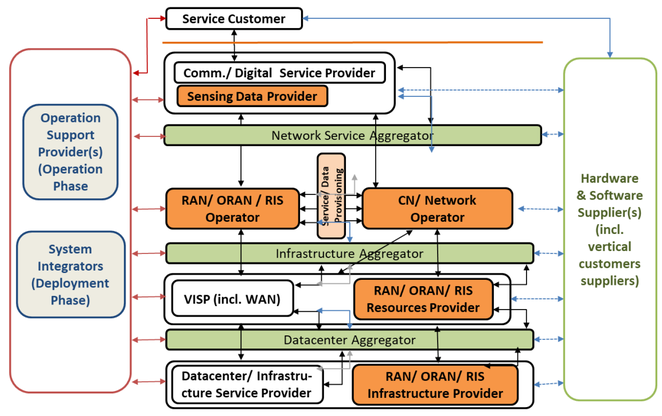
SEamless integratioN of efficient 6G wirelesS tEchnologies for Communication and Sensing

Objectives

- Integration of 6G RAN technologies such as Cell-Free MIMO (CF-MIMO) and Integrated Sensing and Communication (ISAC) to support the 6G vision inspired by the current (and future) architectural framework based on 3GPP and Open-RAN (O-RAN)
- Provide a Multi-WAT (Sub-6, mmWave, Wi-Fi and 5G NR technologies) ISAC platform that ingests cross-technology sensing to evolved O-RAN RICs integrating to achieve sub-cm precision
- Demonstration of a CF-MIMO PHY solution enhanced with real-time control capabilities, demonstrating distributed signal processing, tight synchronization, and efficient fronthaul/backhaul integration.
- Leverage network dataplane programmability and sketch-based data structures to deploy a framework for edge traffic monitoring

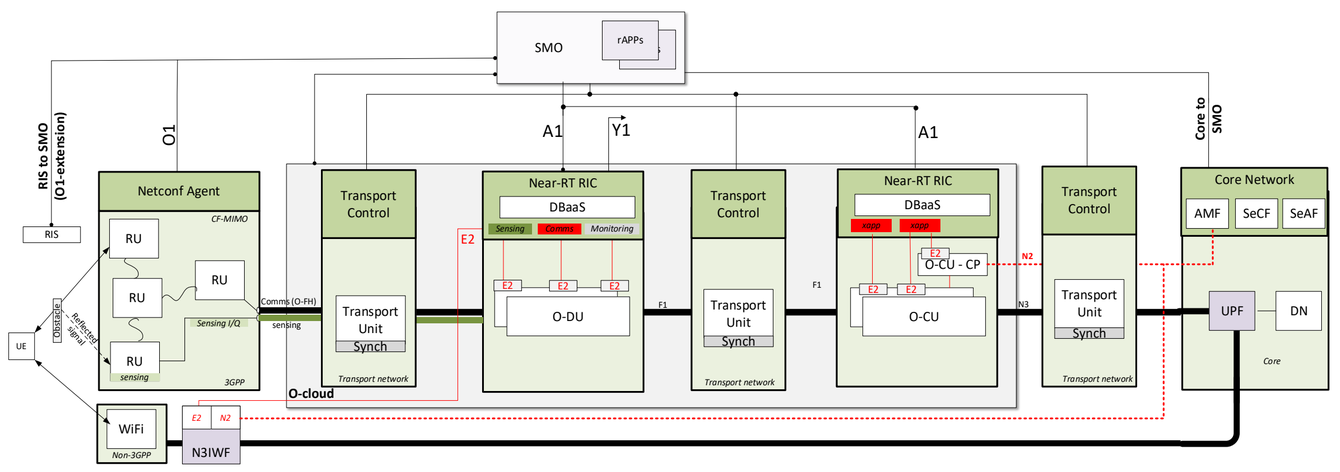
6G-SENSES Use Cases and Ecosystem

- Use Cases: **#1**: Sensing enabled Services, **#2**: Ubiquitous Connectivity & Immersive Services, **#3**: Network Digital Twin (DT)
- Ecosystem – 6G-SENSES enable various RAN provisioning approaches: **1/** RAN as raw infrastructure resources, **2/** RAN as virtualized resources, or/ and **3/** RAN -captured, -processed -exposed data to Network Operators (NOPs) or (even) service customers



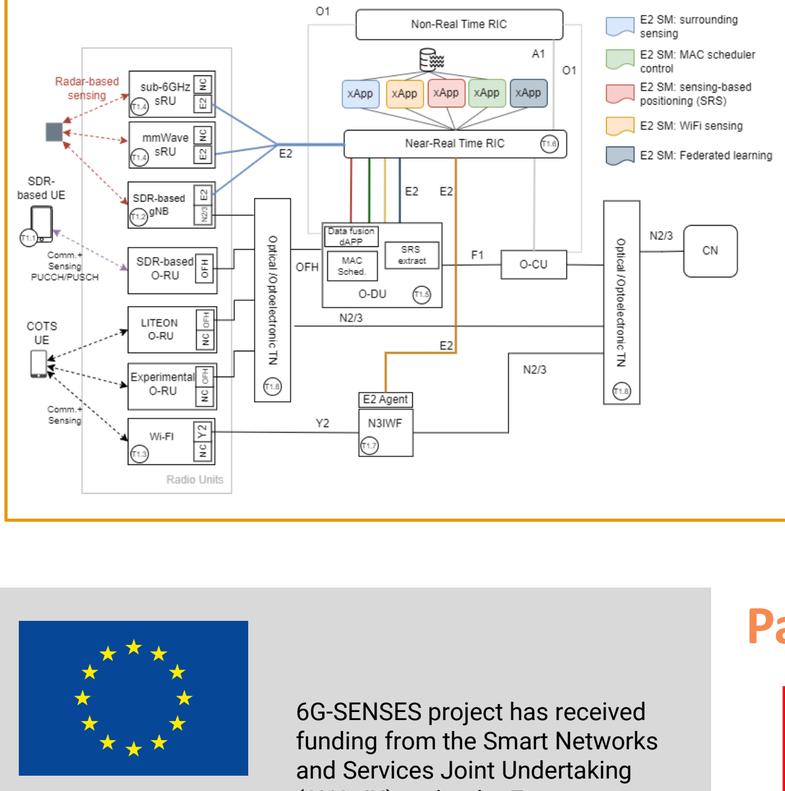
Architecture

- Inspired by the 3GPP and Open Radio Access Network (O-RAN) standards and adopts a disaggregated network approach that separates RAN and CN functions offering increased flexibility and scalability
- CF architecture able to offer ISAC services that exploit the distributed antenna and sensing environment from cell-free and distributed MIMO architectures.
- Interconnects a multi-technology RAN able to offer sensing functionalities (3GPP and non-3GPP) with CN domains, to facilitate joint support of sensing and communication services



PoC#1 – Multi-Technology ISAC Platform

- Sensing information collected at UE level from non-3GPP networks can be exposed to the O-DU through extensions in PUCCH/PUSCH.
- Non-3GPP Wireless Access Technologies, able to perform radar-based sensing, provide sensing data to the RIC.
- A UE transmits SRSs in UL and are passed toa low-latency xApp in real time, who infers the UE position.
- The O-DU is provided with techniques to better manage the radio resources based on sensing information.
- Adopt and appropriately extend N3IWF to allow Wi-Fi networks to securely expose sensing data to the RIC.



PoC#2 – CF-MIMO Prototype

- **RU/UE Layer**: A (distributed) CF-MIMO testbed is implemented with two (or more) USRP RUs and two (or more) UEs, validating both independent and joint transmission modes.
- **RIS Integration** (E2 Interface to Near-RT RIC): demonstrates the feasibility of RIS integration.
- **Near-RT RIC Layer** (E2 Interface): Two xApps—RIS Control and Adaptive Beamforming—are deployed on the Near-RT RIC.
- **Core and Data Network (DN) Layer** (N2/N3/N6 Interfaces): The OAI-gNB connects to the 5G Core through N2/N3 interfaces, while the 5G Core connects to the DN through the N6 interface.

PoC#3 – NDT via RAN Sensing

- Makes use of the sensing functionality of the RAN to optimize network performance and efficiency with the assistance of an NDT.
- The NDT relies on network planning information and network performance/ telemetry data and is implemented in the form of an rApp associated with the O-RAN Radio controllers.
- Three main entities, **i)** the Real Network, **ii)** the Common SMO, and **iii)** the NDT.

Co-funded by the European Union

6G-SENSES project has received funding from the Smart Networks and Services Joint Undertaking (SNS JU) under the European Union's Horizon Europe research and innovation programme under Grant Agreement 101139282

Partners: