the 5G PPP focused on test infrastructures and vertical applications → architecture white paper V4.0
  - Integrates trends towards architecture aspects for deploying vertical applications
  - Separates domains
    - Services for vertical customers
    - Network
    - Infrastructure
  - Mapping between domain and stakeholders

Chapter 3 Outline

RAN	Multi-Technology Wireless Access Network	5GCLARITY
	Enhanced ATSSS	5GCLARITY
	THz RIS and AI based Radio Access Optimisation	ARIADNE
	O-RAN xApps	5GCLARITY
	5G RAN Integration with Audio Capture Devices and Production Site	5G RECORDS
	Intra and Inter Slice Scheduling Algorithm	5G!DRONES
EDGE	Edge Cloud Classification	5G-VINNI
	Autonomous Edge Computing	5G-VINNI
	ML for Edge Resilience	5G-VINNI
	Edge Computing for CAM	5GCroCo
	On-Premise Edge Computing	5GCLARITY
	Kubernetes based MEC Platform	5GZORRO
Localisation	Localisation Enablers	LOCUS
	Positioning Technologies for Industry 4.0	5GCLARITY
	Enhanced Vehicle Localisation	5GCroCo

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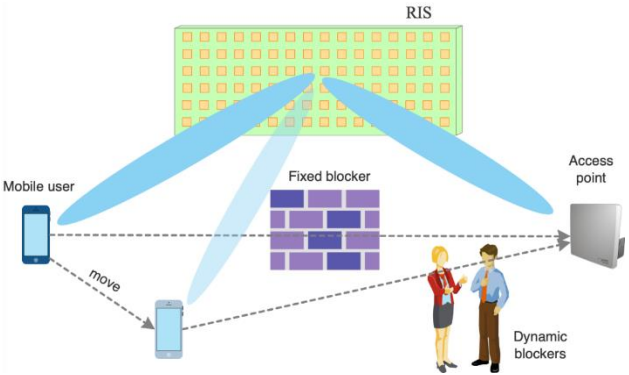
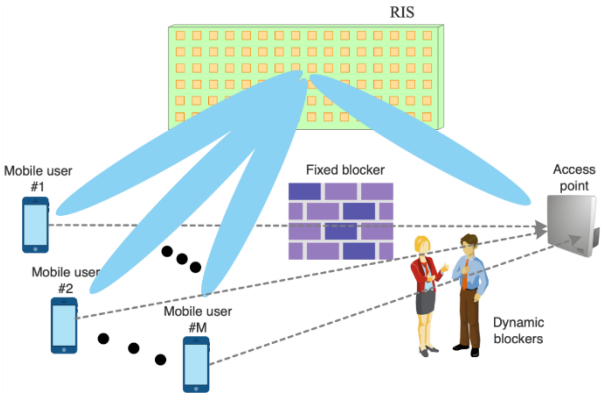
Non-3GPP Access Technologies Aggregation & Enhanced ATSSS

- A practical approach on integrating Wi-Fi and LiFi technologies
- Aggregation within a single SDN enabled layer 2 (L2) network:
  - to provide the ability to control the path followed by packets belonging to different slices within the L2 segment with fine granularity as compared to a standard IEEE 802.1 Ethernet segment,
  - to support seamless mobility.
- The existing mechanism to integrate 3GPP and non-3GPP networks such as N3IWF or trusted network gateway function (TNGF) can be used in combination with 3GPP ATSSS framework to have an integrated 5G/Wi-Fi/LiFi network
- The enhanced ATSSS framework, is proposed a *real-time steering mode,* as the ATSSS rule with the highest priority that adaptively links conditions and network status

RIS and AI based Radio Optimisation

- RIS assisted beamforming scenario
  - RIS as analog beamformer
  - ON/OFF subsets of unit cells to estimate the channel
- RIS assisted broadcasting scenario
  - A single AP serves multiple UEs
- ML-based approaches to reduce latency (e.g. in channel estimation) and probability of blockage and to guarantee high reliability

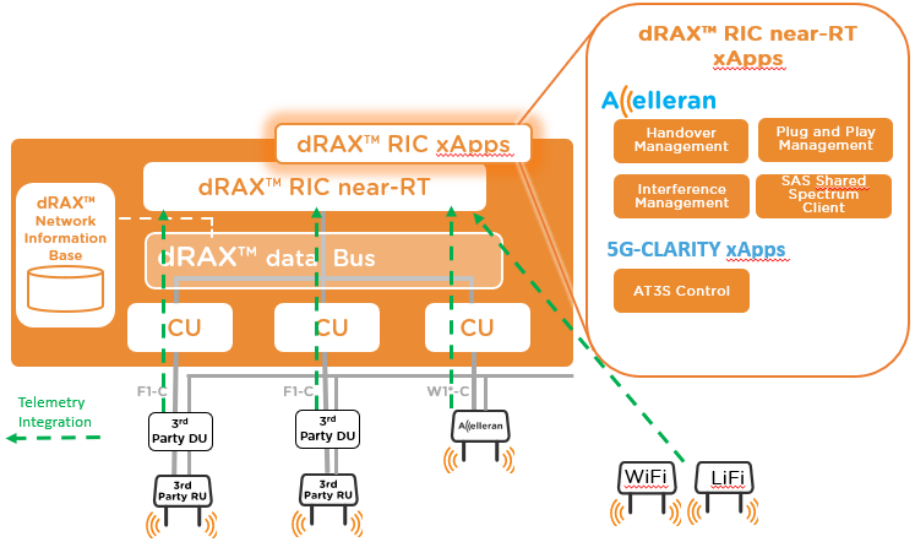




O-RAN xApps

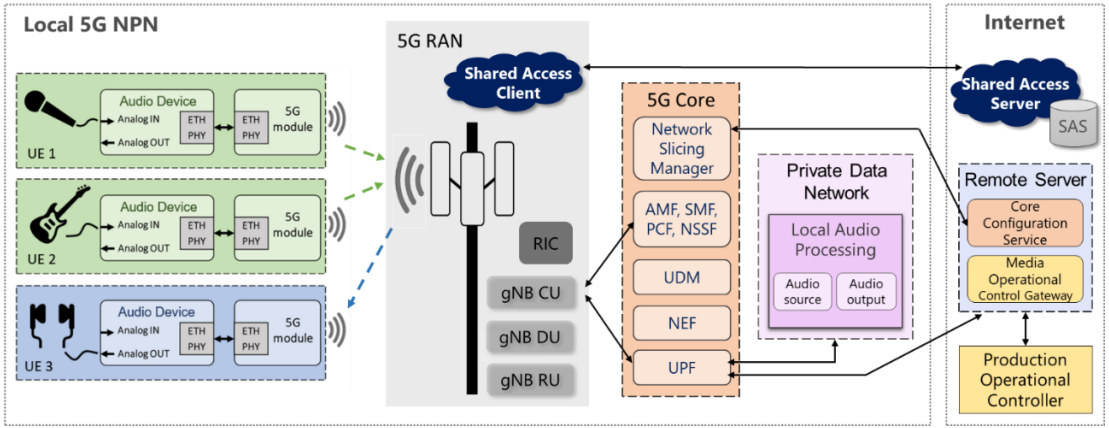
- The (Accelleran) dRAX™ is enabled with multi-WAT telemetry data from 5GNR, Wi-Fi and LiFi which is exposed via the data-bus to the AT3S controller multi-WAT xApp
- Typical default Accelleran xApps relate to usual network functions associated to handling a cluster of 5GNR small cells such as plug and play, interference management, handover management, etc.

near-RT-RIC and non-RT-RIC xApps enabled by the Accelleran dRAX™ solution



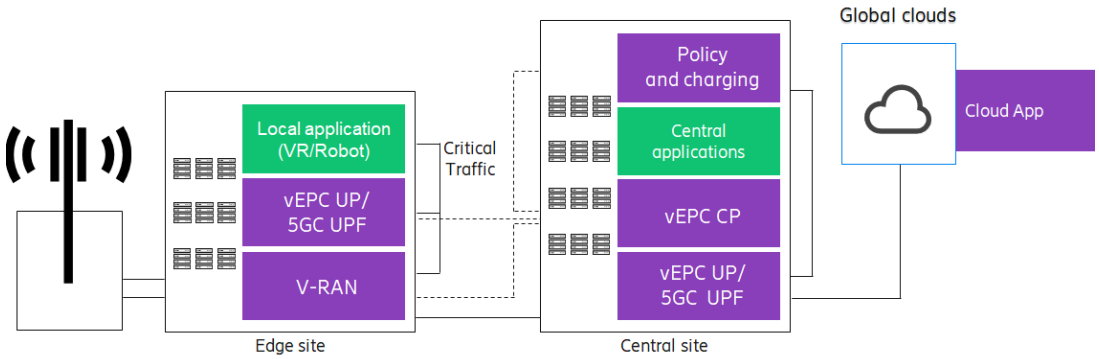
5G RAN Integration with Audio Capture Devices and Production Site

- Open virtualized RAN aligned with the O-RAN Alliance
- An open and extensible software framework for the control plane functions of 4G and 5G RAN and follows the O-RAN architecture
- The O-RAN 5G SA vRAN solution consists of a near-RT RIC, CU-CP, CU-UP and xApp framework components
- 3GPP Control User Plane Separation (CUPS) allows the user and control planes to be fully decoupled



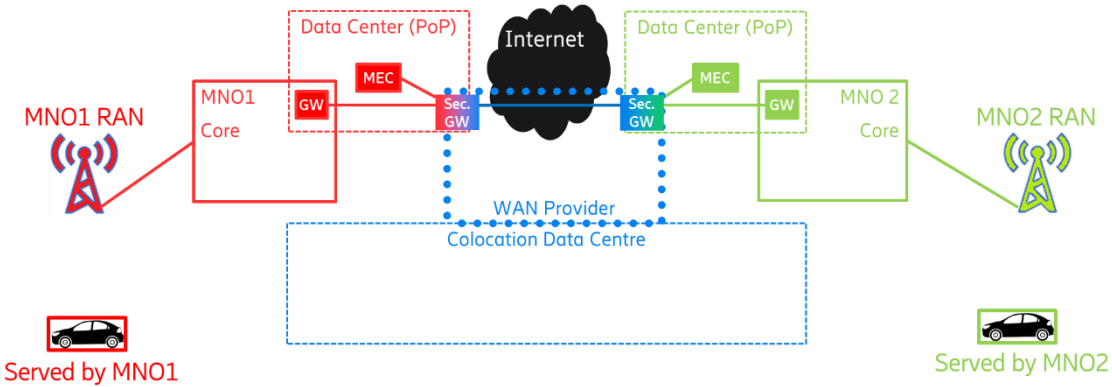
Autonomous Edge Computing

- Autonomous Edge (AE) is a method of optimizing cloud by performing data processing at the edge of the network, ne
- Reduces the bandwidth needed for connection to the core network
  - Performing analytics and knowledge generation at or near the source of the data
  - providing Core Network capabilities in the edge site



Edge Computing for CAM

- Connected and Automated Mobility (CAM) services like Anticipated Cooperative Collision Avoidance (ACCA) require defined end-to-end latency and reliability across MNOs
- The proposed solution is based on purchasing wide area network services with controlled QoS between data centres of MNOs where the gateways are located
- For cross border hand-overs, Service and Session Continuity mode 3 (5G SA feature), also known as “make-before-break” gateway switching, allows to first connect to the new gateway and then releasing the packet data network connection from the old one



Localisation Enablers

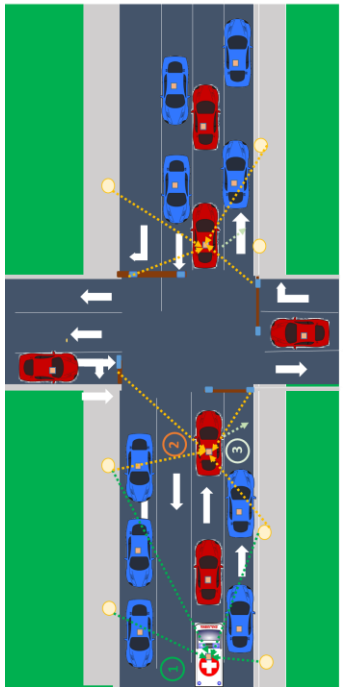
- 5G advanced localisation techniques
  - mMTC: energy and bandwidth efficient alternatives
  - URLLC: allocate mini-slots to reduce localisation service response
  - eMBB: lightweight mmWave localisation algorithms
- Non-3GPP technology-based localisation
  - Information extracted from non-3GPP systems, e.g. 80.11, serve as input in heterogeneous data fusion
- Device free localisation
  - Capability of detecting and tracking objects that do not communicate within the localisation infrastructure
  - Relies on active or passive schemes
  - Takes advantage of any modulated signal at any frequency

Enhanced Vehicle Localisation

- RAT dependent methods
  - Rx measurements on the 5GNR link (beam-based) fused with other on-board sensors (lidar, radar, camera, etc.)
- RAT-independent solution
  - Hybrid of GNSS inertial systems and UWB positioning

Priority access of an ambulance in a crowded road is facilitated using enhanced positioning system

- Hybrid approach
  - LTE positioning protocol (GNSS Real-Time Kinematic)



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Positioning Technologies for Industry 4.0

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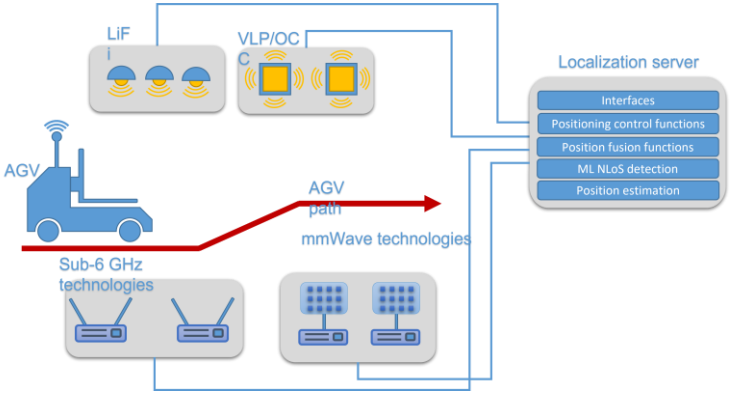
- Rel-17 NR Positioning Enhancements:
  - ‘positioning accuracy shall be better than 0.2 m for IIoT use cases’
- Using multiple technologies for accurate positioning of AGVs
  - Sub 6GHz: TDoA, WiFi, Bluetooth, other range-based methods
  - mmWave: custom 60 GHz system, 2 GHz BW, sub-cm accuracy
  - LiFi: RSS based, dense deployment of LiFi nodes
  - Optical Camera Communications: UE equipped with VLC camera to light source IDs and positions
- ML assisted merging algorithms to enhance the position estimate



The 5G Infrastructure Public-Private Partnership

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