6G-BRICKS

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Outline

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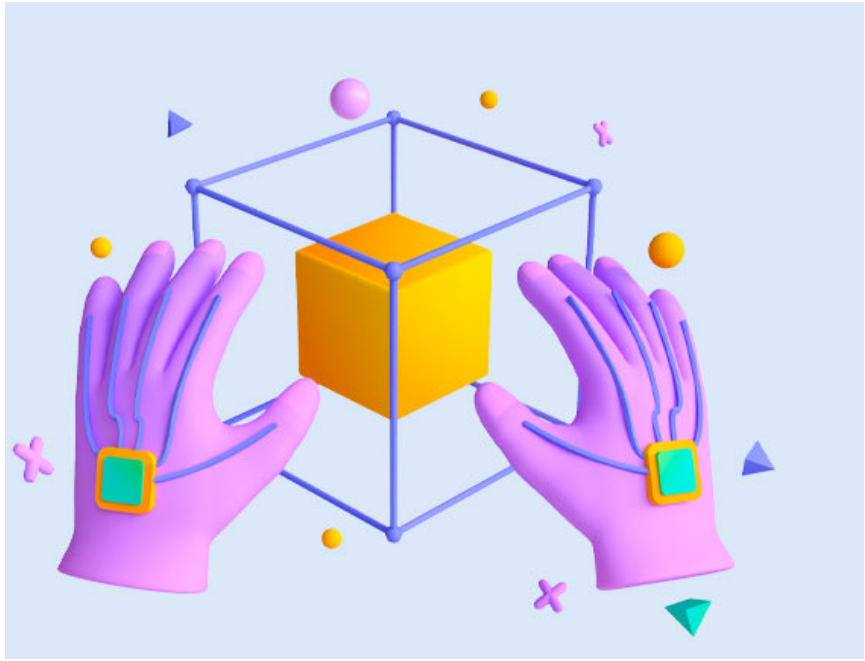
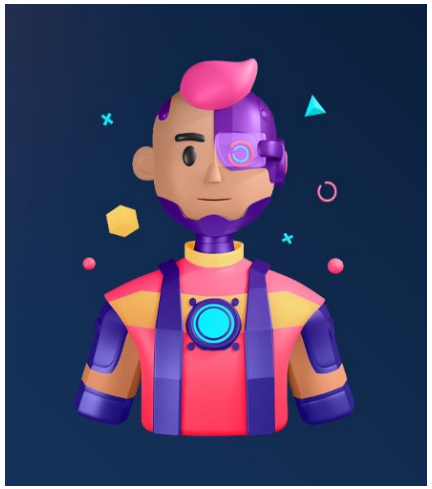


General Information

- ✓ **Grant Agreement:** 101096954
- ✓ **Duration:** 36 months
- ✓ **Starting date:** 01/01/2023
- ✓ **Total budget:** 8,849,599.50 €
- ✓ **EC funding:** 8,404,533.38 €
- ✓ **Cascaded funds:** 1,696,563.18 €
- ✓ **Total PMs:** 833
- ✓ **Project Coordinator:** Prof. Christos Verikoukis (ISI/ATH)
- ✓ **Technical Manager**: Dr. Kostas Ramantas (IQU)
- ✓ **URL:** www.6gbricks.eu
- ✓ **Project Officer**: Dr. Odysseas Pyrovolakis



Project Partners

Why 6G-BRICKS?

6G-BRICKS is a continuation of key ICT-20 and ICT-52 B5G projects (MARSAL, MonB5G, RISE6G, REINDEER) joining forces with the aim to shape the next generation of Smart Networks

Mature experimentation tools from the ICT-41 5GMediaHUB project were leveraged for the federation of 2 well established platforms (KUL, EUR) and an Experimentation site (ISI/ATH & IQU).

Experience from past 5G-PPP efforts has shown that the enormous complexity of the software stacks and interoperability challenges makes evolvability extremely challenging.

6G-BRICKS Objective

6G-BRICKS bringing together specialists on breakthrough 6G technologies, such as cell-free networking, distributed processing and Reconfigurable Intelligent Surfaces (RIS), and adopting principles of modularity and softwarization **to deliver the first truly modular end-to-end 6G experimentation platform in Europe**.

6G-BRICKS will structure the various architecture tiers **around the concept of "LEGO Bricks"**, delivering self-contained testbed nodes that can be reused across testbed infrastructures. This significantly lowers the barrier of entry to an end-to-end experimentation platform for specialists to bring their breakthrough technologies for validation and experimentation.

Technical Objectives (1)

Objective 1	**To deliver an evolvable 6G experimentation facility that will integrate breakthrough 6G technologies and federate two testbeds under a common set of experimentation tools**
KPI-1	Federate breakthrough technologies from 4 B5G ICT-52 projects
KPI-2	Offer experimentation and service creation time from minutes to seconds
KPI-3	Support service deployment in a continuum of 3 orchestration domains
Objective 2	**To validate advanced use cases in holographic communication, metaverse and digital twinning, showcasing the benefits of 6G breakthrough technologies and architectures**
KPI-1	Design, implement and showcase 2 extreme 6G use cases each offering 2 PoC
KPI-2	Showcase at least 5 KPIs exceeding 5G target values
KPI-3	Support service deployment in a continuum of 3 orchestration domains
Objective 3	**To support disaggregated and programmable Software-Defined Infrastructures (SDIs), adopting virtualization, softwarization and O-RAN compliant interfaces to promote modularity and reusability**
KPI-1	Contribute at least 10 open and reusable enablers (“bricks”)
KPI-2	Deliver at least 4 O-RAN compliant xAPPs and 2 O–RAN stacks

Technical Objectives (2)

Objective 4	Offer a fully decentralized management plane, supporting zero-touch orchestration of compute and communication resources based on Explainable AI
KPI-1	Deliver DMOs for at least 3 technological domains
KPI-2	80% of ML models deployed on 6G-BRICKS are explainable
KPI-3	Reduce the life-cycle of service validation through experiments by half thanks to XAI-MR-based root cause analysis

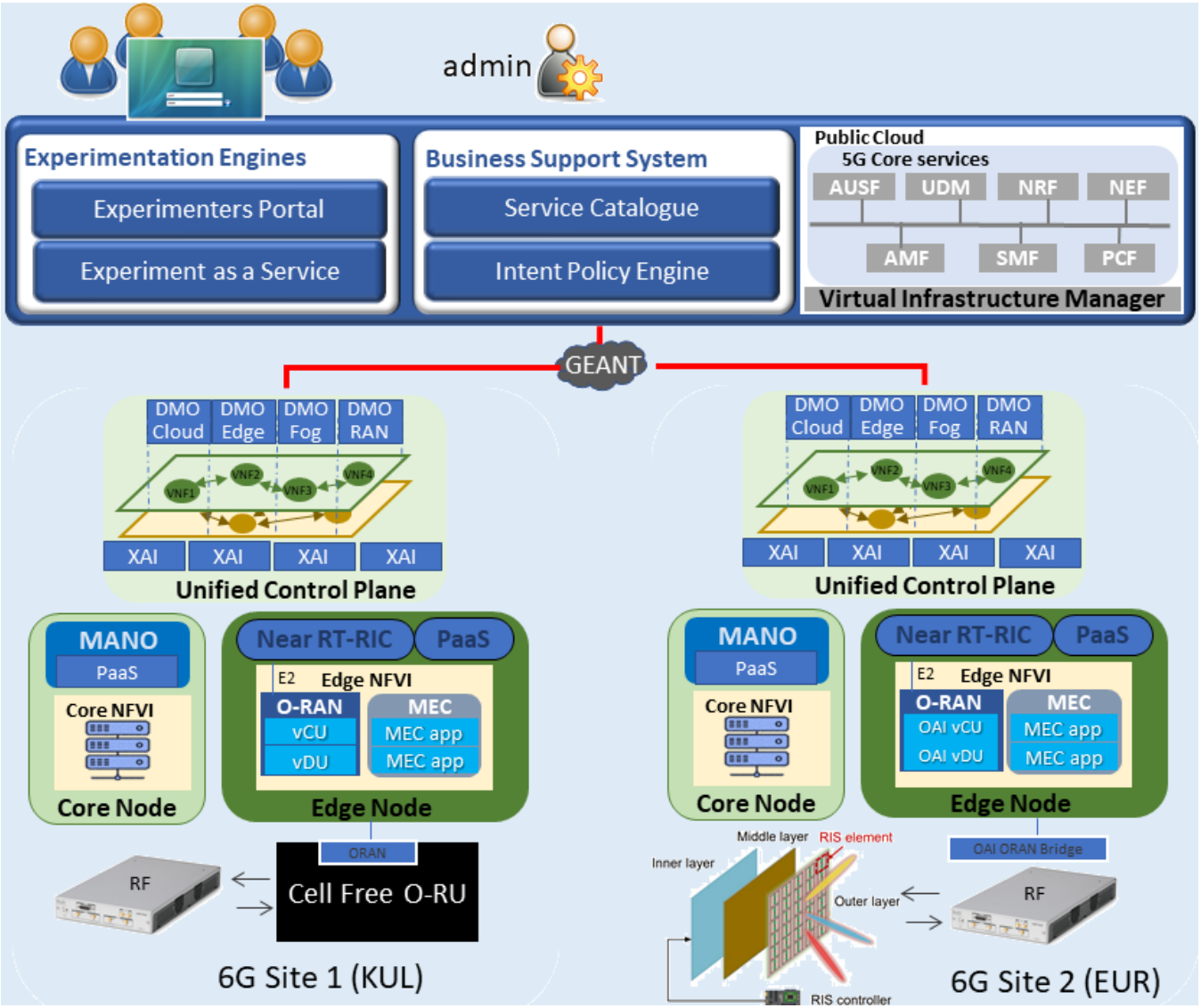
Objective 5	Offer a Compute Continuum abstraction framework supporting a disaggregated wireless X-Haul
KPI-1	Time to compose: from the moment a slice that includes Platform as a Service (PaaS) services (from Cloud to Edge) as well as IoT devices (Far Edge), is requested until the time that it is successfully deployed; <1 minute
KPI-2	Time to migrate: from the moment that it is decided that a PaaS service should migrate, until the time that migration is completed; <20 seconds

Technical Objectives (3)

Objective 6	Deliver breakthrough technologies towards a 6G RAN via Distributed Cell-free and RIS
KPI-1	Reduce by 80% the mmWave connection breaks and SLA violations due to obstacles and UE mobility
KPI-2	Improve the spectral efficiency for the 5% worst users by a factor of 2
KPI-3	Reduce synchronization overhead by 50%

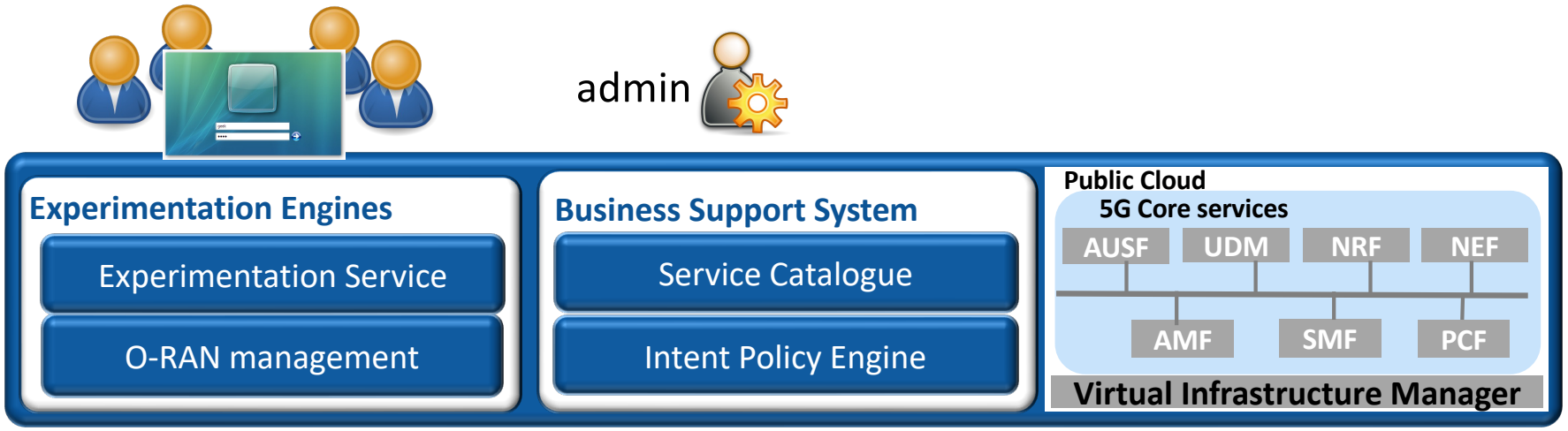
Objective 7	Provide a secure and trusted Experimentation Facility for multiple concurrent tenants and experimentation platforms
KPI-1	Demonstrate dynamic establishment of cross-domain perimeters in less than 1 minute
KPI-2	Demonstrate automated security policy reinforcement and trust establishment of at least 4 tenants

Overall Architecture

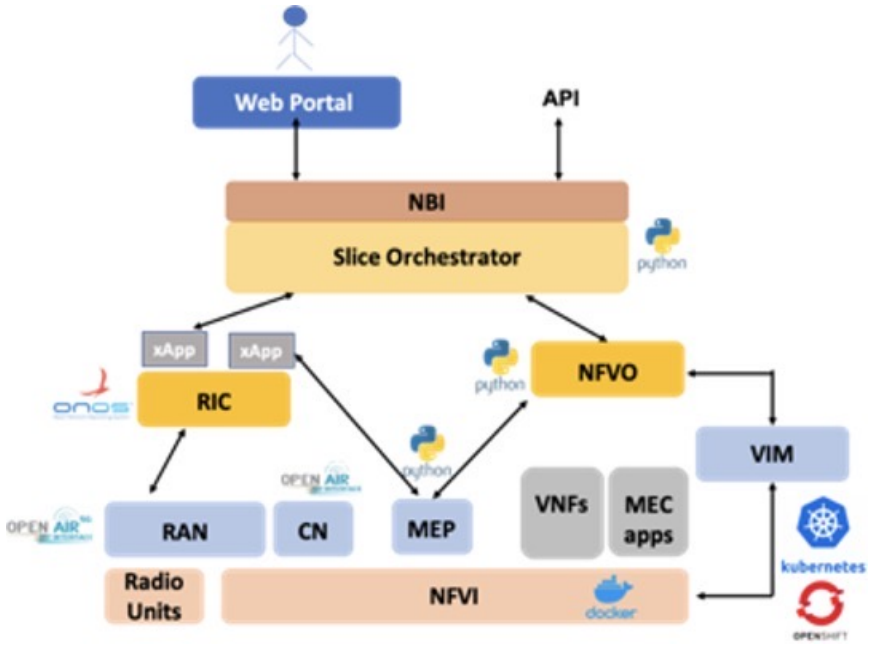


Experimentation Facility

- Federation of KUL and EUR testbeds with an end-to-end experimentation facility, which automates experiment execution.
- Experimentation Engines, offering automated onboarding of experiments (leveraged from 5GMediaHUB) and for the first-time experimentation down to Radio Units (RUs) via O-RAN compliant xApps
- Business Support System (BSS) towards vertical applications, offering a service catalogue with Service-level Intents and SLAs definition support

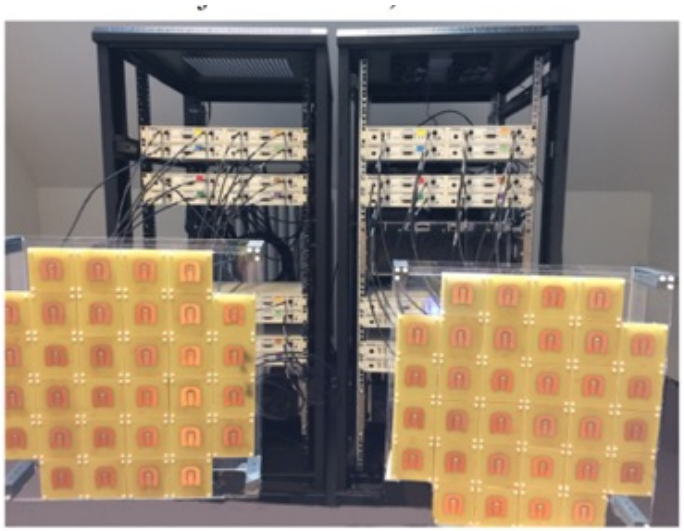


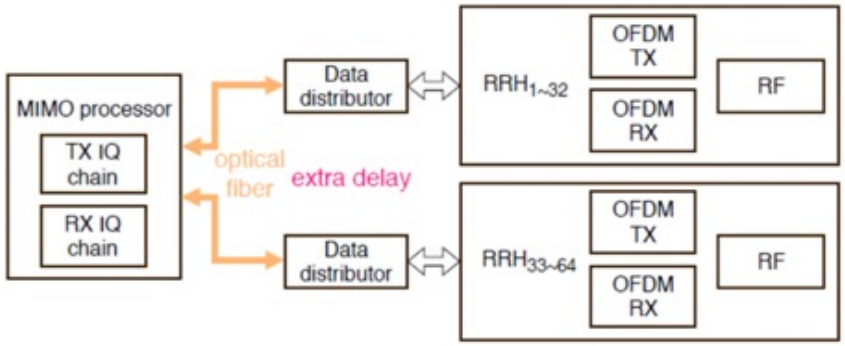
EUR testbed



- EUR runs a 5G and beyond facility as an extendable experimental playground for the OpenAirInterface (OAI).
- Fully open-source tools.
- The radio infrastructure includes indoor and high-power outdoor radio-units operating in several frequency bands in the immediate vicinity of the test site.
- The testbed also includes an Open RAN (RIC based on ONF xONOS) capabilities, and a compliant MEC ETSI platform and application ecosystem.
- The edge infrastructure uses a cluster of computing resources managed by OpenShift 4.9 Kubernetes container platform.
- To be upgraded with a RIS platform.

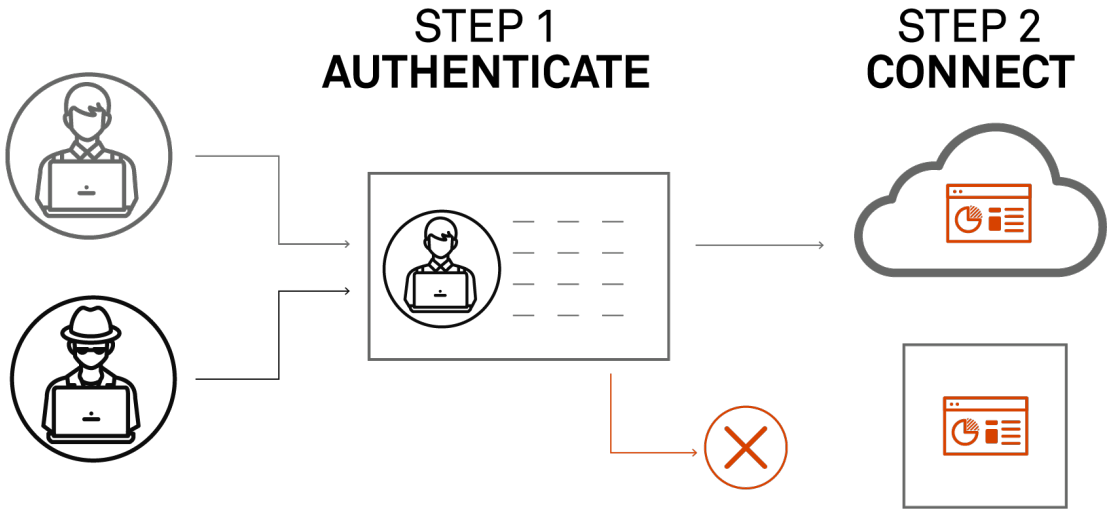
KUL testbed





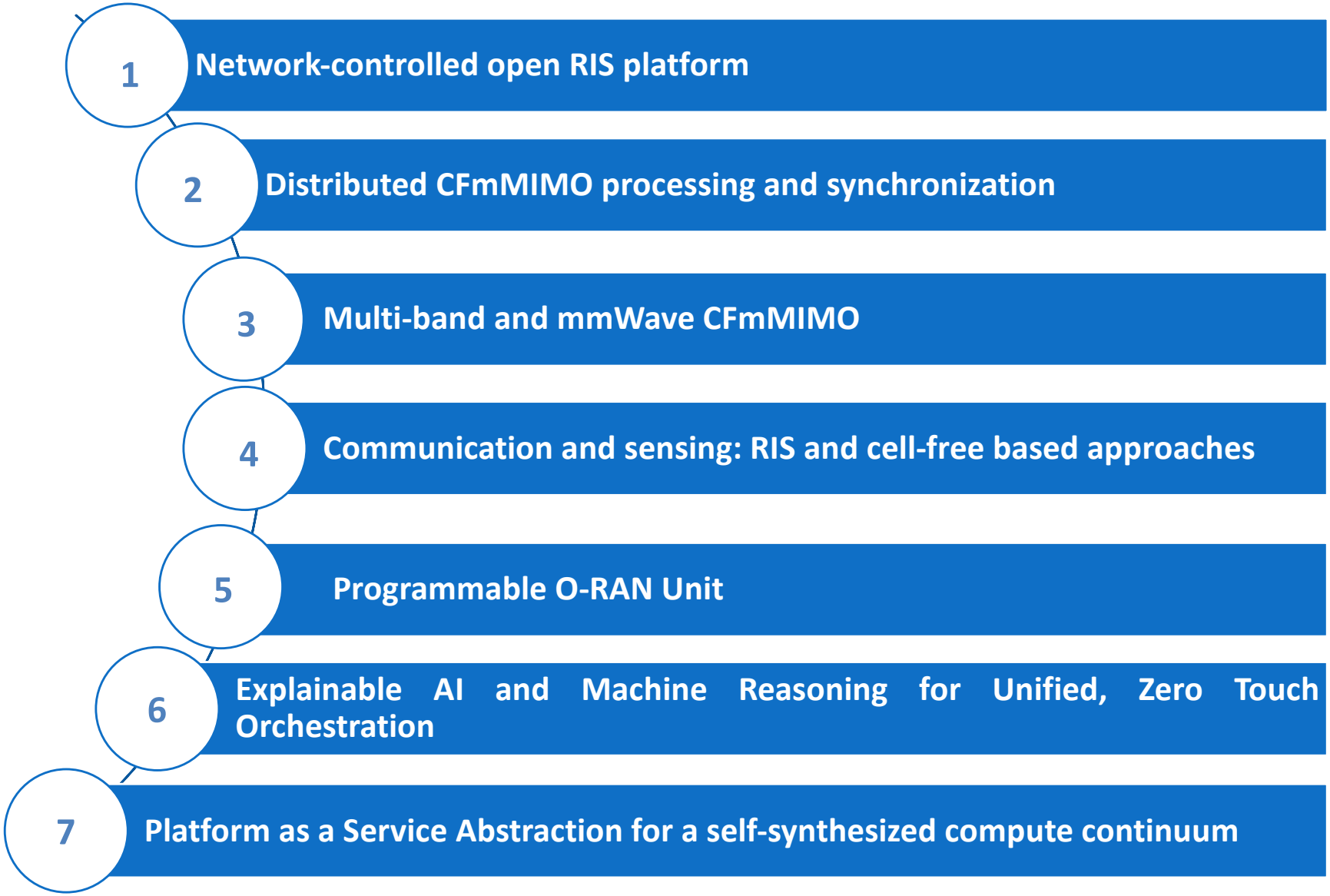
- KUL operates a distributed cell-free massive MIMO testbed, and a private 5G Standalone Network for experiments.
- 32 National Instruments USRPs (2942R/USRP RIO) equally divided into two sub-systems, where each of them supports 32 APs. The system further has centralised and distributed processing power.
- The APs are connected to a programmable MIMO processor (e.g. cell-free CPU) via two 40 meters optical fibers responsible for the front-haul.
- Upgrades ongoing: mmWave connectivity and advanced features such as full duplex communication and joint communication and sensing

Security of the Facility



- Innovative security framework based on Software Defined Perimeters (SDP) and VPNaaS support, offering zero-trust security for 6G networks.
- Dynamically configurable zero trust environment where privileged infrastructure is completely isolated from less privileged one where tests and vertical microservices are deployed.
- Tenants and authenticated users can be dynamically assigned access to perimeters by the facility administrator

Innovation Streams – innovative “Bricks”



UC1 – Metaverse for the workplace

- The Metaverse is expected to drive the transition to 6G systems, due to the extreme KPI requirements, as well as the digital transformation of societies, allowing users to interact in Virtual Environments (VEs)
- A Multi-point Control Unit application handles the real-time processing of “holograms” (i.e., the 3D representation of users), and streaming 360 VR Spheres of the VE to each participant
- Distributed Cell-Free ensures increased SE (2x) and 80% reduction in blocking, helping ensure QoE. The PaaS enabler helps exploit a continuum of resources to facilitate computational offloading and real-time service migration.

Scenario 1: Holoconferencing in a virtual meeting room

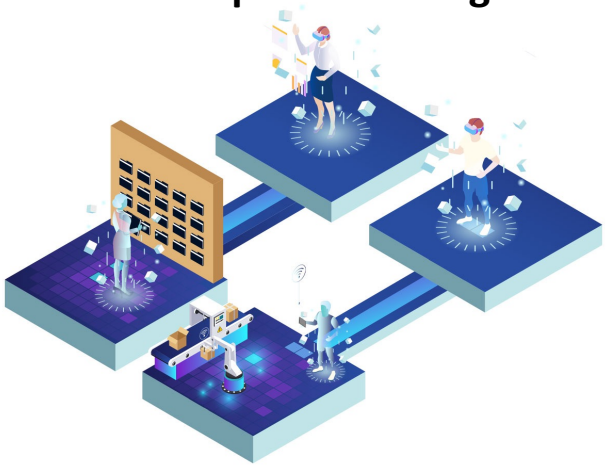
Scenario 2: Virtual Team building activities

UC2 – 6G I4.0 applications

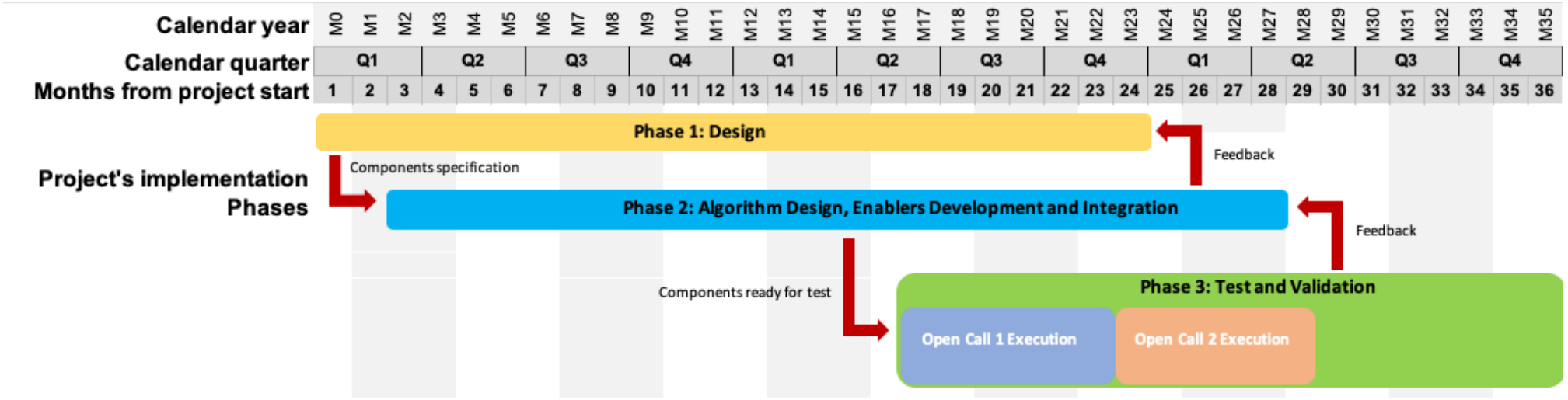
- Autonomous robots and Digital Twins are a rapidly growing market for industrial applications and heavily relies on the collection of high-volume data with low-latency.
- 6G-BRICKS technologies will provide the required reduction in blocking probability, as well as JCAS functionality required for efficiently tracking and beam steering.
- Autonomous robots in a factory environment with low latency and 100% coverage (no disconnection).
- Very high bandwidth for video and 3D streaming with low latency and 100% coverage (no disconnection

Scenario 1: Autonomous robots in Industry 4.0

Scenario 2: AR inspection of digital twin



Work Plan and Open Calls



Open Call 1
Proposals for covering, but not limited, devices and components via O-RAN xAPPs, compute continuum leveraging the UE Farms, and novel XAI modules.

Open Call 2
Proposals for covering, experiments in different vertical domains and applications.

THANK YOU!

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