



Opening Flashlight Accelerating Network Disaggregation

FOTIS KARONIS | Capgemini



ACCELERATING TRANSFORMATION TO DISAGGREGATED OPEN NETWORKS

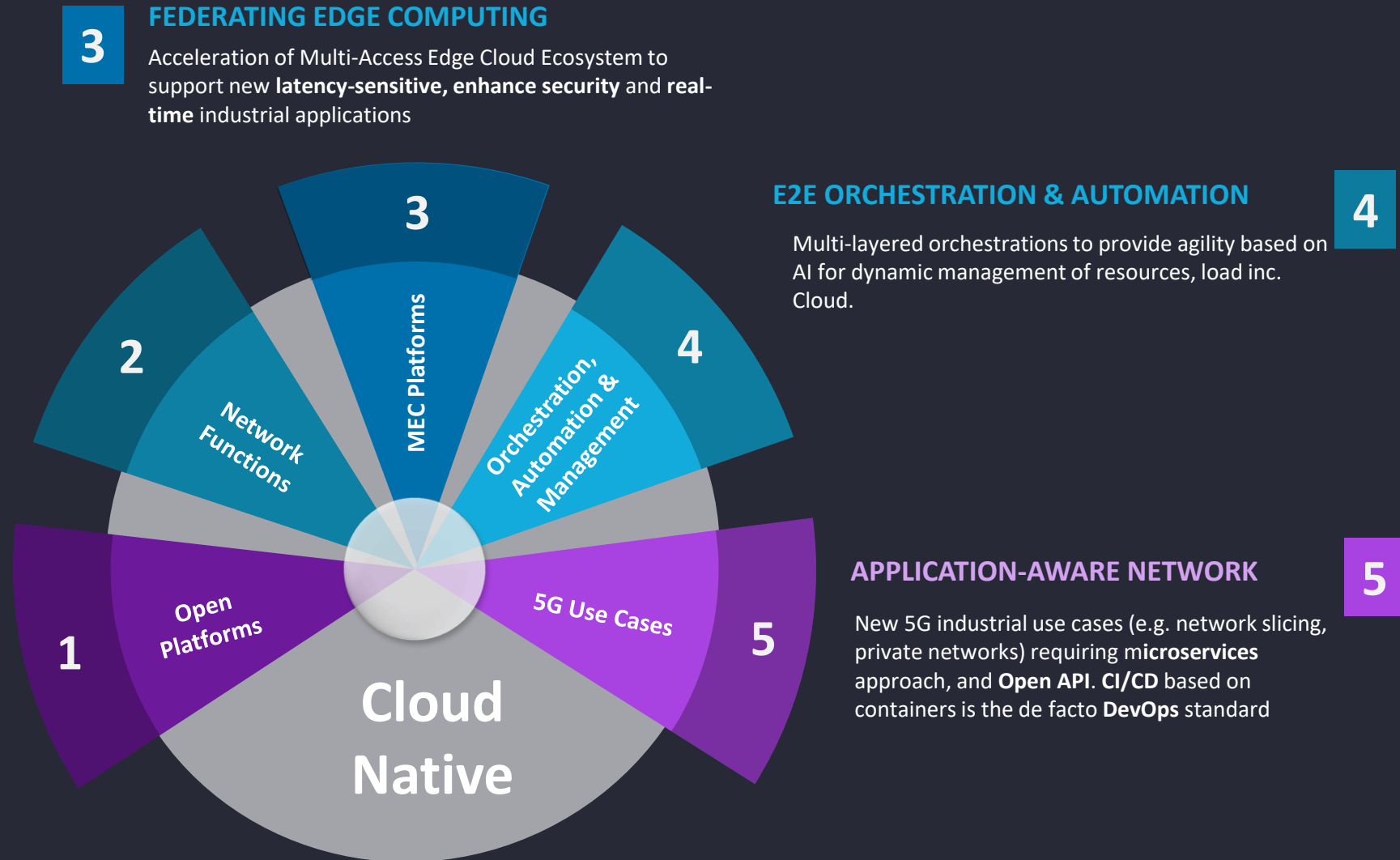
Fotis Karonis

June 9, 2022

GET THE FUTURE
YOU WANT



THE NEED FOR DISAGGREGATION IN A 5G ERA





KEY TRENDS IN CLOUD NATIVE OPEN NETWORKS

1.

5G Cloud Native Applications for Verticals & OSS Transformation to Cloud

2.

Cloud Native Edge Compute (MEC)

3.

5G Standalone Core Network

4.

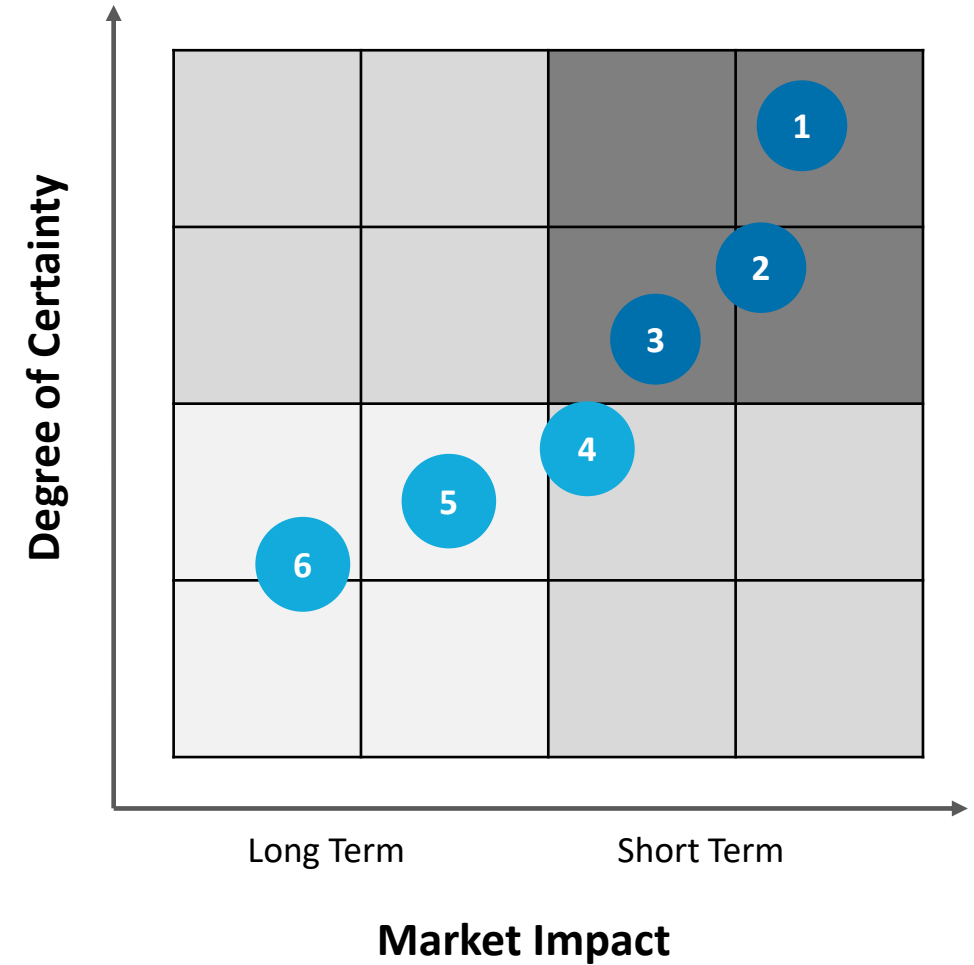
Disaggregated OpenRAN and Cloud-RAN

5.

Data Driven Autonomous Network

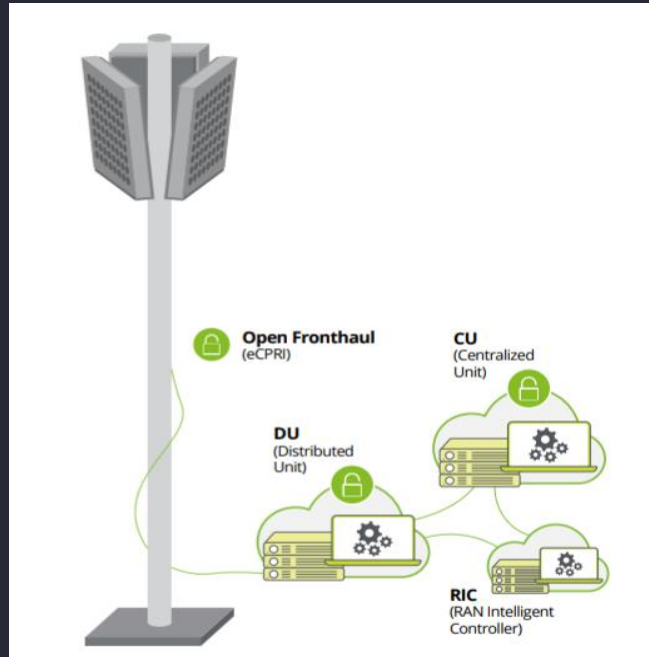
6.

Sustainable Cloud Native Networks for Telcos



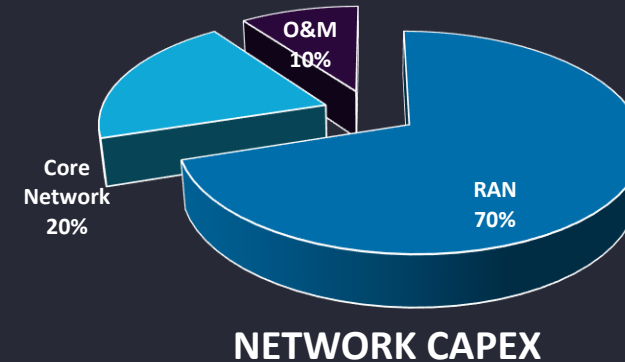


THE FUTURE OF NETWORK WILL BE OPEN & SMART



A **Disaggregated approach** with open, interoperable protocols and interfaces allows **increasing flexibility** over traditional architectures for **TCO optimization**

RAN represents **70%** of **Network CAPEX** for Telcos





DISAGGREGATION IS BRINGING NEW BENEFITS BUT ALSO SOME MAJOR ISSUES TO OVERCOME

Opportunities

- **TCO** efficiencies
- **Diversity** of players
- **Innovation** development
- **Time to market** reduction

Challenges

- **Performance & Features** parity
- **Interoperability** challenges
- **Skills** & capabilities
- **Security** challenges

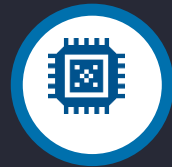


BUT RECENT TECHNOLOGY DEVELOPMENTS HAVE CONSIDERABLY ACCELERATED OPEN RAN MATURITY



BURSTING RADIO UNIT (RU) MARKET

Many NEP vendors developing RU HW



COTS HW PERFORMANCE ENHANCEMENT FOR BBU

BBU virtualization on COTS hardware (vDU, vCU) has long been limited by L1 performance. Development of new FPGA chipsets / accelerators in HW L1 now matured



MULTI-VENDOR INTEROPERABILITY BECOMES A REALITY

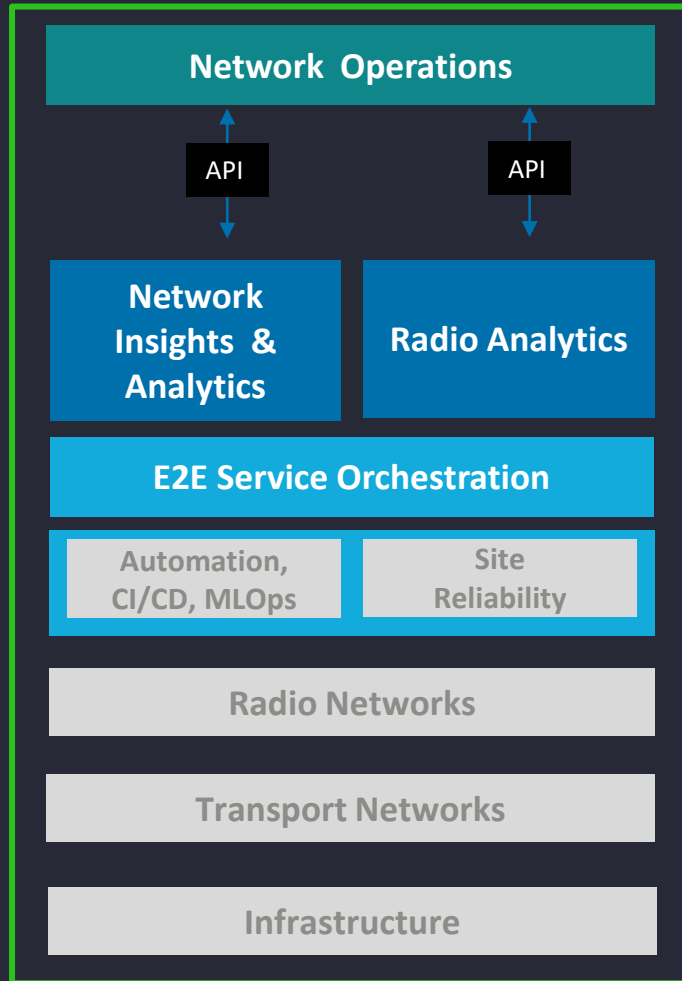
Industry bodies & standardization groups (ORAN alliance, TIP) have fostered the development of standardized / semi-proprietary protocols & interfaces (eCPRI).



HYPERSCALERS' INTEREST IS ACCELERATING

After collaboration on Telco cloud migration, edge computing, they are now looking at adding Open RAN technologies to their portfolio for small / macro cells, B2B private networks...

OUR STRATEGY: ACCELERATE MULTI-VENDOR SYSTEM INTEGRATION *LEVERAGING DEEP ECOSYSTEM & CLOUD EXPERTISE*



Cloud RAN Focus

Global Managed Services organization: Dedicated vendor management and procurement functions for network solutions

Orchestration, RIC & Network Analytics assets: Investments in specific solutions and innovative services for O-RAN xApps and O-RAN use cases

Dedicated vRAN/O-RAN 5G Interop Labs: for integration, testing, automation, validation. Partnerships with all major Test/measurement vendors, proven O-RAN Testing Stacks.

System Integration: Leading O-RAN product integrator for Tier-1 Telcos, with deep product experience

Expertise in O-RAN Product Dev: 40+ Software licenses sold in the areas of O-RAN (CU/DU) to NEPs

Transport networks for O-RAN: Fronthaul & Disaggregated Cell Site Gateways development expertise

Strong Global Partnerships in O-Cloud Infra: engineering and deployment expertise in Cloud Native O-RAN platforms

Partnerships with all major vendors which are also Capgemini's O-RAN product Development clients

SUSTAINABILITY & POWER CONSUMPTION REDUCTION



Supporting a green economy, optimize 5G usage and the CO₂ footprint



Energy Saving

- ✓ **Dynamically** optimize cells across different power and capacity modes.
- ✓ **NWDAF** (Network Data Analytics Functions) with network AI to manage energy



MARCONI project with



Innovation AWARD Winner

NetAnticipate

Capgemini AI Platform for Self-learning Networks



RATIO platform

Capgemini O-RAN RIC Framework



Industry's First AI/ML-based RAN App

Spectral Efficiency boosts by 15%

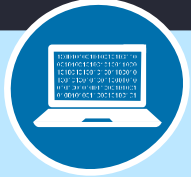
- ✓ **higher cell capacity** with **less equipment**, reducing the environmental impact

[Press Release Link](#)



WE HELP CLIENTS STRATEGIZE, BUILD, TRANSFORM AND DELIVER BUSINESS VALUE WITH 5G & EDGE

FOCUS AREAS 2022



PLAN & STRATEGY – DIGITAL TRANSFORMATION

Build a digital transformation strategy around 5G & Edge and set-up new business models and partnerships

5G monetization & Telco architecture evolution



5G OPEN NETWORK INFRASTRUCTURE

Navigate the complex network & technology ecosystem, design and build an end-to-end network architecture blueprint and roadmap

ORAN, Core Cloudification, NaaS (inc. slicing)



STRATEGIC SERVICE PLATFORMS

Design & develop end-to-end digital service enablement platforms and API management systems

Telco Edge Cloud & Hyperscalers



USE CASES & APPLICATIONS

Design, set-up, define path to monetization and run industry specific 5G / Edge use cases and applications (IoT, Edge, Cloud)

Advanced Connectivity (5G) for Industries



ECOSYSTEM ORCHESTRATION & INTEGRATION

Assemble & integrate solutions to form a coherent, scalable, agile, software-driven and futureproof E2E technology stack:

- Integrate leading partners and open-source solutions
- Engineer complementary solutions where required

LaaS, ORAN & NaaS (inc. slicing), Cloud native services



5G END-TO-END BUSINESS & OPERATIONAL SERVICES

Transform operating model, organization and OSS/BSS in line with new IT/NW infrastructure, new products and services, automating tasks & processes and providing managed services

Managed services for CSPs

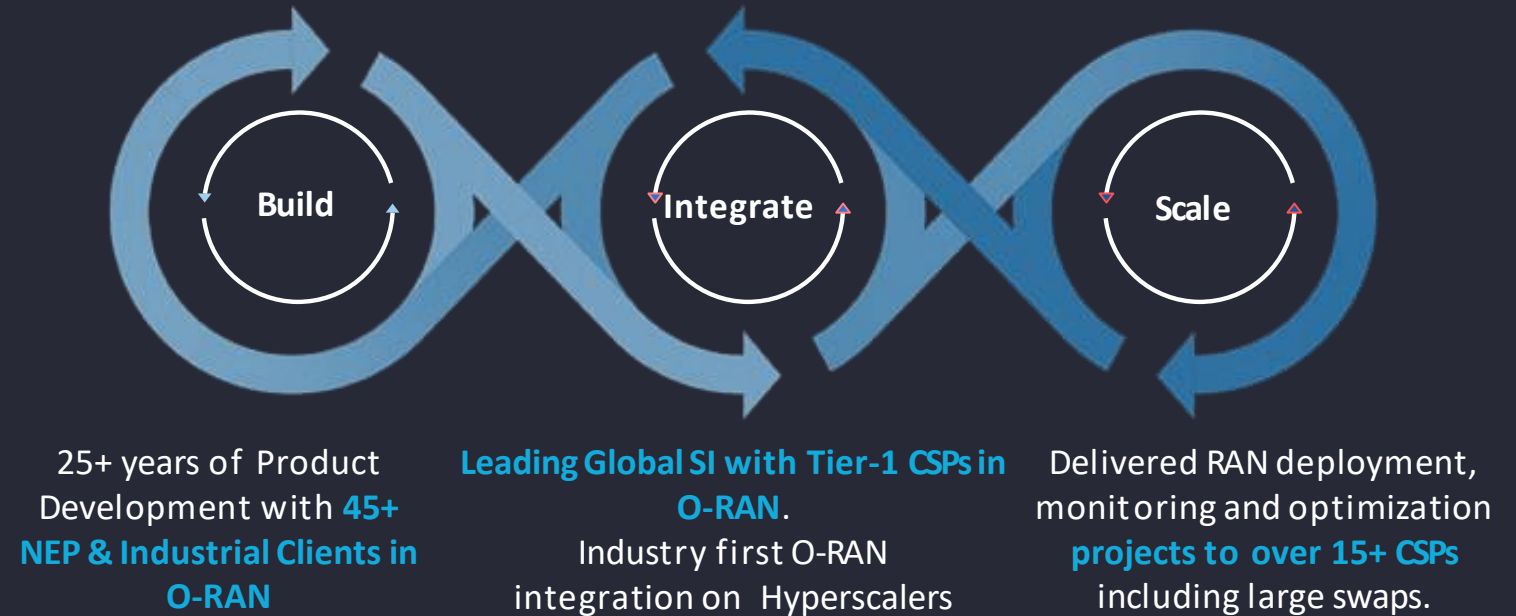


CAPGEMINI'S COMMITMENT TO DRIVE O-RAN AT INDUSTRIAL SCALE

CREDENTIALS & INNOVATION

1. Founding member of TIP and O-RAN Alliance
2. Key Integrator and SW provider for Industry O-RAN players
3. Deep expertise in RAN Silicon and L1 with strong partner ecosystem e.g., Intel, Qualcomm, NVIDIA
4. Demonstrated Industry First RIC innovation (TIP RIA)
5. Demonstrated Industry's first AI/ML based radio network increasing Spectral efficiency up to 15% (Marconi project)

OUR VALUE PROPOSITION



A large, thin, light blue arc curves from the top right towards the bottom left, passing behind the central text.

**GET THE
FUTURE
YOU WANT**

What Is Open RAN All About?

PETR LÉDL |
Deutsche Telekom

Open RAN

Petr Lédli, DTAG – VP, Chief O-RAN Architect; 09.06.2022



Why do we need open RAN?



Ecosystem challenge

Deployment cost & flexibility

Cumbersome & costly RAN swap

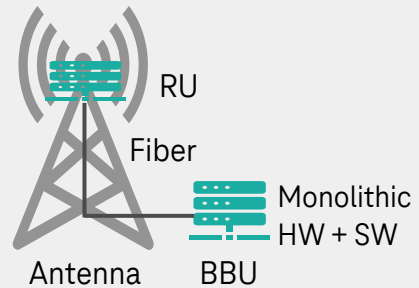
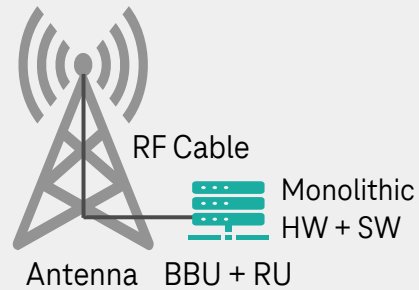
Low flexibility limiting innovation speed

RAN disaggregation

Network disaggregation breaks-up monolithic network gear



TELECOM INFRA PROJECT



Modular/Decomposed



Cloudified/Software-based



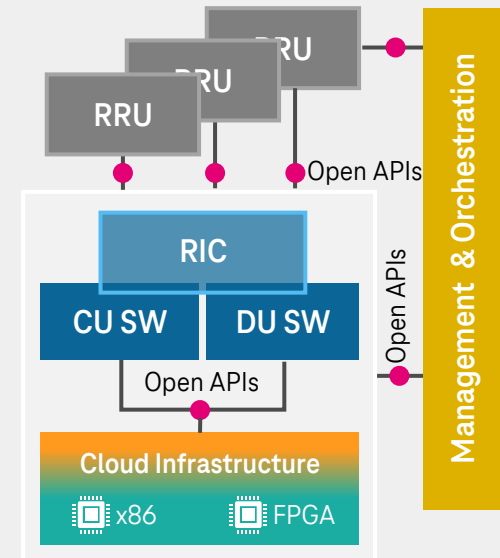
Open APIs & Ecosystem



Automated



Antenna



Disaggregated RAN

RRU = Remote Radio Unit, RIC = Radio Intelligent Controller, CU/DU = Centralized/Decentralized Unit

RAN = Radio Access Network, BBU = Baseband Unit, RU = Radio Unit

RESULTS AND IMPACT

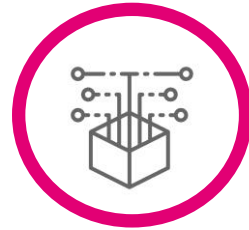


- TCO reduction
- Avoid Vendor lock-in, enable and “secure” new players
- Network softwarization for more flexibility, innovation and reduced T2M

Global industry approach



Architecture & Specifications



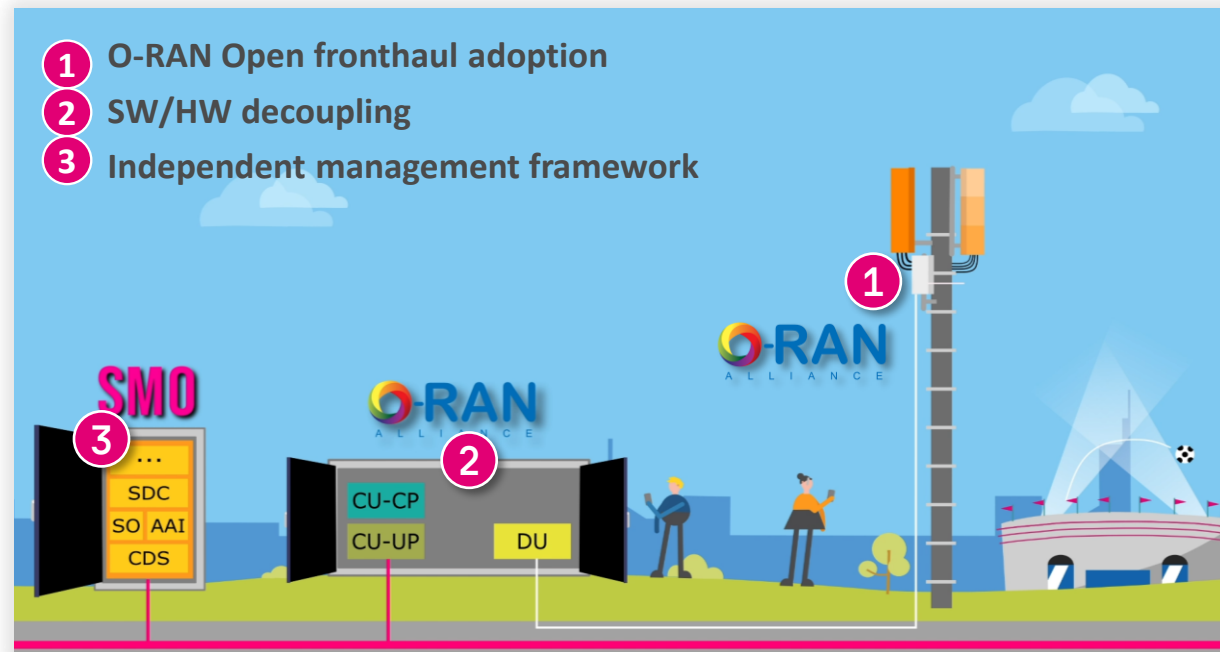
OS development



Testing & Validation



DT approach to open RAN



**O-RAN Open Fronthaul for
RU/BBU decoupling**

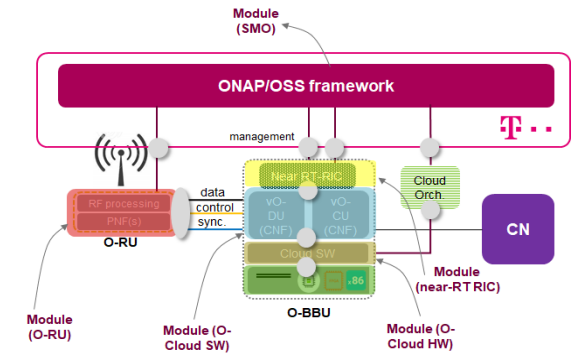
**SW/HW Decoupling to bring
cloudification benefits into RAN**

**Independent management
framework**

Main challenges for open RAN

System Integration

- Control vs. complexity
- Market and specifications maturity
- RAN performance & superiority
- Legal structure and relationship
- Diversity of requirements



Operating Model

- System Integrator vs. Partnership
- Structure & organizational set-up
- Business roles & processes
- Skills
- Automation & Tools



DT open RAN journey



O-RAN TOWN

- Gain operational insights and drive features readiness



SMO/AUTOMATION

- Avoid any vendor lock-in and manage integration complexity



INDUSTRY ECOSYSTEM

- Foster a vibrant and sustainable supplier landscape

6 Key components on our way to Open RAN

Skills Development

- Build required skills and resources



New Operating Model

- Define and Implement required new operating model

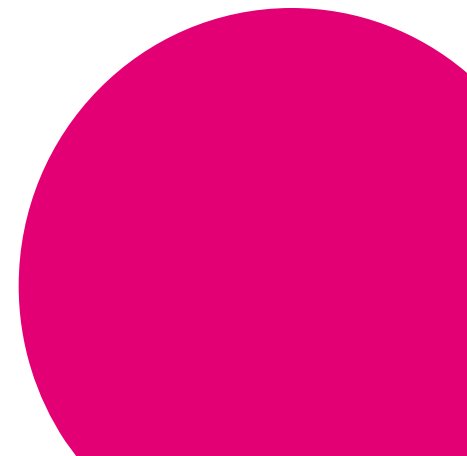


Vendors selection

- Vendors selection for large scale O-RAN deployment



Thank you



The background is a dark grey-blue color. It features several small, solid purple squares scattered across the surface. A thin, vertical purple line is positioned to the left of the main title. At the bottom of the image, there is a horizontal band consisting of a grid of purple and dark grey squares, creating a pixelated or mosaic-like effect.

TIP Release Plans & Testing

DAVID HUTTON | TIP

Telecom Infra Project

A Community Approach to Telecom Networks

Presentation for i14Y Lab Summit22
9th June 2022



TELECOM INFRA PROJECT



What is TIP?

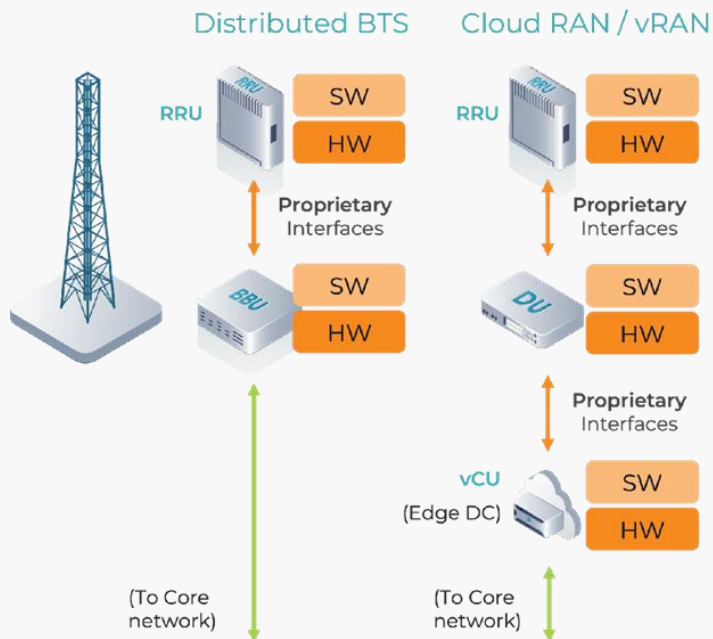
Founded in 2016, TIP is a community of diverse participants that includes hundreds of companies - from service providers and technology partners, to systems integrators and other connectivity stakeholders.

We are working together to develop, test and deploy open, disaggregated, and standards-based solutions that deliver the high quality connectivity that the world needs - now and in the decades to come.

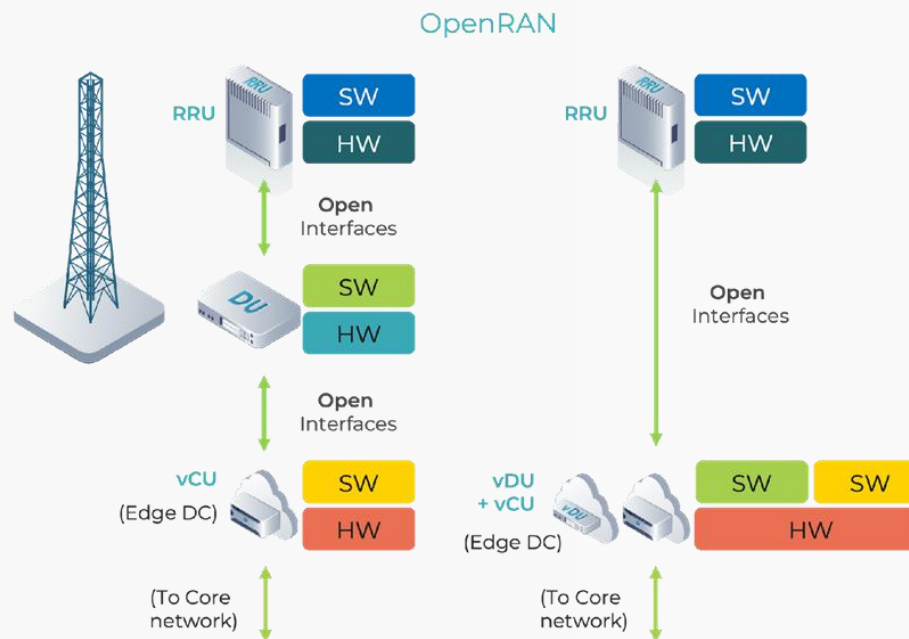
Together We Build, Test & Deploy.

OpenRAN addresses the challenges to achieving greater, higher-quality connectivity

FROM: Single-vendor, fully integrated RAN



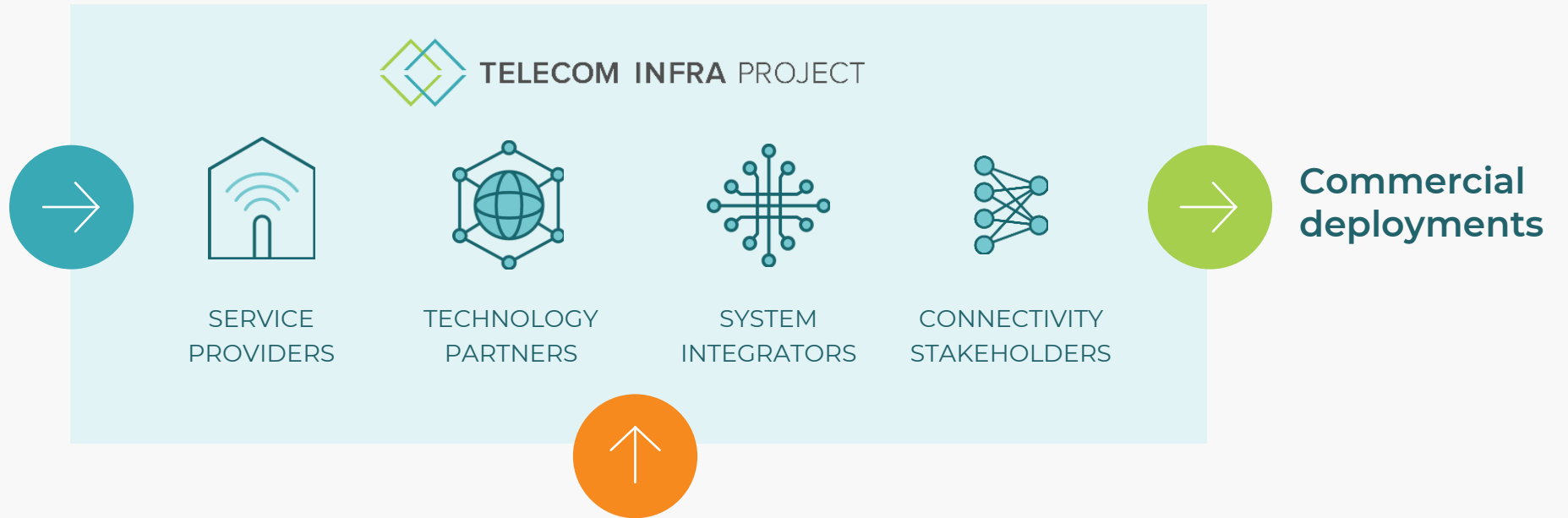
TO: Multi-vendor, disaggregated interoperable RAN



- Build a more **sustainable supply chain**
- Accelerate **innovation** in connectivity
- Improve network **economics**

The Telecom Infra Project is a diverse community accelerating commercial adoption of open & disaggregated network solutions

1. Industry standards



2. Market demand



3. Software and lifecycle management tools

TIP is helping the industry accelerate the commercial deployment of open solutions across the network

Connect. Build.

TIP Exchange brings together the ecosystem to drive new connectivity solutions to market.

TIP members collaborate to develop technical requirements

Suppliers submit their response to the technical requirements

Compliant products are eligible to be listed on TIP exchange website

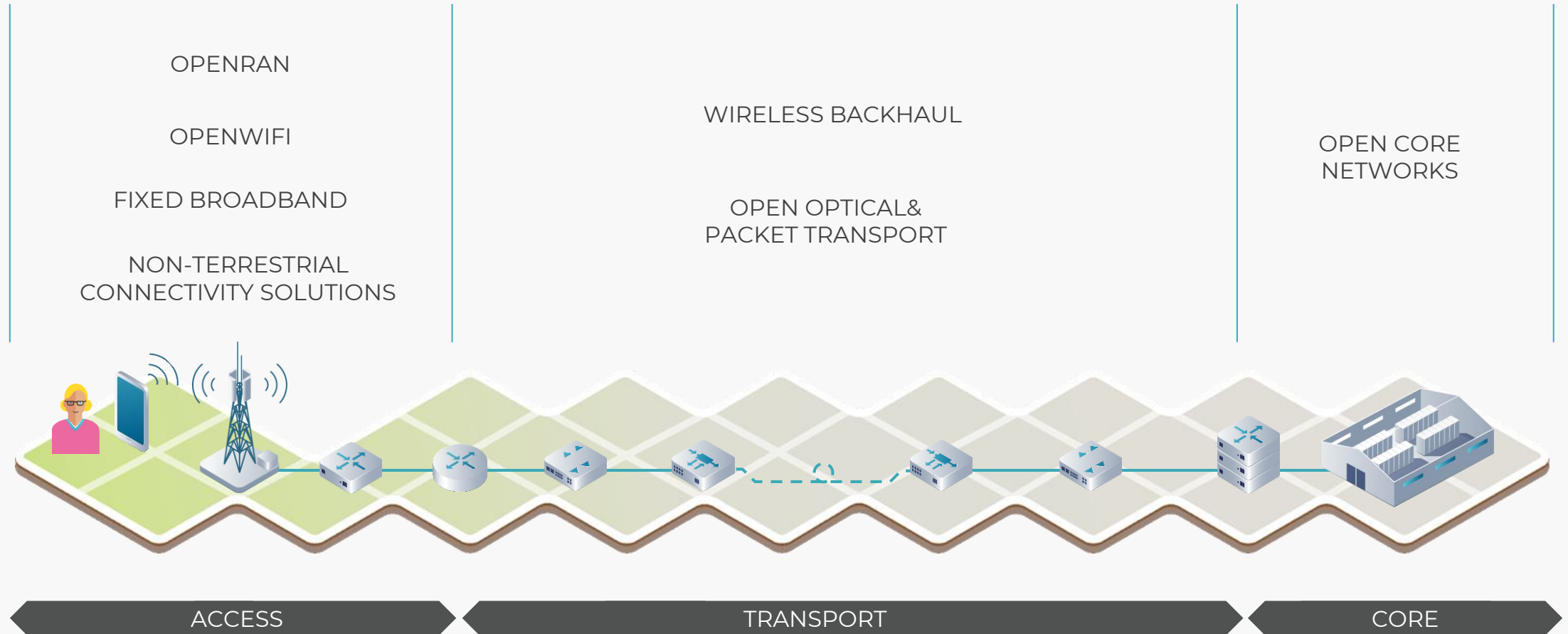
TIP members develop test plans that validate products and solutions against the technical requirements

Collaborative testing in controlled lab environments and TIP badge awards



We are building products across all network layers

PRODUCT GROUPS – Linked to specific network layers



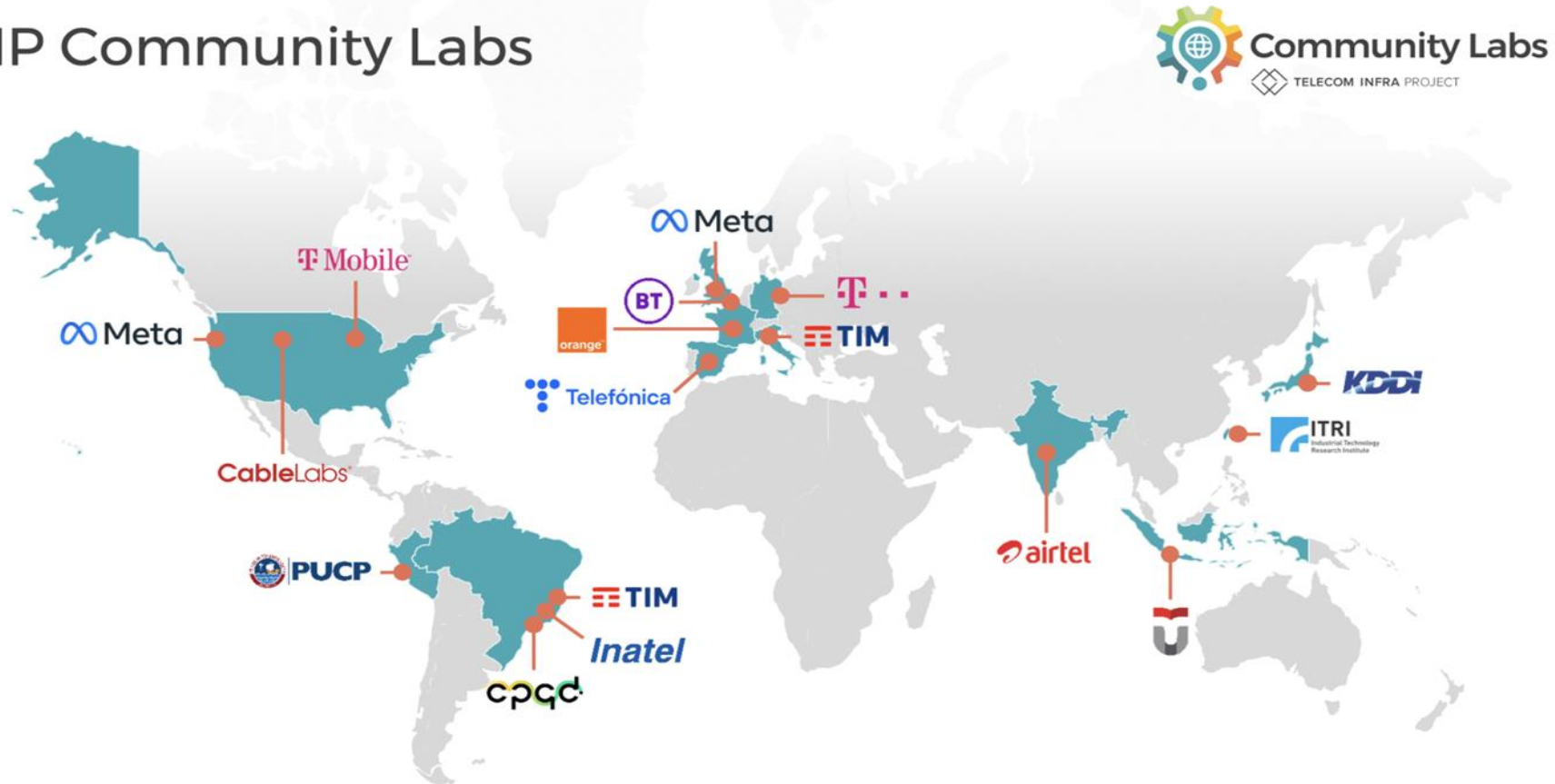
OpenRAN Trials and Deployments



TIP Community Labs: Testing, Integration, and Validation



TIP Community Labs



TIP Community Labs: A Global Network





TELECOM INFRA PROJECT

TIP Community Lab

Telkom University, Centre of Excellence

Bandung, Indonesia



TELECOM INFRA PROJECT

TIP Indonesia Program Pillars

In 2020, TIP launched a 5-year, 5-pillar comprehensive connectivity plan in alignment with Indonesian Government objectives

2020 ONWARDS (5 years Program)



Testing and validation of TIP promoted technologies



Operator commercial trials/deployments in Rural & Urban Indonesia



Dissemination of Learnings and Promotional Activities



Building local skills and capacity, in 4G & 5G assembly & system integration



TIP TEAC - Startup acceleration

CORE COMMUNITY



GROWING





TELECOM INFRA PROJECT

TIP Community Lab

Inatel – National Institute of Telecommunications

Santa Rita do Sapucaí-MG, Brazil



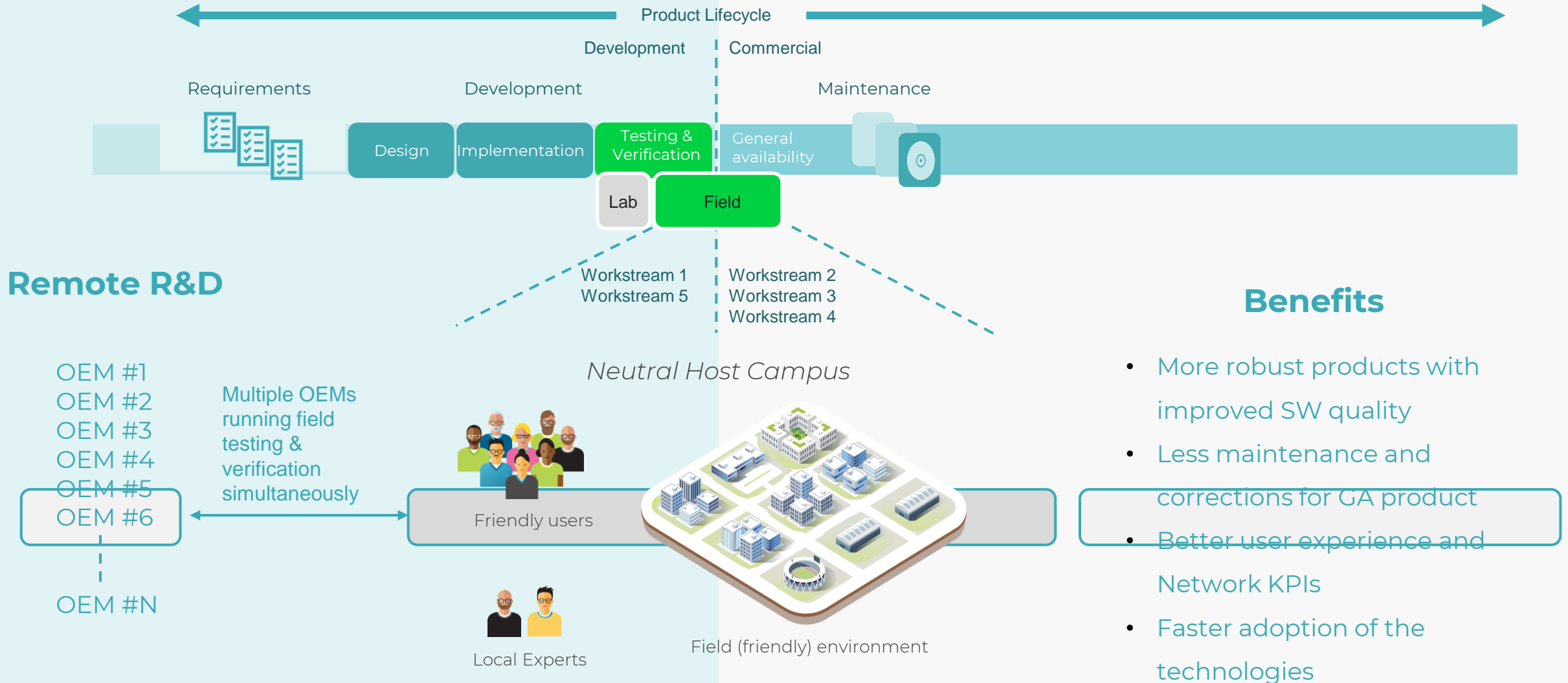
TELECOM INFRA PROJECT

Open Field Program

Field Environment For Pre-GA and GA Products

Workstreams

WS1 – Product Piloting
WS2 – Test & Validation
WS3 – Ecosystem Assessment
WS4 – Training
WS5 – xApp/rApp Development




TIP Community Labs: Lessons Learned

- Test and Validation driving productisation
 - Product level maturity is increasing
 - Interoperability and integration still major focus of testing
 - Need to move towards continuous and automated testing
 - AI/ML will play an important role in OpenRAN
- Labs Can Adopt a Range of Formats Depending on Unique Needs & Local Context
 - Incorporation of training program
 - Open sandbox for trials with access to spectrum and OTA capabilities
- Policymakers Play an Important Role in Fostering Innovation
 - Can exercise power to convene
 - Offer incentives for open technology deployment
 - Support regulatory sandboxes for innovation and trials
- Disseminating Lessons Benefits the Global Ecosystem
 - Sharing learnings, infrastructure blueprints, and best practices and coordinating among testing initiatives can help **create greater efficiencies** for the ecosystem by **eliminating redundancy, maximising the output of test learnings**, and leveraging local learnings for the benefit of the global community



Thank you



How Open Communities Accelerate Disaggregation and The Growth Of Open Source Hardware Designs

STEVE HELVIE | OCP

i14 Lab Summit 2022



Open Compute Project

*“The power of Open Communities
to accelerate disaggregation”*

June 9th, 2022 – Berlin

Steve Helvie – VP of Channel OCP
steve.helvie@opencompute.org

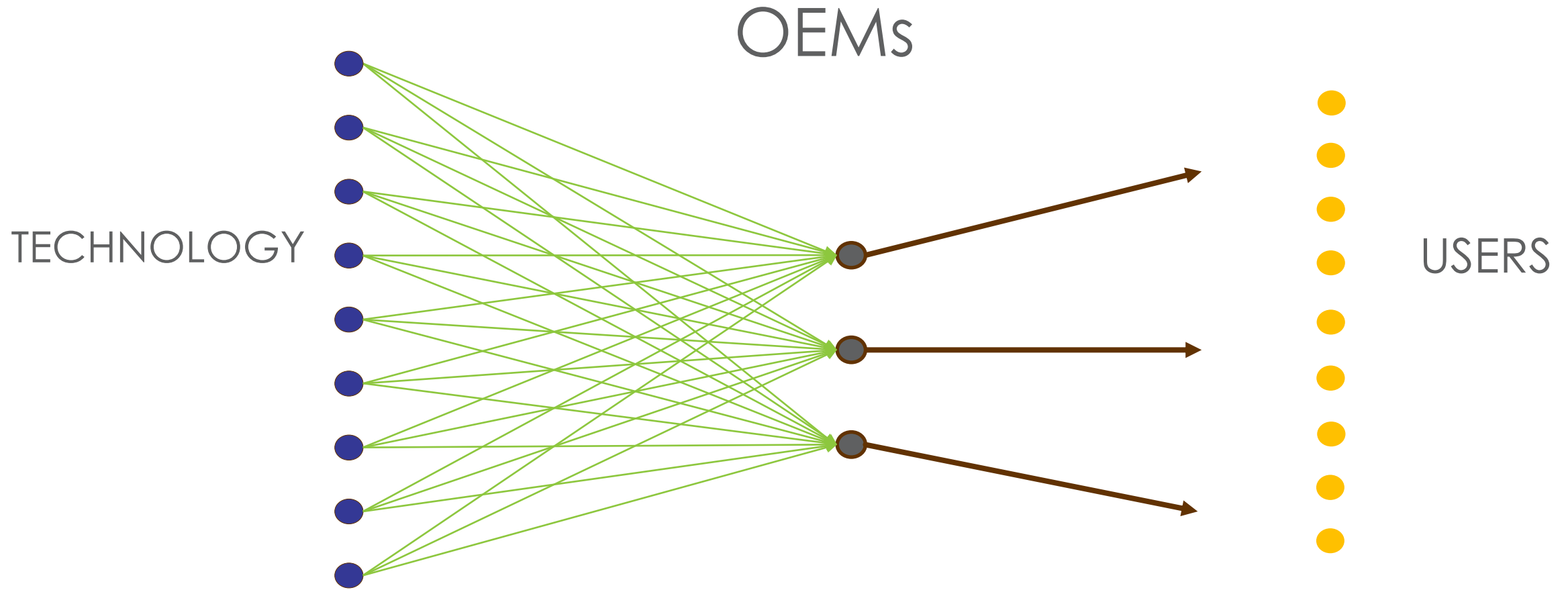
Connect. Collaborate. Accelerate.



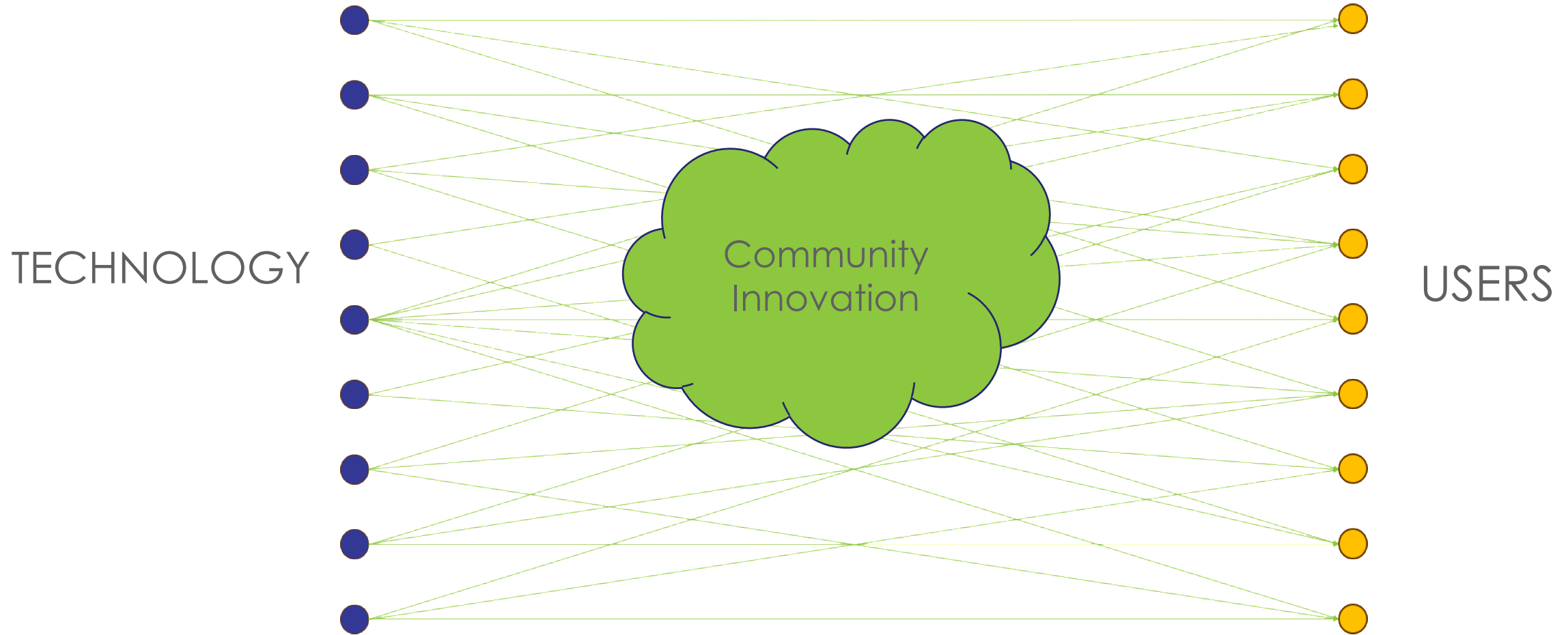
OPEN
Compute
Project®



The Old Innovation Pipeline

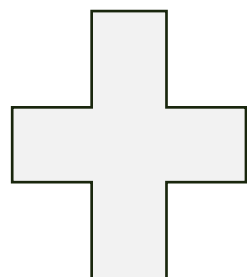


Open Source Innovation Model





Commodity Hardware



Open Source



OPEN
Compute Project®

Connect. Collaborate. Accelerate.



250+ companies
8K engineers
30+ projects
≈200 contributions

OCP Tenets



OPEN
Compute
Project®

Connect. Collaborate. Accelerate.



Open Edge Servers
&
Network Devices



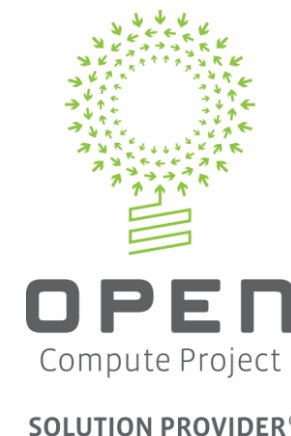
TELECOM INFRA PROJECT

Connect. Collaborate. Accelerate.

Disaggregation...what's really happening in the market?



<https://stordis.com/>



Lukasz Lukowski
Chief Technology and Knowledge Transfer Officer - STORDIS

OCP Community Lead for Europe

Open Networking Foundation Ambassador

Lukasz.Lukowski@stordis.com

Connect. Collaborate. Accelerate.



The Power of Open Communities

Influence & establish the technology roadmap

Access to engineering resources

Mitigate supply chain risks

Ensure sustainable infrastructure roadmap

Brand recognition as technology thought leader and access to talent pool



THANK YOU

Connect. Collaborate. Accelerate.



Steve Helvie
VP of Channel – Open Compute (OCP)
steve.helvie@opencompute.org



OPEN
Compute
Project®

How i14y Lab Is Meant to Support Various Test Types | Scenarios & Activities

CARSTEN ROSSENHOEVEL &
RANGANAI CHAPARADZA



Versatile Test Scenario Support & Services

CARSTEN ROSSENHOEVEL | **EANTC**
EUROPEAN ADVANCED NETWORKING TEST CENTER



Agenda

**Technology
Coverage**

**Architecture
Coverage**

**Multiple Lab
Locations**

**Test Types:
Functionality,
Performance,
Security, etc.**

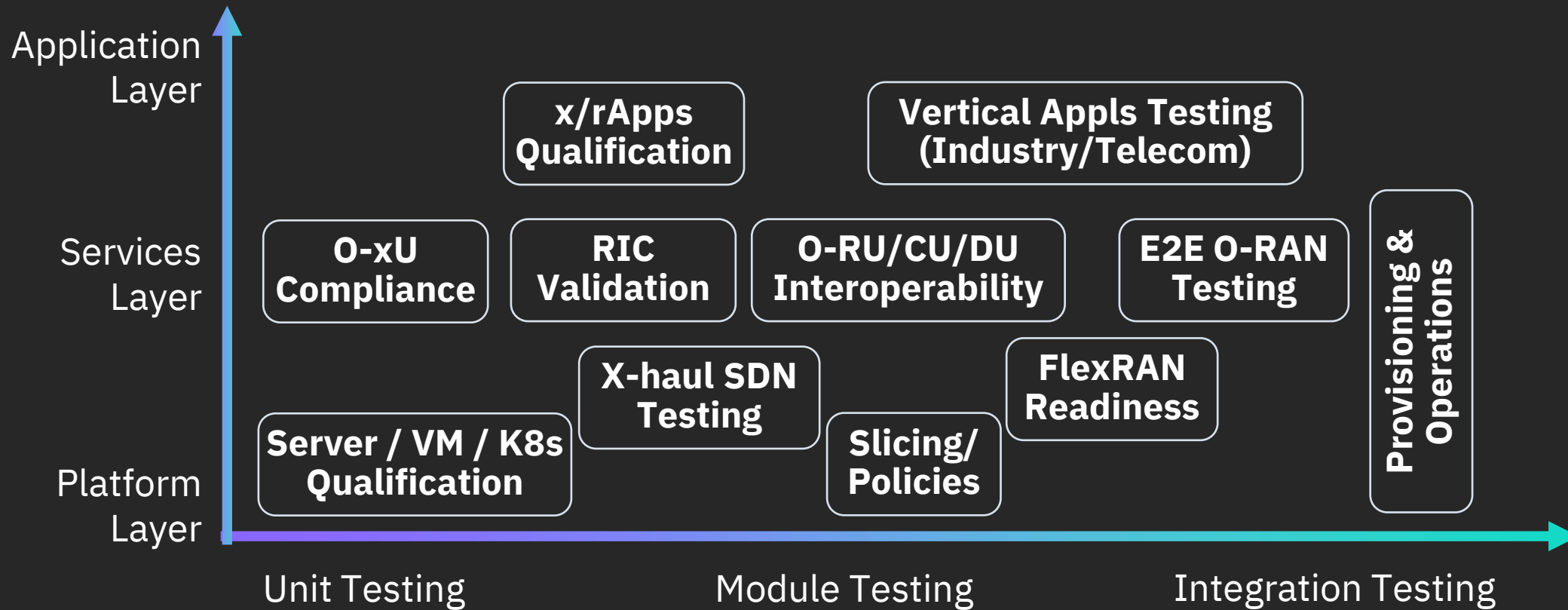
**Achievements –
Plugfest Q4 2021**

**Upcoming
Interoperability
Plugfest**

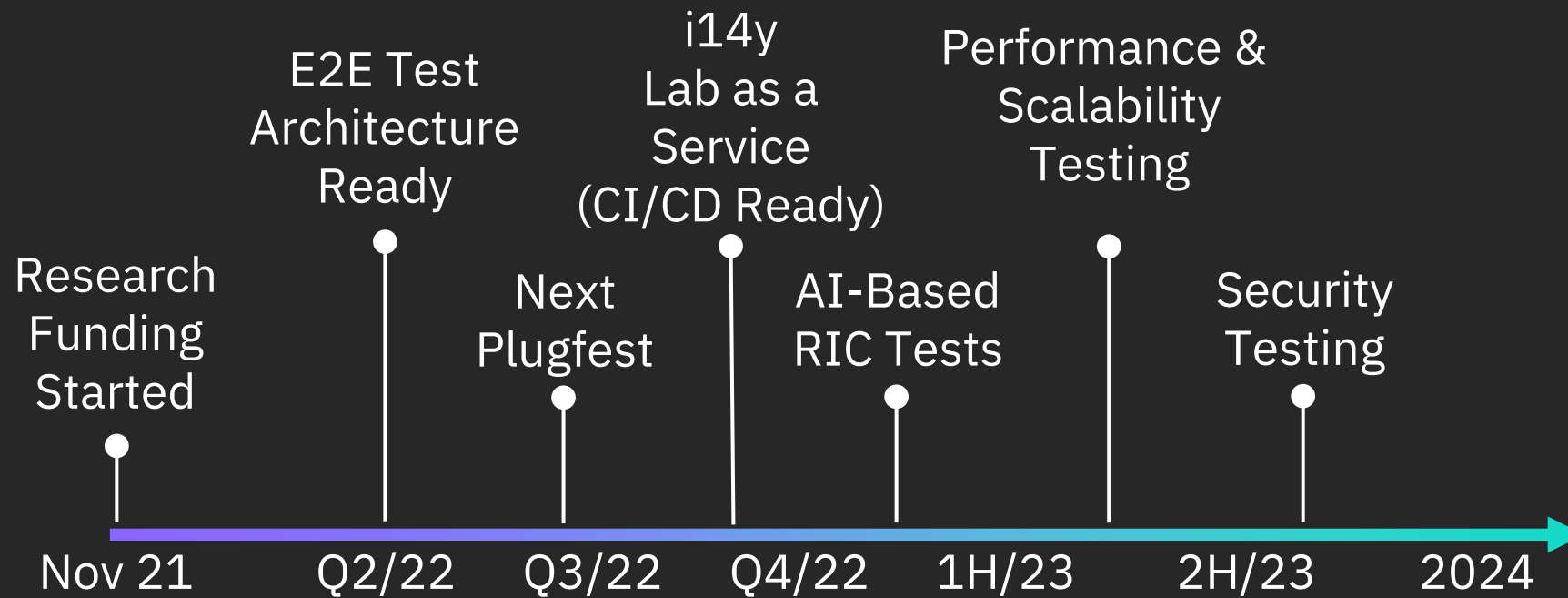
Test Automation

Add-on Services

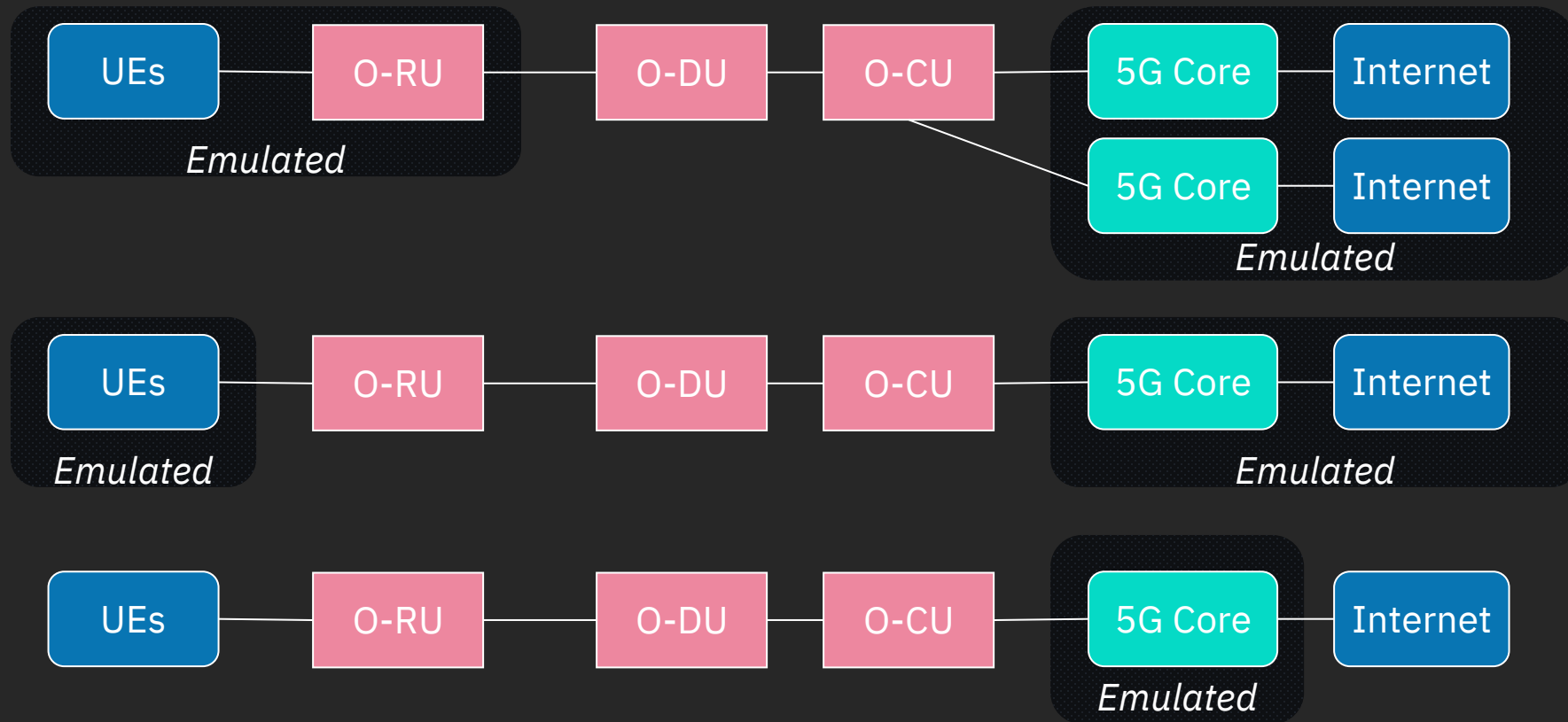
Technology Coverage



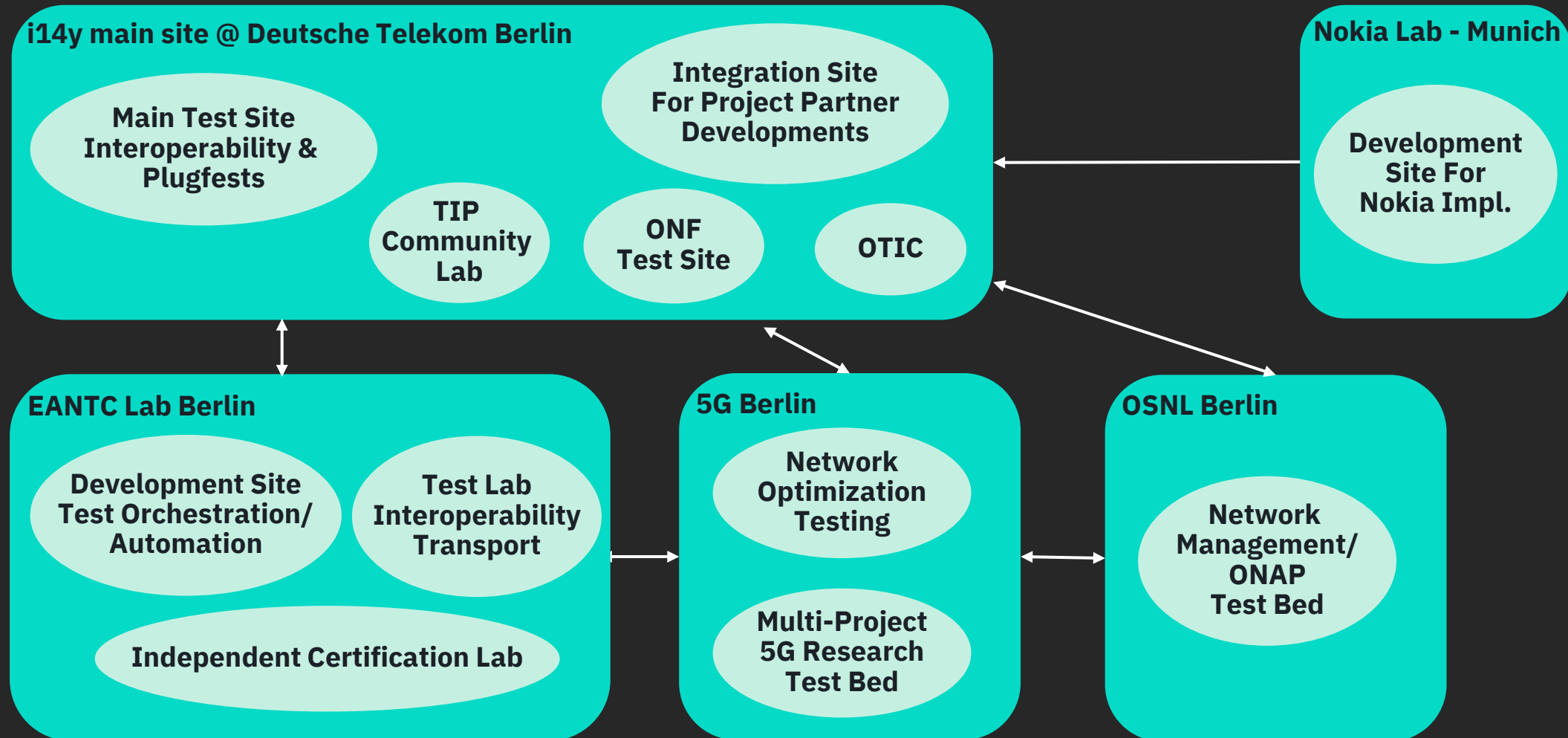
Project Roadmap



Standard O-RAN Integration Test Scenarios



Collaboration Between Partners & Labs in i14y Lab Project



Joint O-RAN Alliance & TIP PlugFest Q4 2021

Joint European
O-RAN & TIP

PLUG FEST 2021

09.11.–24.11.
@i14y Lab Berlin

Winterfeldtstr. 21
10781 Berlin

 i14y LAB



Testing showed
advanced maturity
of the Open Fronthaul
implementations

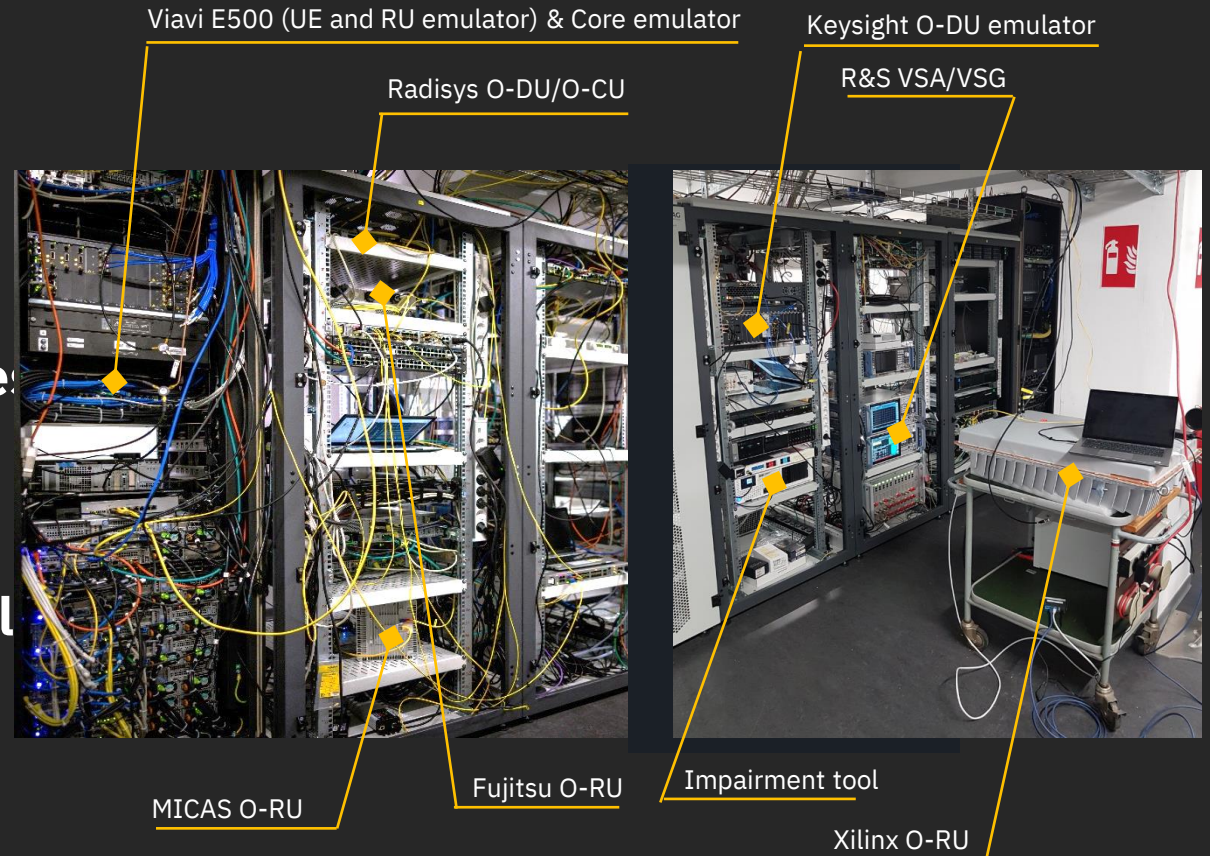


Joint O-RAN Alliance & TIP PlugFest Q4 2021 - Details

- **18 Participating companies with 9 devices under test**
- **12 Test scenarios, 65 test case runs**

Results Highlights

- **E2E RAN scenarios (O-RU, O-DU, O-CU) test**
- **Initial container-based vRAN testing**
- **Demo of multi-macro cell outdoor setup**
- **Many scenarios tested with multiple emulators**
- **Initial non-RT and near-RT RIC testing**



Upcoming Plugfest Q3 2022 hosted by i14y

Covering the whole ecosystem of O-RAN Alliance-based components and end-to-end systems:

RAN components	X-haul Transport	Controllers	Cloud architectures	Management Plane
<ul style="list-style-type: none">• O-CU, O-DU• O-RU	<ul style="list-style-type: none">• FH switches• Clocking	<ul style="list-style-type: none">• RICs• xApps/rApps	<ul style="list-style-type: none">• Edge servers• Hypervisors	<ul style="list-style-type: none">• SMOs• M-Plane tests

- **Addressing advanced O-RAN Alliance and TIP scenarios, aiming to go beyond the proven basics and close gap to production readiness**
- **Efficient, automated test execution, accelerating test progress**
- **Alignment of test coverage and results across European SPs participating in Joint European O-RAN Alliance and TIP Plugfest**
- **Part of the Global O-RAN Alliance Fall 2022 Plugfest (planned**

Invited participants expected to provide:	O-RU, O-DU, O-CU; near-RT or non-RT RIC; SMO, xApps, rApps; test and measurement equipment; cloud platforms and acceleration solutions
Pre-registration Deadline	18 July
Shipping Deadline	15 August
Prestaging	18 August–9 September
Main PlugFest	12 September–7 October
Troubleshooting Time (optional)	10 October–4 November
Report Editing	November 2022
Publication	Early December 2022 Following O-RAN Alliance planning

E2E Automated Testing: Rationale

Greatly speeds up testing

Reduces efforts per test run; enables regression testing

Enables sharing of test tool resources across multiple test setups

Supports remote and distributed testing

Ensures reproducibility of results

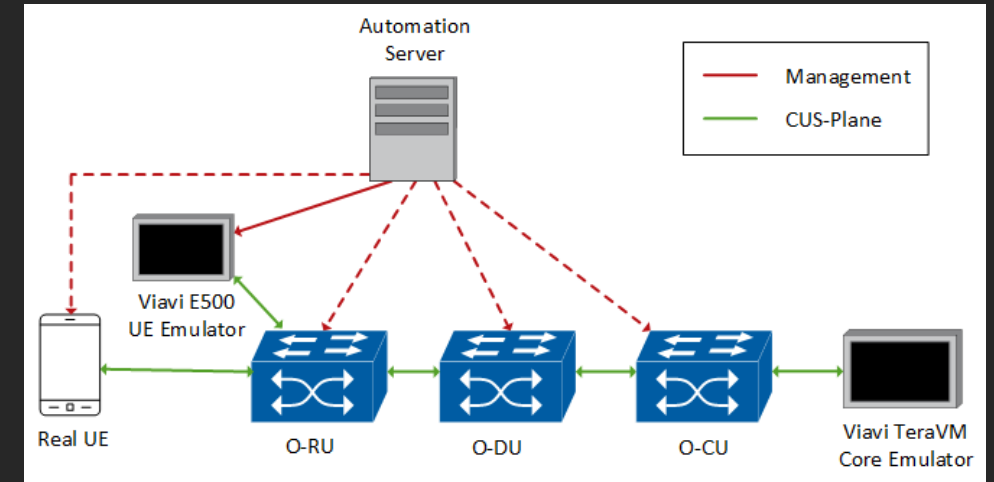
Test Automation

Test automation environment ready, covering

- *UE emulator and RU emulator, 5GCore emulator*
- *Auxiliary tools (variable attenuator, remote controlled PDU, optical cross-connect)*
- *Implementing O-RAN Alliance and TIP test cases*

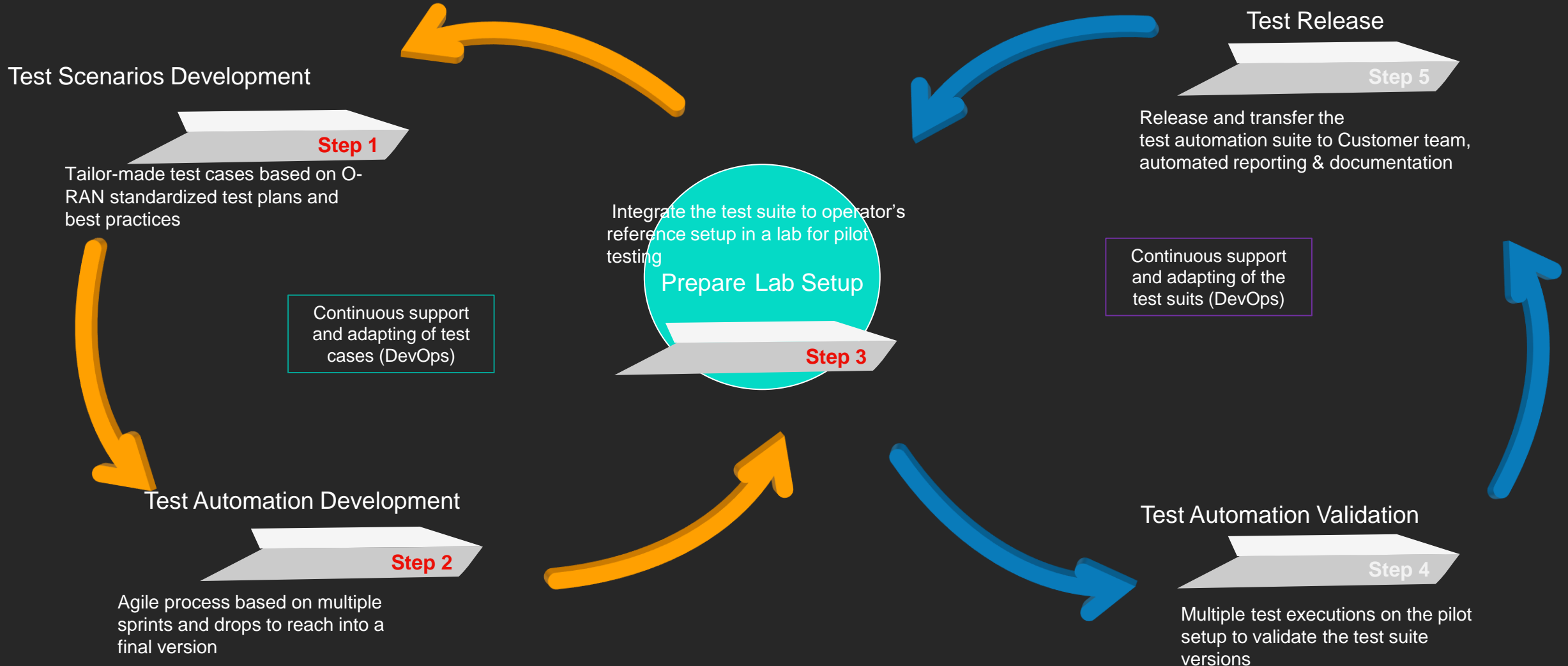
Implementation based on open-source tools such as ROBOT framework and Python (no third-party commercial licenses)

- Flexible test automation controller
- GUI support to create/update test cases, start/stop test runs, and collect/review results and logs.
- Interfacing with multiple lab test tools and auxiliary systems
- Role-based access control enables parallel use by project teams (admins and users)



Check out the demo booth at the Summit today!

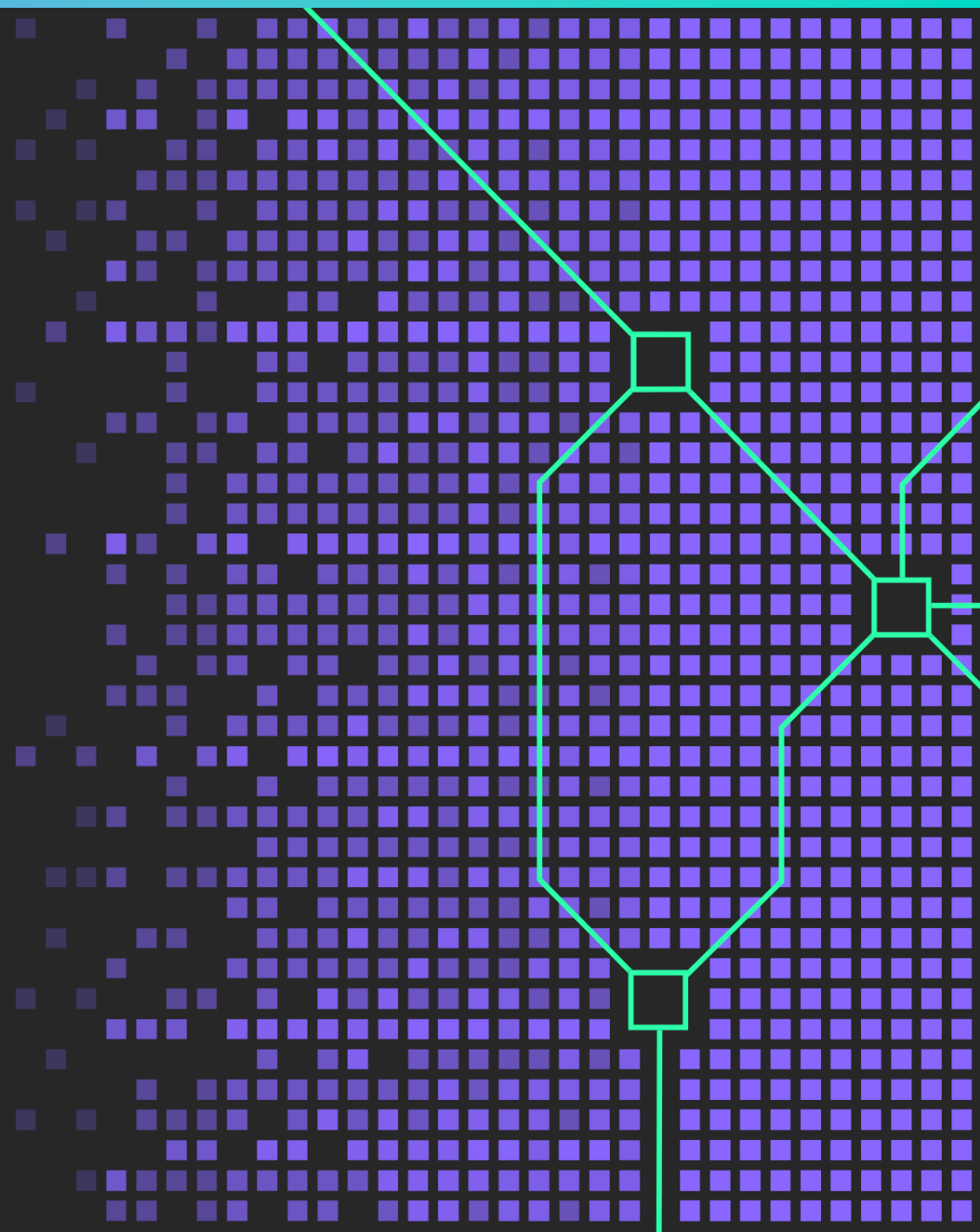
Lab-as-a-Service Test Automation



Thank you

Carsten Rossenhoevel | EANTC AG

cross@eantc.de





Scope of Regular | Continuous | E2E Testing

RANGANAI CHAPARADZA | CAPGEMINI ENGINEERING



Main Drivers w.r.t. Test Scenarios selection | scoping

Phased
approach

Driving Input #1

TIP | MoU Group of priority requirements based **BASELINE*** of scope & test scenarios of priority in phases in the driving Input #1

Driving Input #2

Other additional test scenarios of interest to operators | CPS in the Consortium that add to the **BASELINE**

Driving Input #3

Other additional test scenarios of interest to vendors that add to the **BASELINE**

*BASELINE = TIP|MoU Blueprint adopted|customized or newly created by i14ylab and associated test plans

Test Scenarios Selection | Executions

Phased
approach

BASELINE

- Any Added Operator | CSP Test Scenarios
- Any Added Vendor Test Scenarios

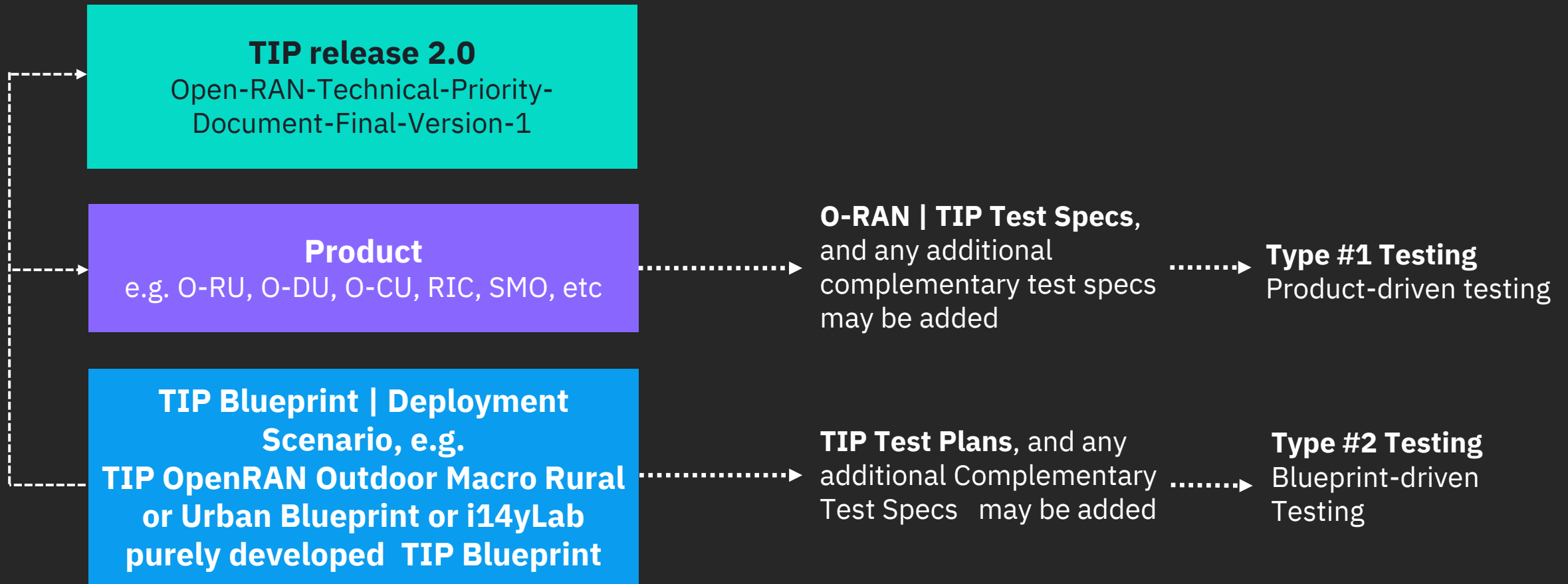
Step 1

AGREED SCOPE to be targeted in Phases

Step 2

Request the Vendors and Test Solutions Providers to be involved in the Project to indicate which Tests are doable (executable) when (Timeframe) based on the AGREED SCOPE to be targeted in Phases

Approaches: Scope of Regular | Continuous | E2E Testing



User Stories for i14yLab

Visit our
i14y Lab
info booth

User A

- Brings components, e.g. O.DU, O-CU, MEC, test tools - also part of the testing automation platform
- Installs components| tools, perform basic tests using components within the existing test architecture or requires a new test architecture to be deployed
- Wants to perform multi-vendor integration and interoperability testing

User B

- Makes use of already running | deployed components & test architecture
- Wants access & book resources for performing test scenarios | cases of interest
- Might have devised own advanced test scenarios

User C

- Wants to access already deployed components or platforms, e.g. RIC platform
- Targets to enhance components or platforms with certain modules, e.g. xApps | rApps or new SW | HW release
- Compile unit test or load the modules before they become integral parts of the test architecture

User D

- Enhances, configures or prepare a test environment or an element, e.g. Test automation platform, RIC etc. To provide certain enhancements, e.g. Real-time metric, defect tracking, dashboard
- Makes the new capabilities ready to use

User E

- A TIP | O-RAN independent tester | validator | certifier interacting with vendors who want to test | validate their products | solutions against TIP | O-RAN requirements
- Receives TIP | O-RAN badge or ribbon award in case of successful validated | certified product or solution

User E

- A plugfest organizer attending to use i14y Lab for hosting a plugfest

Multi-Vendor Functional & Network Performance Testing & Service Testing | Functional & Performance



How we close Gaps in our Test Scenarios & Test Setups

Gaps in terms of Missing Components/Capabilities in specific Test Setups

DUTs SUTs and IUTs in the specific Test Architecture (TA) Setup	Test Architecture Setup, e.g. E2E Reference Test Architecture Components Required Involved in the Test Scenario	Test Scenario Test Type and Reference O-RAN TIP Test Specification of Test Cases	Test Methods and Tools to be used	Missing Components/Capabilities in E2E Reference Test Architecture, and indications of if/when the missing Components/Capabilities could become available

Thank You!

Lab Inauguration

FRANZ SEISER | Deutsche
Telekom &
STATE SECRETARY SCHNORR |
BMDV

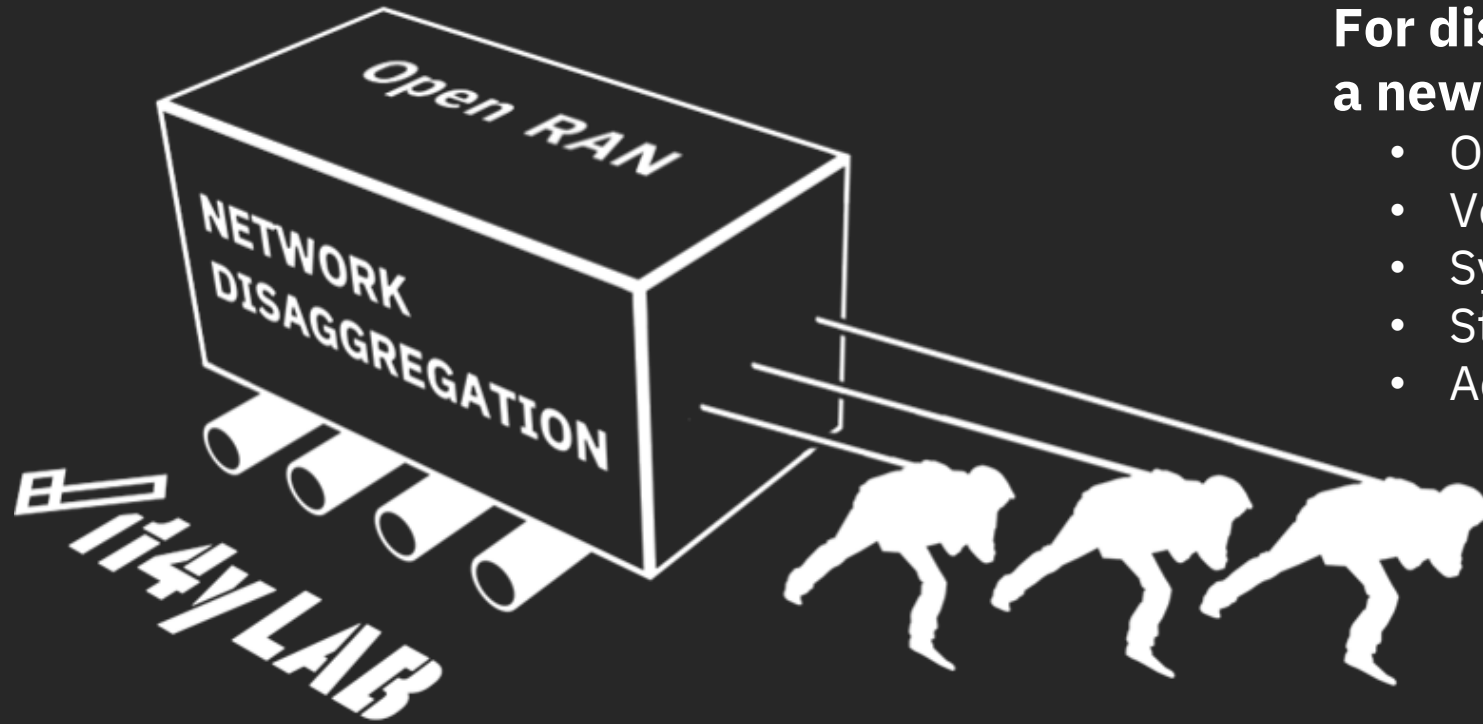


Inauguration

FRANZ SEISER



Ecosystem & testing



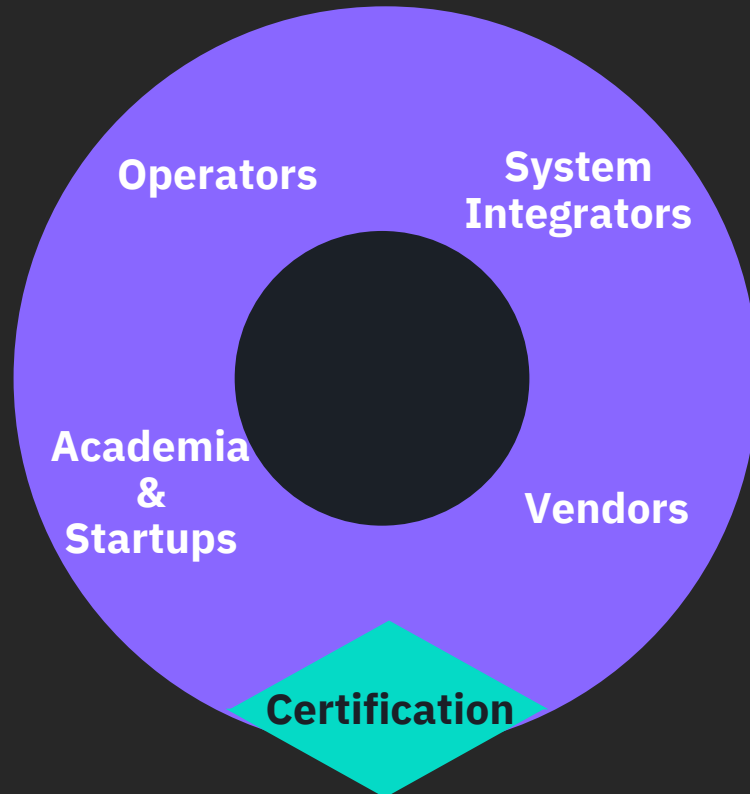
For disaggregation to succeed we need a new way of collaboration among

- Operators
- Vendors
- System Integrators
- Startups
- Academia ...

Bringing players together

i14y Lab in the Open RAN ecosystem

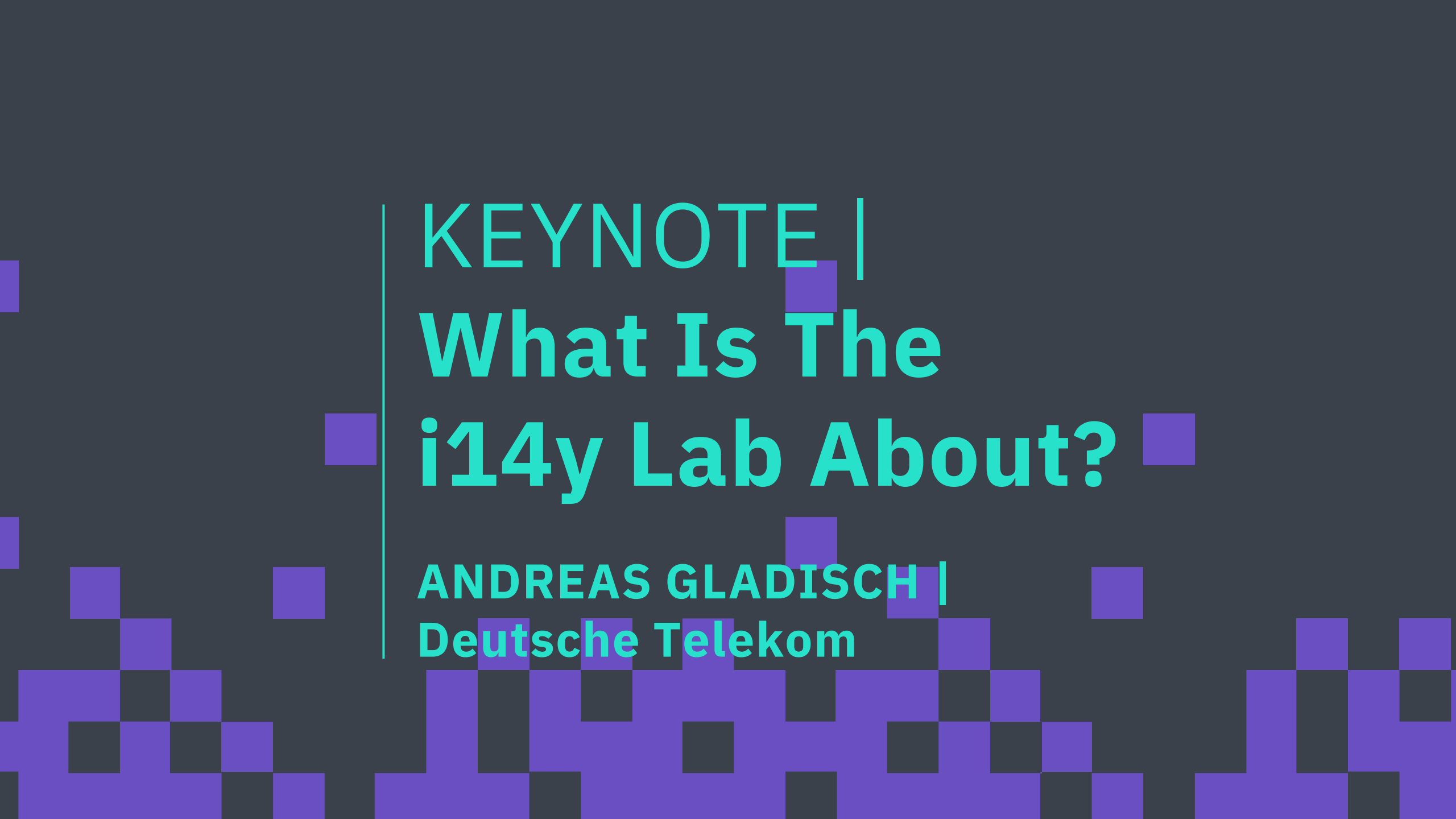
incubate | foster | support



- Ecosystem initiatives
- Certified O-RAN components for delivery to operators

Role of i14y Lab

- Host industry plugfests
- Provide reference implementations
- Infrastructure access for start-ups & academia
- Lower effort for testing & integration
- Certification and badging



KEYNOTE | **What Is The i14y Lab About?**

ANDREAS GLADISCH |
Deutsche Telekom



What is the i14y Lab about?

ANDREAS GLADISCH



Disaggregation | Learning from Hyperscalers success

WHAT

Open source solutions

Split of Software &
Hardware

Modularization of
logical | physical
subsystems

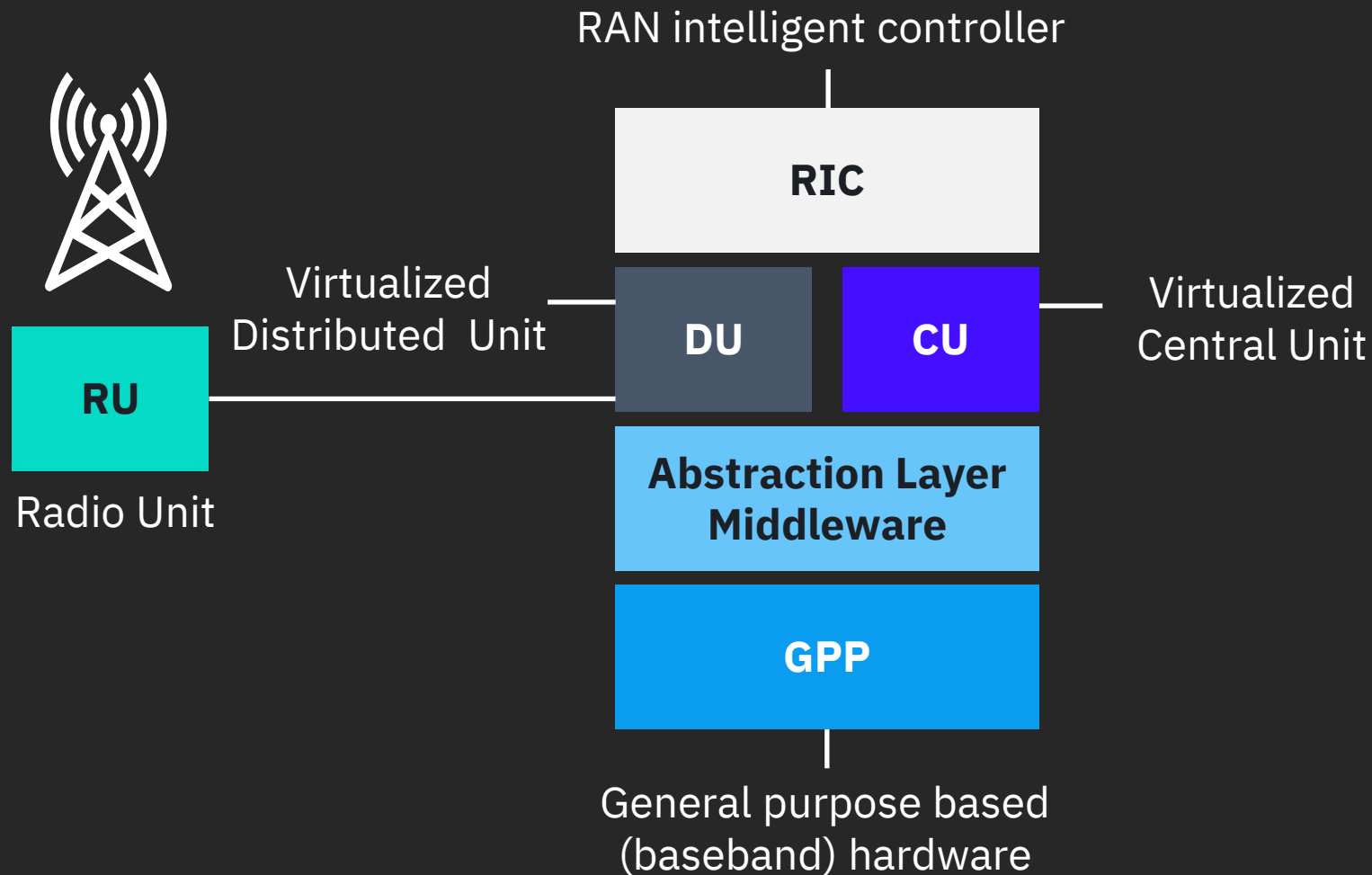
Universal Hardware

Well established among
hyperscalers networks

WHY

- flexibility
- minimize vendor lock-in
- keep costs stable
- enable emerging eco-systems
- enable faster innovation

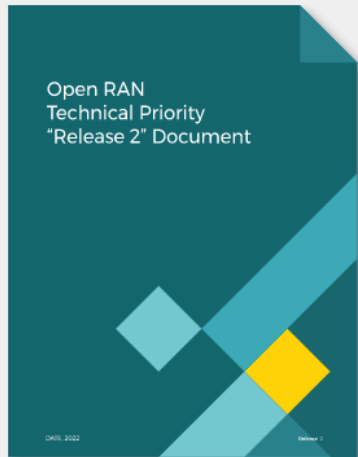
Open RAN | general building blocks



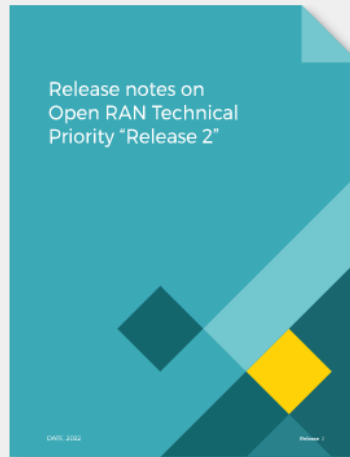
[Source: What is Open-RAN Architecture ? | UPSC - IASbhai](#)

Major European operators sign OpenRAN MoU

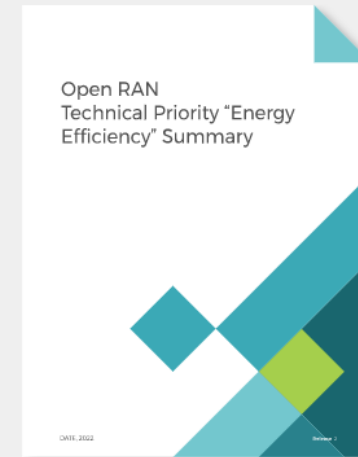
26.01.2021 Memorandum of Understanding to implement Open RAN across Europe signed.
Deutsche Telekom | Orange | Telefónica | Vodafone Group



Open RAN Technical
Priority "Release 2"
Document



Release notes on Open
RAN Technical Priority
"Release 2"



Open RAN Technical
Priority "Energy
Efficiency" Summary

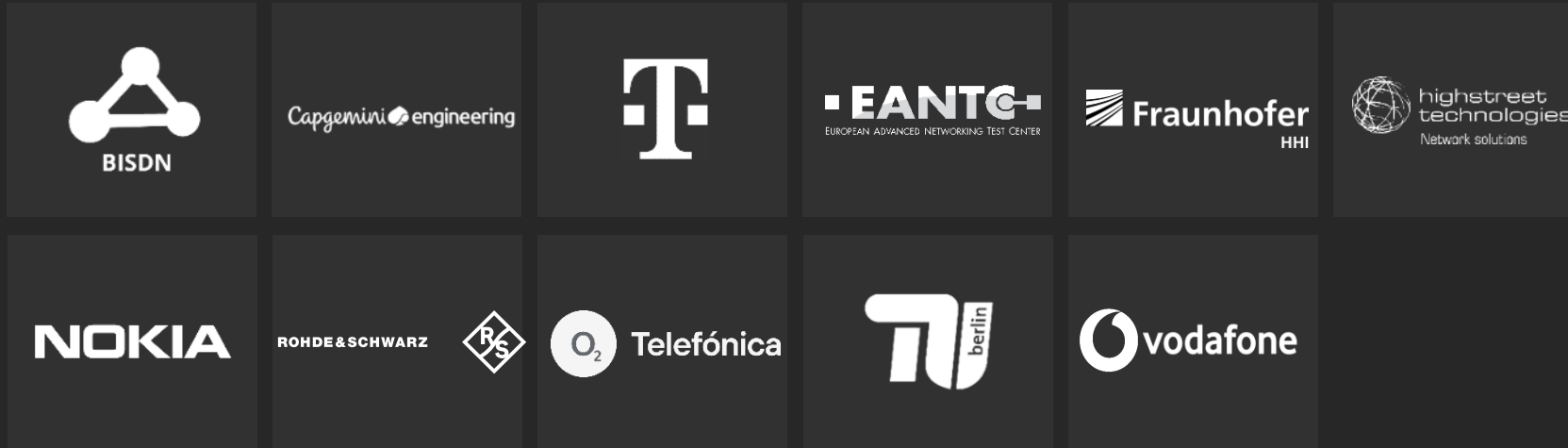
Mission i14y Lab

We accelerate time to market for multi-vendor disaggregated telco systems

We do this by creating and providing a vendor independent environment to promote the development of an innovative, open, and interoperable telco ecosystem.



Our consortium partners



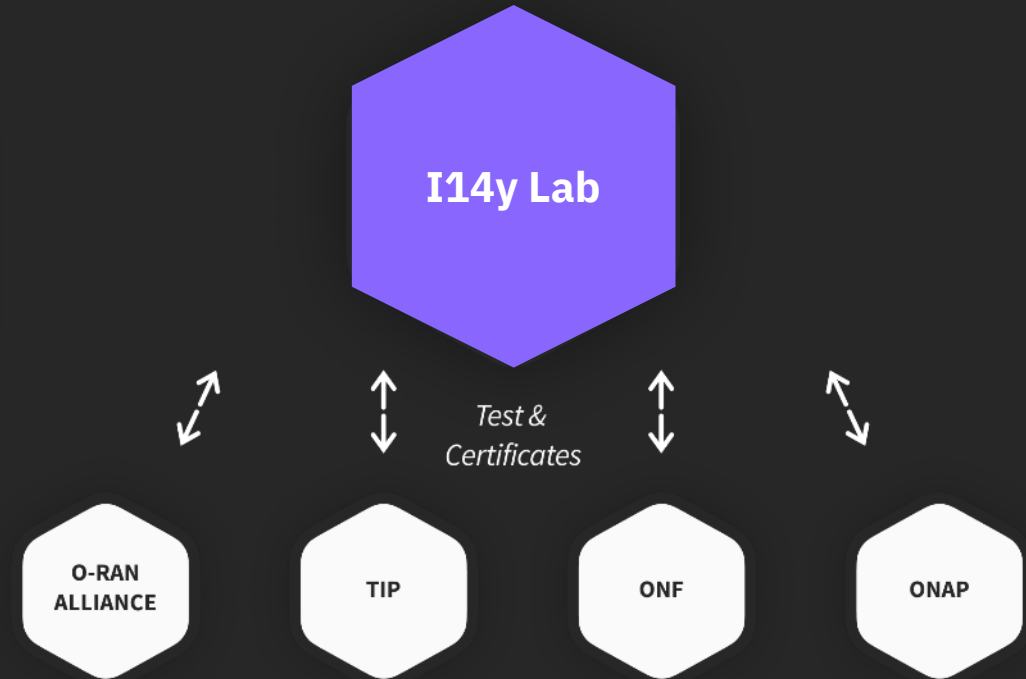
Our supporters



Where and how



Location: heart of BERLIN



Open Ecosystems as broader frame for
CERTIFICATION | STANDARDIZATION

Impressions plugfest | Q4 2021

Joint European
O-RAN & TIP

PLUG FEST 2021

09.11.–24.11.
@i14y Lab Berlin

Winterfeldtstr. 21
10781 Berlin

 i14y LAB



ACCELERCOMM
Capgemini
ALTRAN
FOXCONN
is-wireless
JUNIPER NETWORKS
Radisys
RS
Acelleran
XILINX
FUJITSU
VIavi
EANTC
KEYSIGHT TECHNOLOGIES
ULAK

Next steps

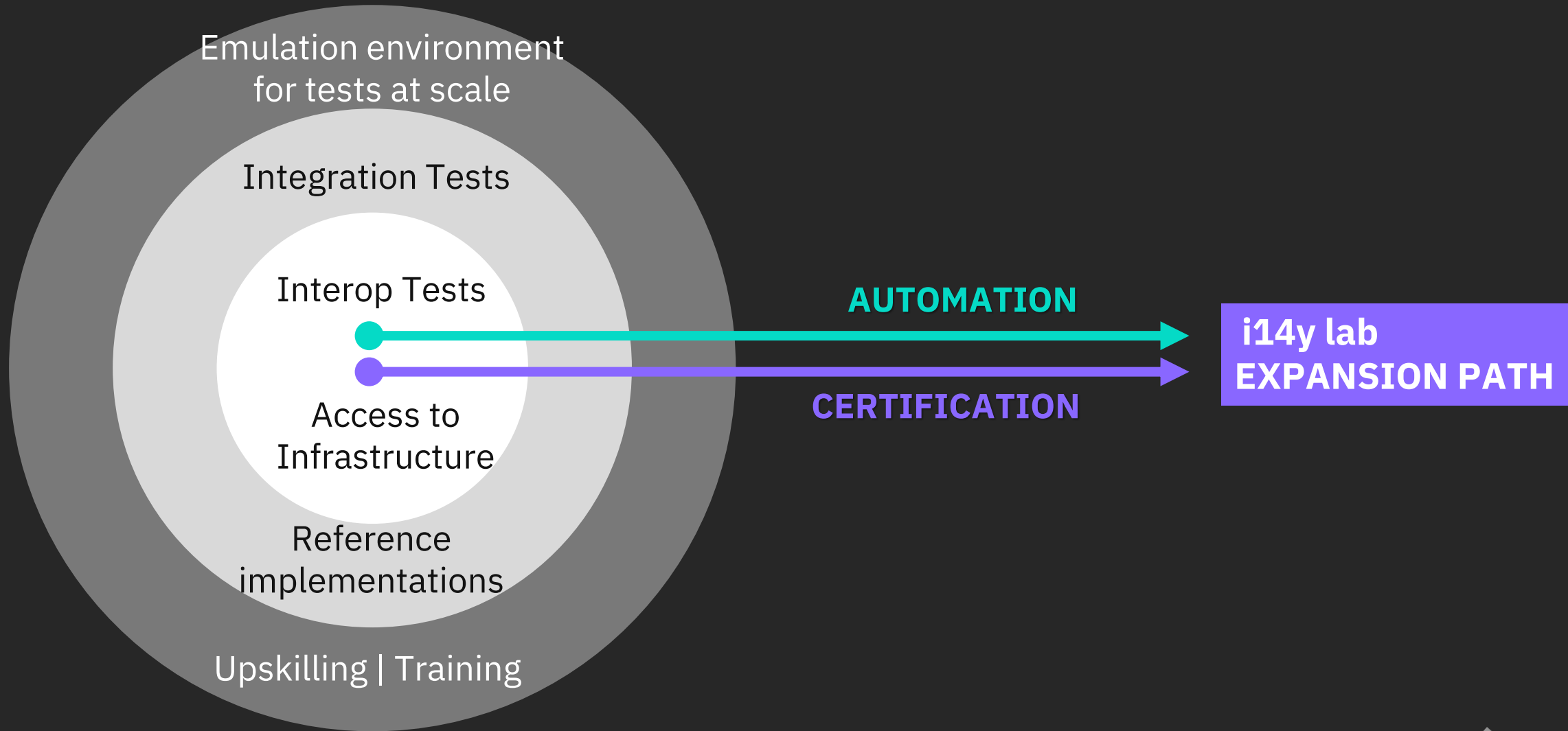
1 Be a host of the joint European ORAN | TIP Plugfest in autumn 2022

2 Realize test plans based on the requirements of the MoU group and the specific needs of the operator partners of i14y

3 Build on test specifications of ORAN | TIP and utilize TIP and O-RAN badges in order to accelerate the ecosystem developments

4 Realize reference configurations based on MoU group and TIP specs and offer regular tests beginning of Jan 2023

Lab as a service ^{plus+}



Stay in touch with us



www.i14y-lab.com



[YouTube](#)



[LinkedIn](#)



KEYNOTE |

Testing, Automation and Intelligent Apps in The Context of RAN Disaggregation

SHAMIK MISHRA | Capgemini



KEYNOTE

TESTING, AUTOMATION AND INTELLIGENT APPS IN THE CONTEXT OF RAN DISAGGREGATION

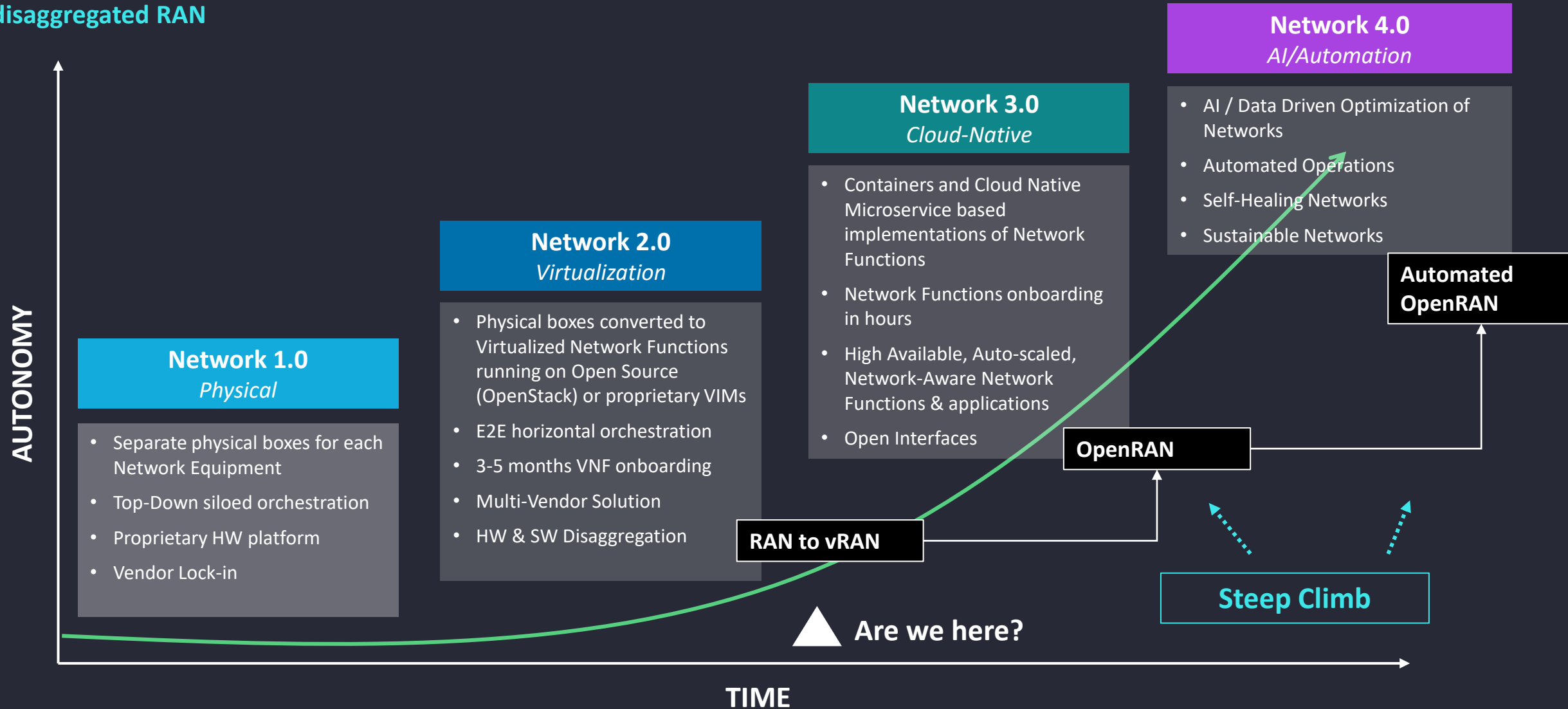
#SUMMIT22 „Mix & Test“

Shamik Mishra

Vice President & CTO Connectivity
Capgemini

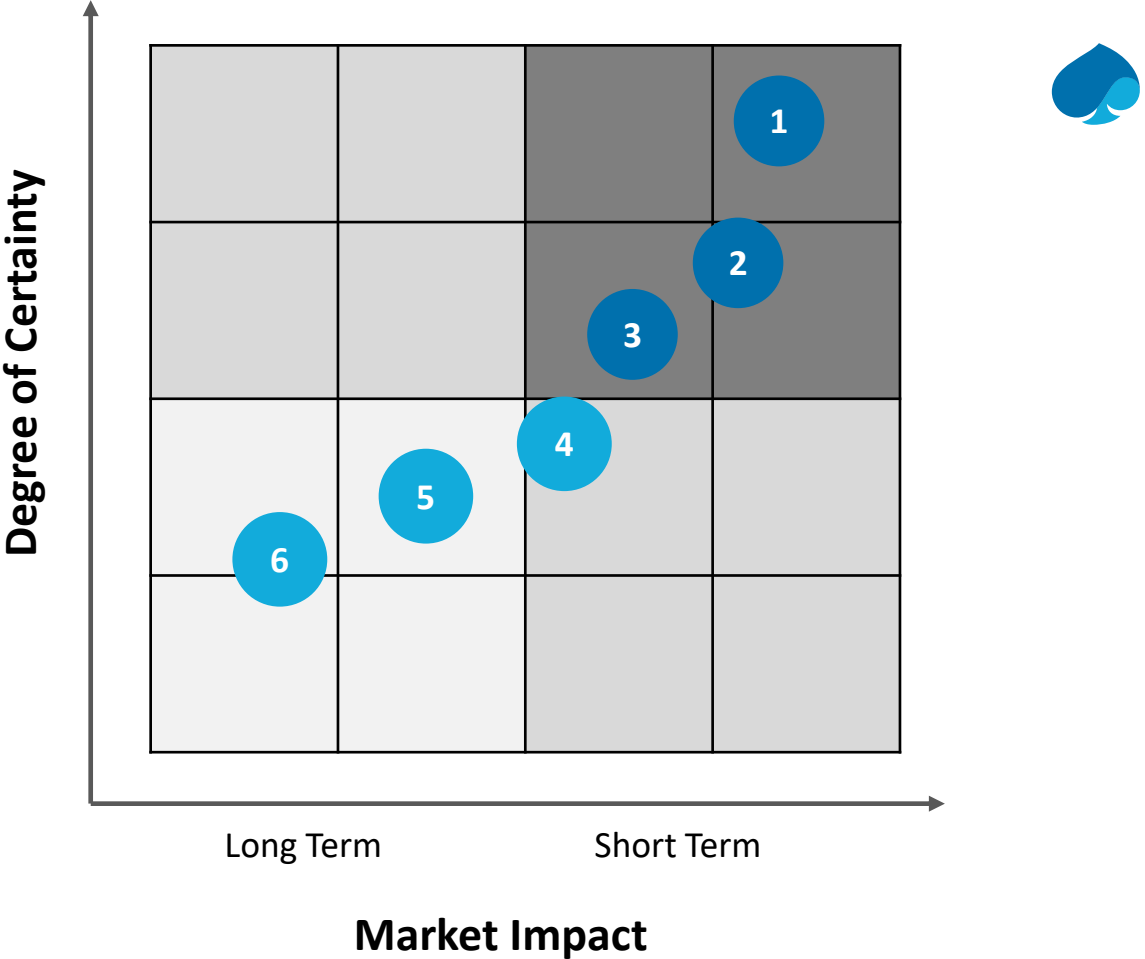
THE TELCO NETWORK IS RAPIDLY EVOLVING...

Success depends on how industry collaborates while testing integrating and automating disaggregated RAN



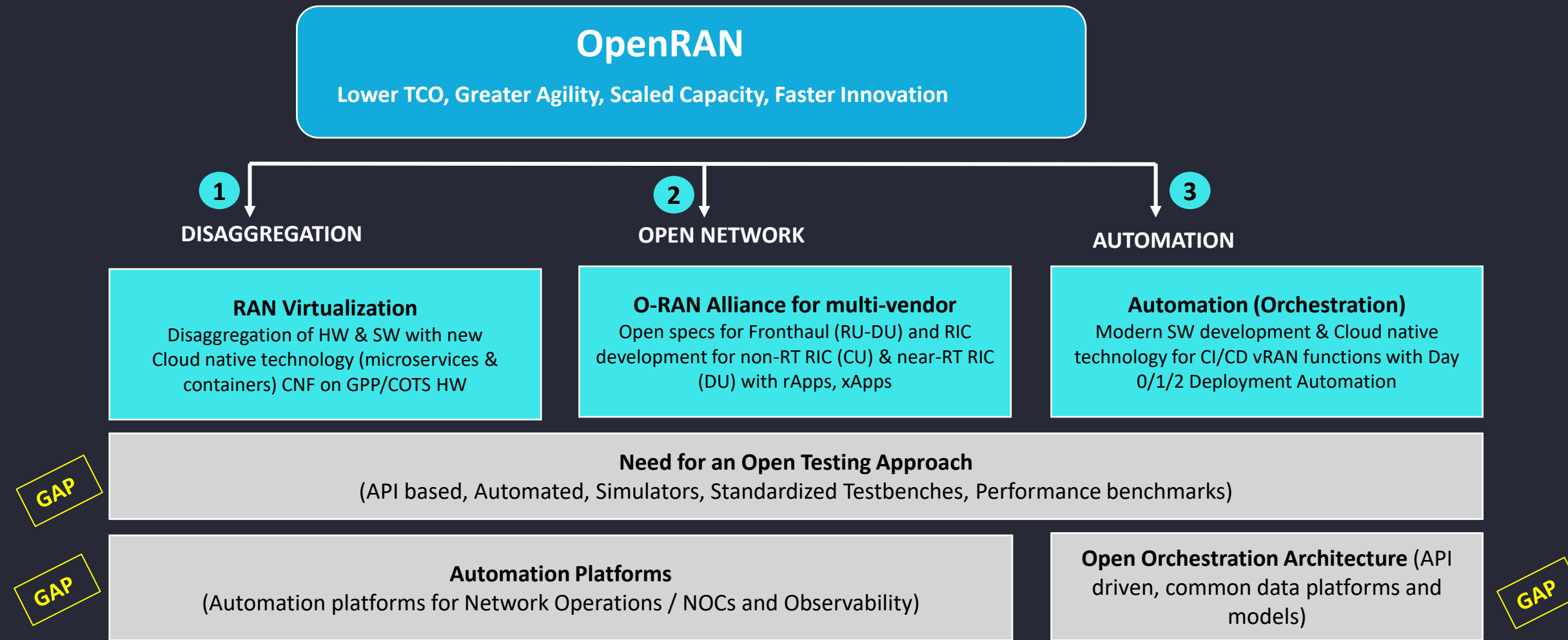
KEY TRENDS IN CLOUD NATIVE OPEN NETWORKS

1.	5G Cloud Native Applications for Verticals & OSS Transformation to Cloud
2.	Cloud Native Edge Compute (MEC)
3.	5G Standalone Core Network
4.	Disaggregated OpenRAN and Cloud-RAN
5.	Data Driven Autonomous Network
6.	Sustainable Cloud Native Networks for Telcos



To accelerate impact, collaboration in common standards, architecture and models are essential in test & automation domain

SHORT OVERVIEW ON THE CHALLENGES

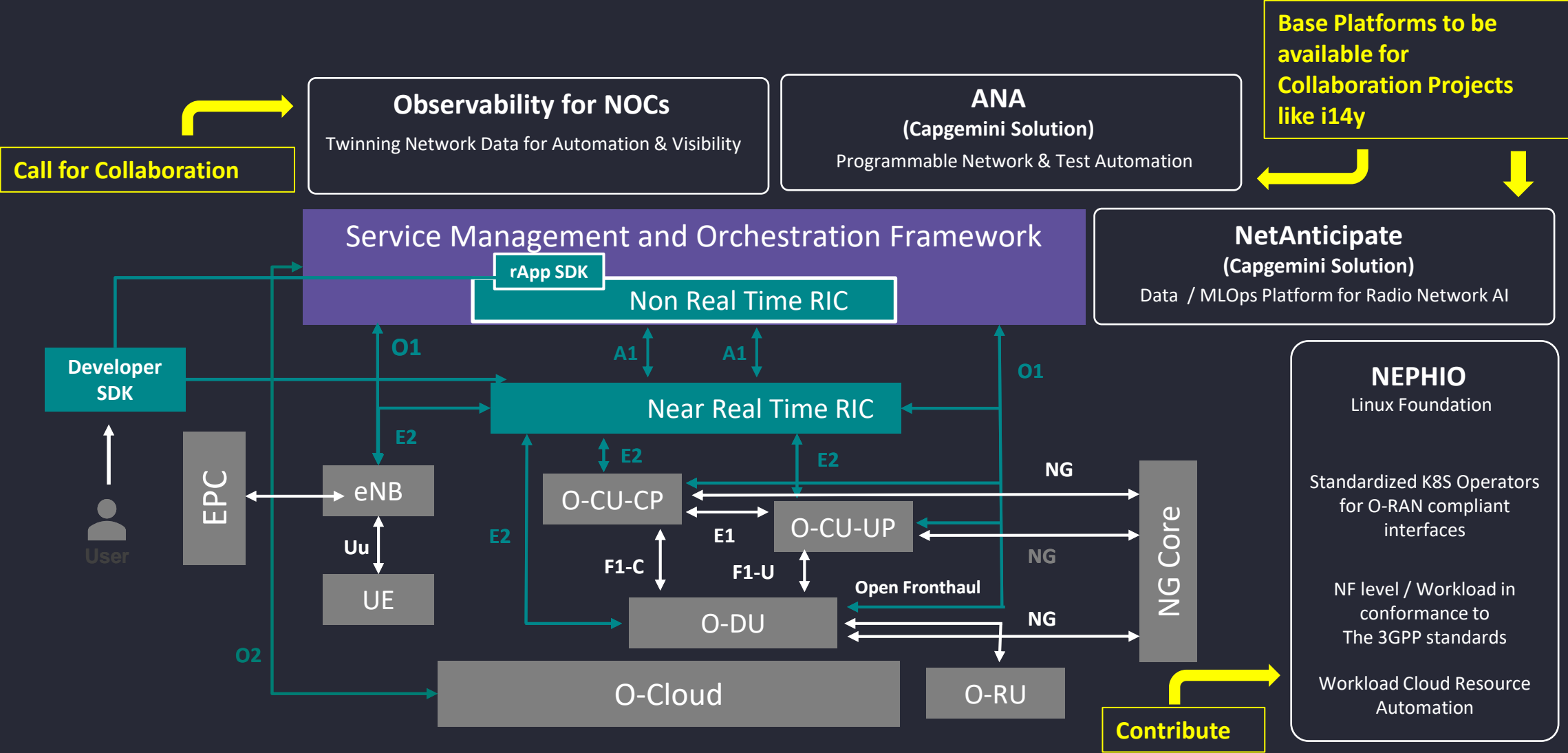


DEEP DIVE ON ENGINEERING CHALLENGES



SERVICE ORCHESTRATION	End-to-End Service Orchestration, OSS & BSS integration and Efficiency improvements <ul style="list-style-type: none">How do I orchestrate end to end services (and network slices that can be monetized)?How do I integrate cloud-based solutions to my legacy or cloud-based OSS & BSS systems?How do I improve efficiencies O&M, energy, resource management, user experience and honoring customer commitments through cloud?
NETWORK ORCHESTRATION & MANAGEMENT	Multi-Site / Domain Orchestration, Slice Management, SDN Control, Automation and Operations <ul style="list-style-type: none">How do I orchestrate and manage workloads across multiple heterogenous clouds?How do I manage multi-site interconnection, SDN?How do I automate the solution across Telco and cloud deployments
TELCO NETWORK FUNCTIONS	High Available & High-Performance Cloud Native Network Functions <ul style="list-style-type: none">How do I ensure that public cloud deployment serves the high availability and reliability requirements and SLAs?How do I ensure that public cloud uses the right set of HW accelerators required for real-time carrier grade trafficHow do I ensure security and regulatory compliance with cloud-based cloud deployments?
CLOUD PLATFORMS (IAAS / PAAS)	Multi-Tenant Network Service & Resource Management <ul style="list-style-type: none">How would a public cloud ensure multi-tenancy across 100s of edge and cloud datacenters with same SLA levels?How can the resource management be made deterministic?How are my subscriber data made secure across transit from Telco to Cloud?
INFRASTRUCTURE	Emergence of COTS Hardware with Silicon Accelerators <ul style="list-style-type: none">How much control would a telco have on the selection of HW and Silicon accelerators with hyper-scalersHow easy it would be to swap a telco function from one to another vendor?How will my performance get impacted due to move to hyper-scaler cloud hardware?

OUR APPROACH & R&D PROJECTS

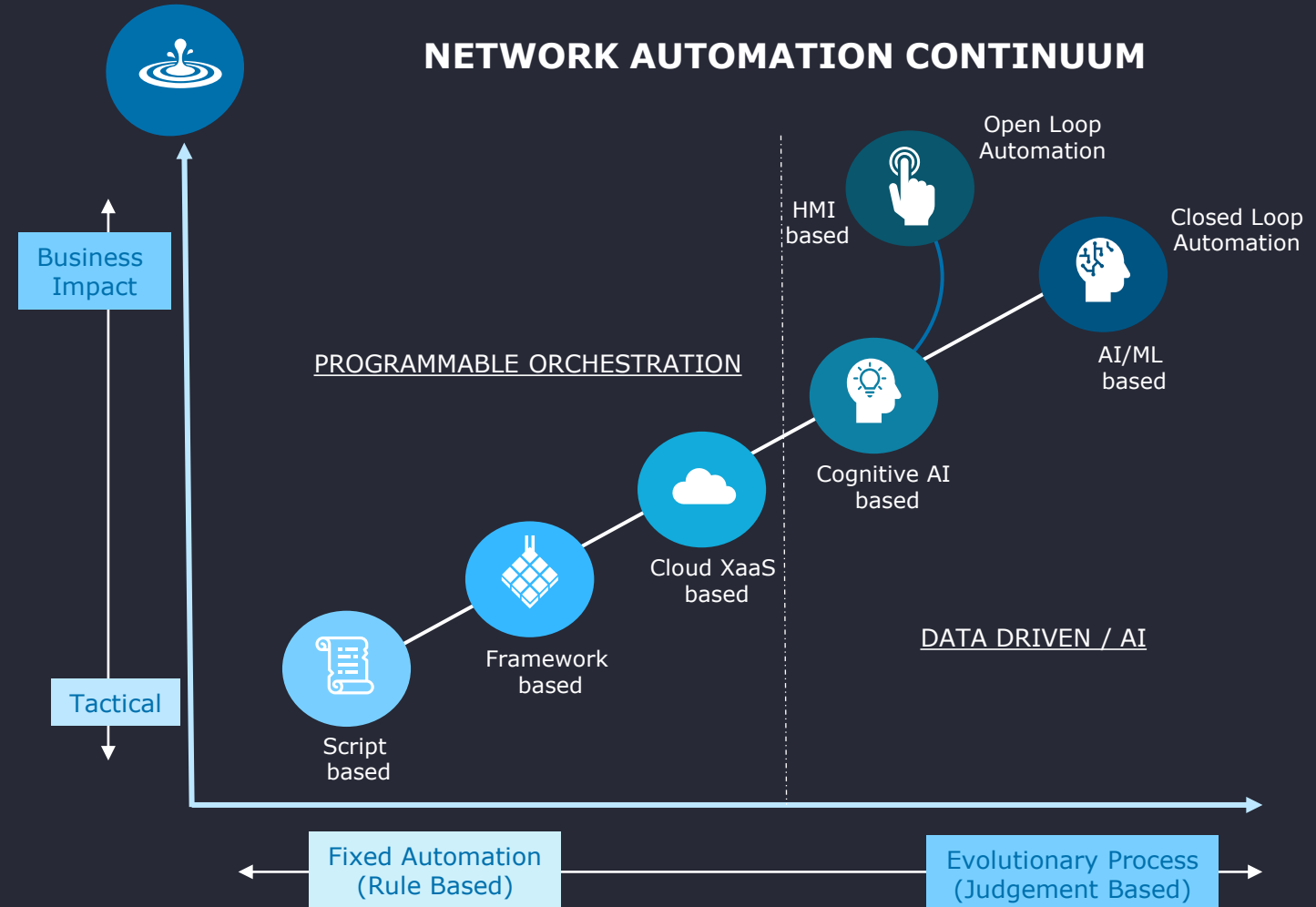


NETWORK AUTOMATION & ORCHESTRATION

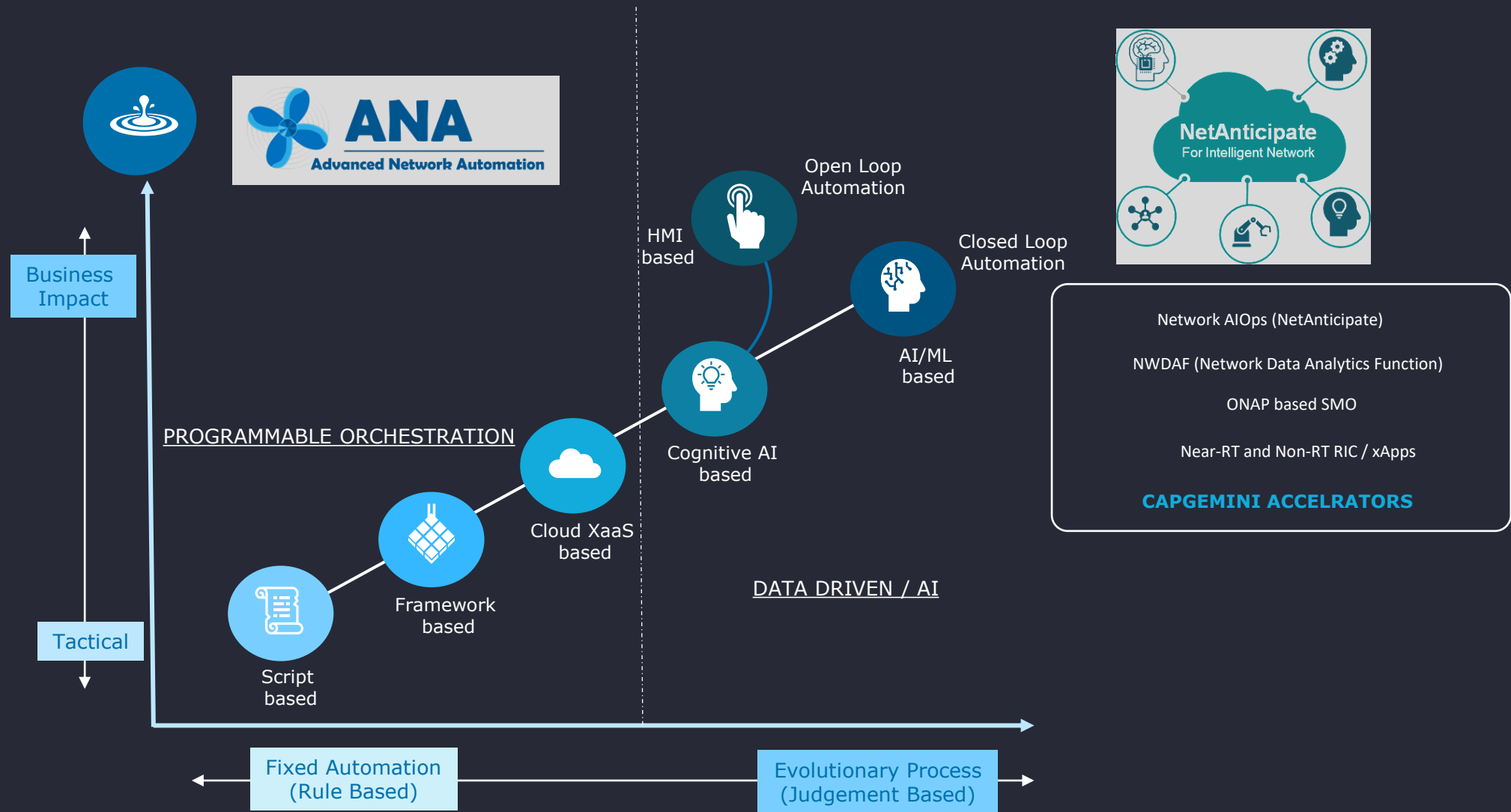
TRANSFORMATION TO HIGHLY AUTOMATED NETWORK THAT SUPPORTS AGILE SERVICE DELIVERY & INNOVATION



- Intelligent, Coherent & Interconnected Closed loops throughout Service & Network layers
- Fully Automated E2E Solution that manages the entire Service lifecycle that will support silos across Design, Development, Assurance
- Service Layer will orchestrate the underlying network domain and each network domain executes its closed loop automation itself



CAPGEMINI NETWORK AUTOMATION FRAMEWORKS



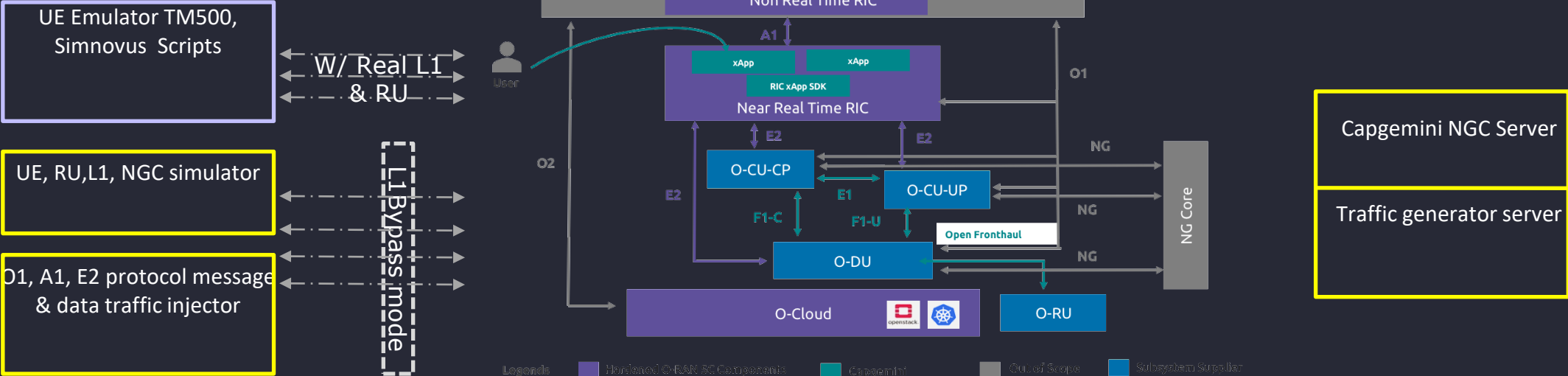
END TO END PROGRAMMABLE TESTING



- Capgemini includes different software frameworks as components accelerating 5G gNodeB and NGC development as part of their 5G product offering.
- As part of Capgemini Engineering’s 5G partner ecosystem we have commissioned multiple 5G and ORAN labs capable of executing end to end 5G scenarios
- This focuses on testing and verification of O-RAN stacks, RIC as well as xApps to be verified in near real end to end environment for all possible permutation and combination of 5G scenarios in controlled lab environment.



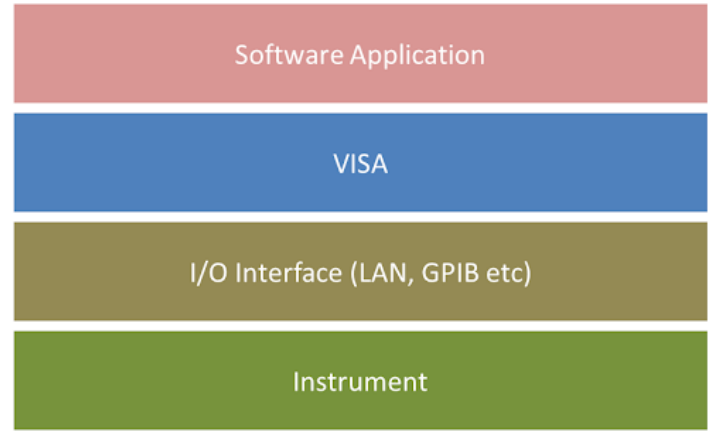
Automation through
Microservices



Legends: Capgemini's automation scripts for Commercial/3d party tools

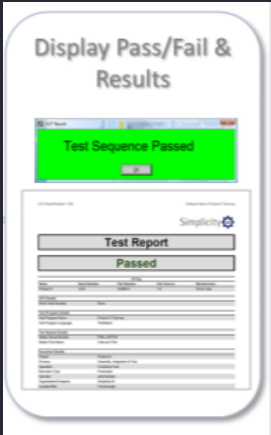
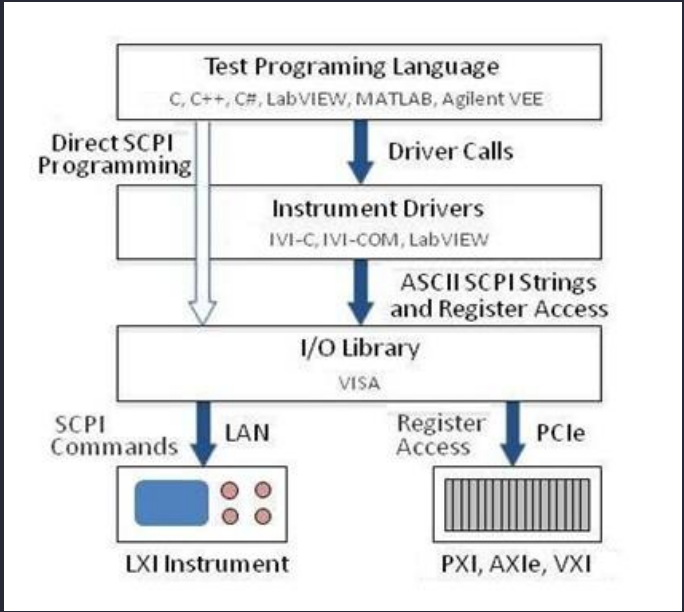
Capgemini 5G/ORAN Offerings

RADIO UNIT VALIDATION APPROACH

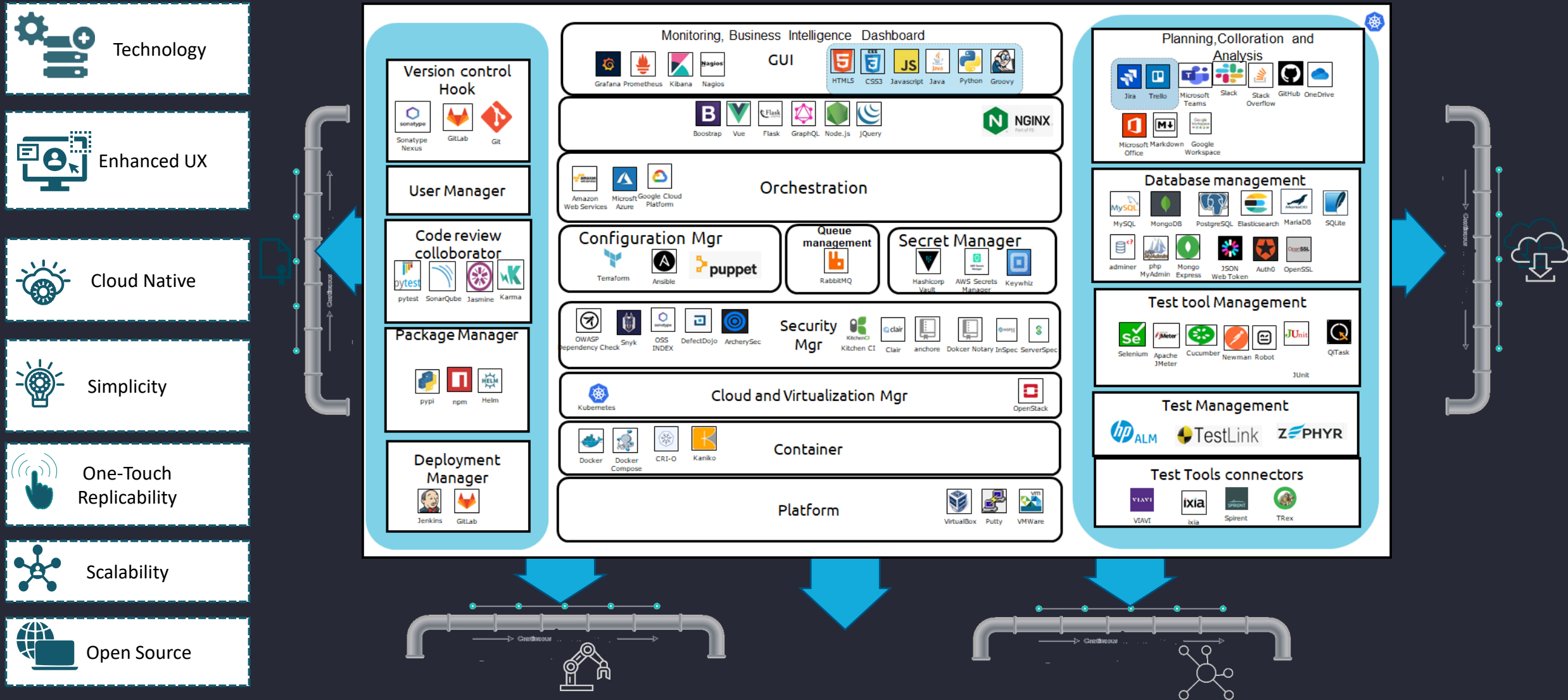


Methodology

- NI TestStand forms the top-most level of automation. It is a Test Sequence Executive.
- NI LabVIEW was used to develop the Tx & Rx functional test case code modules.
- RRH & BBU boot-up scripts were developed in Python.
- The RF test equipment device drivers were developed using SCPI Commands & VISA.
- The RF test equipment, eCPRI & the Radio Unit communicate with the PC over LAN (LXI).
- The Tx & Rx test cases were executed as separately as Automated Test Sequences on separate test setups.
- The Test Results Report (TRR) was generated in MS Excel & saved to the database.



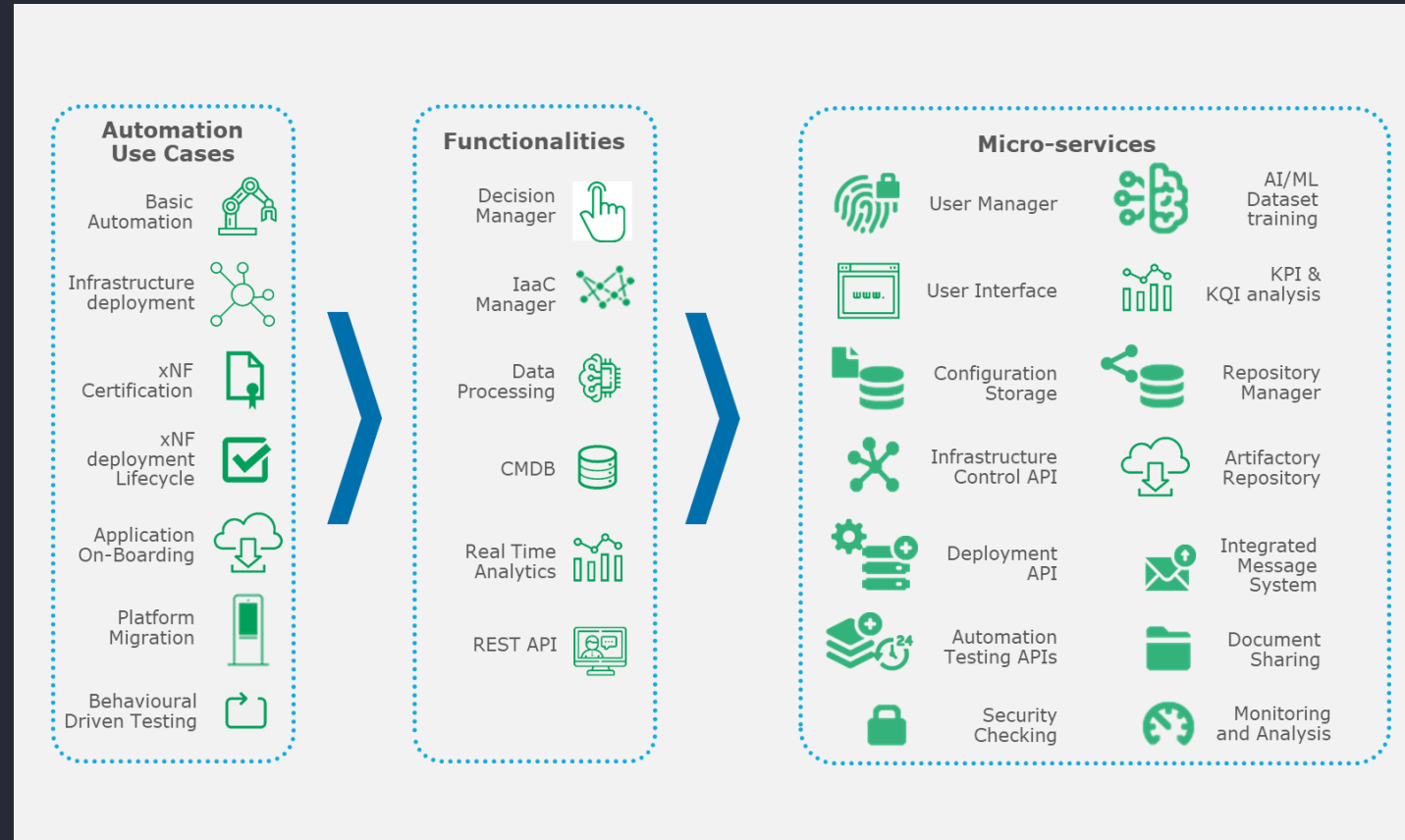
AUTOMATION MODELLING USING ANA FACTORY



AUTOMATION MODELLING USING ANA FACTORY



- 1 UCS WITH DIFFERENT REQUIREMENTS**
but have common basic functionalities
- 2 DESIGN BY μ SERVICES**
whose specific combination implements existing UC enabling the creation of new ones.
- 3 INTEGRATED IN A STRUCTURED SW FRAMEWORK**
Exposed via APIs
- 4 DEPLOYABLE IN DIFFERENT IAAS/PAAS TECHNOLOGIES**
including the ones available from the OTTs
- 5 ENGINEERED TO WORK IN ANY IAAS/PAAS ARCHITECTURE**
Localized/Distributed MEC/Centralized Cloud & Data Centers in either Public and/or Private Networks.

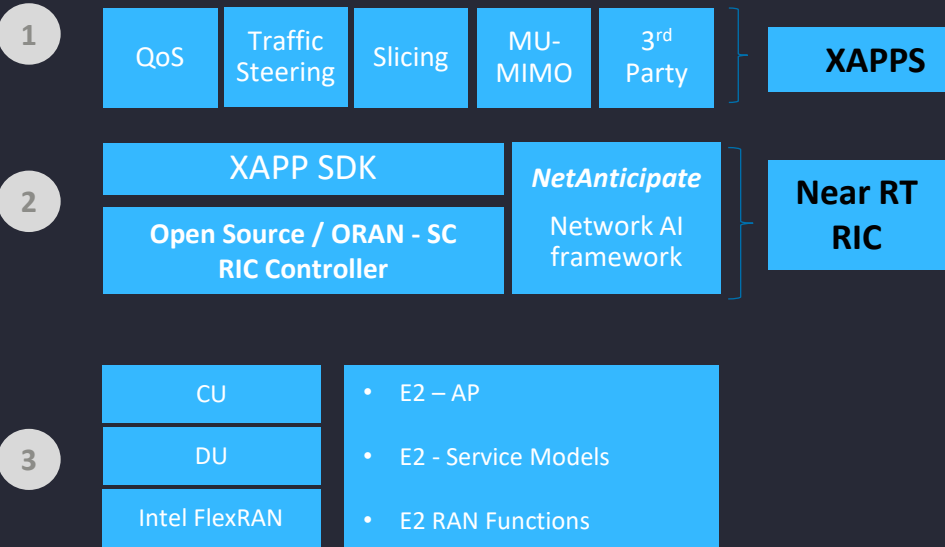


5G SOFTWARE FRAMEWORKS:

E2E TESTING SOLUTIONS COMBINED AI / ML / AUTOMATION TO ACCELERATE MARKET ADOPTION

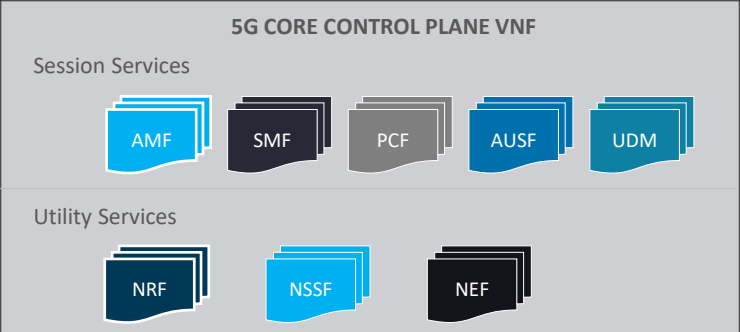


SFS INTELLIGENT RAN



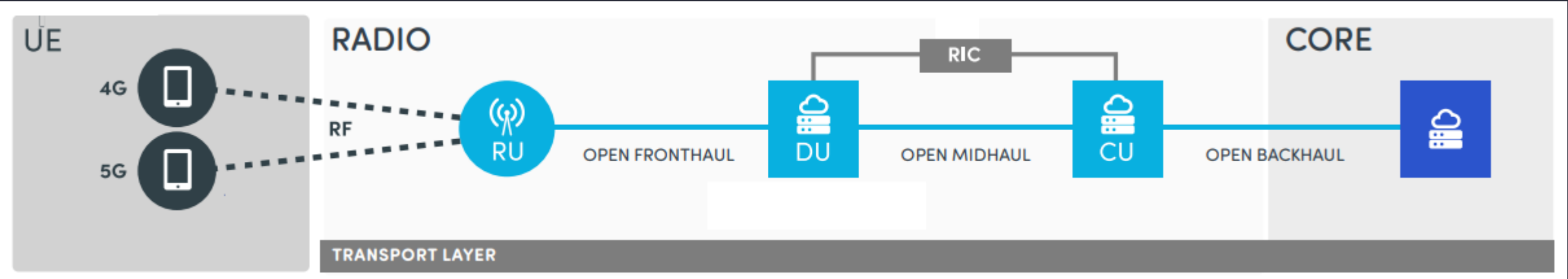
5G NGC - VINGC

- Micro - services based architecture
- Runs on **Kubernetes** or similar env
- Complies with **cloud native** principles
- Compliant to **CUPS** architecture
- Integrated with **Jenkins** for **CI / CD**



NFVI Infrastructure – Kubernetes / Openstack / KVM / Linux

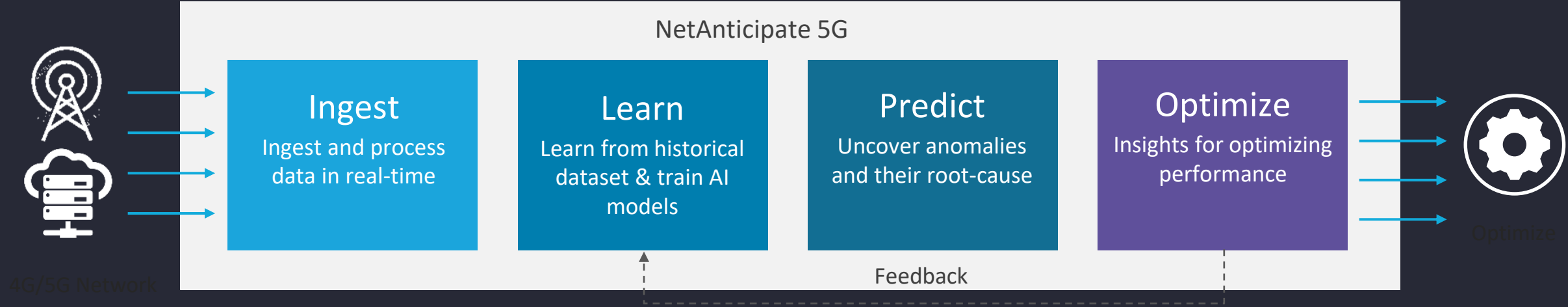
Compute / Storage / Networks



DATA-DRIVEN AUTOMATION SOLUTION



NetAnticipate is self-driving-network platform for realizing **intelligent network operations**. It analyses substantial number of hidden and hierarchical influencers to predict potential network anomalies, build autonomous decisions and takes preventive actions. Autonomous feedback loop ensures the network self-learns to improve actions it takes over time.



Awards & Recognitions

NETWORK AUTOMATION USE CASES



Predictive Maintenance

Prevent Complex Faults & Performance Issues

NoC Automation

Root Cause Analytics & Guided Diagnostics

Energy Optimization

Radio & Core Energy Efficiency Improvement

User Experience

Prevent QoE degradation due to network issues

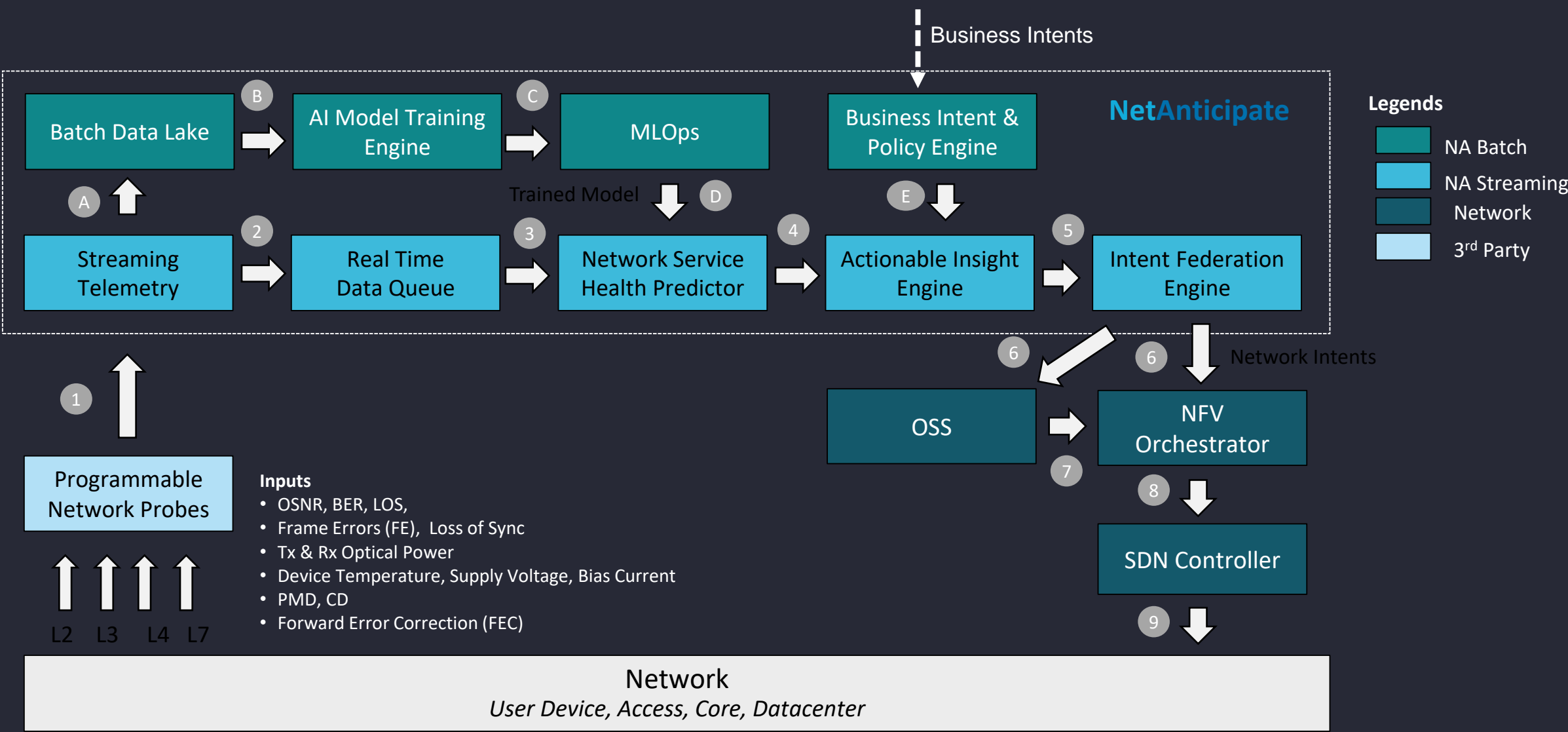
Network Slicing

Intent Based Dynamic Network Slicing

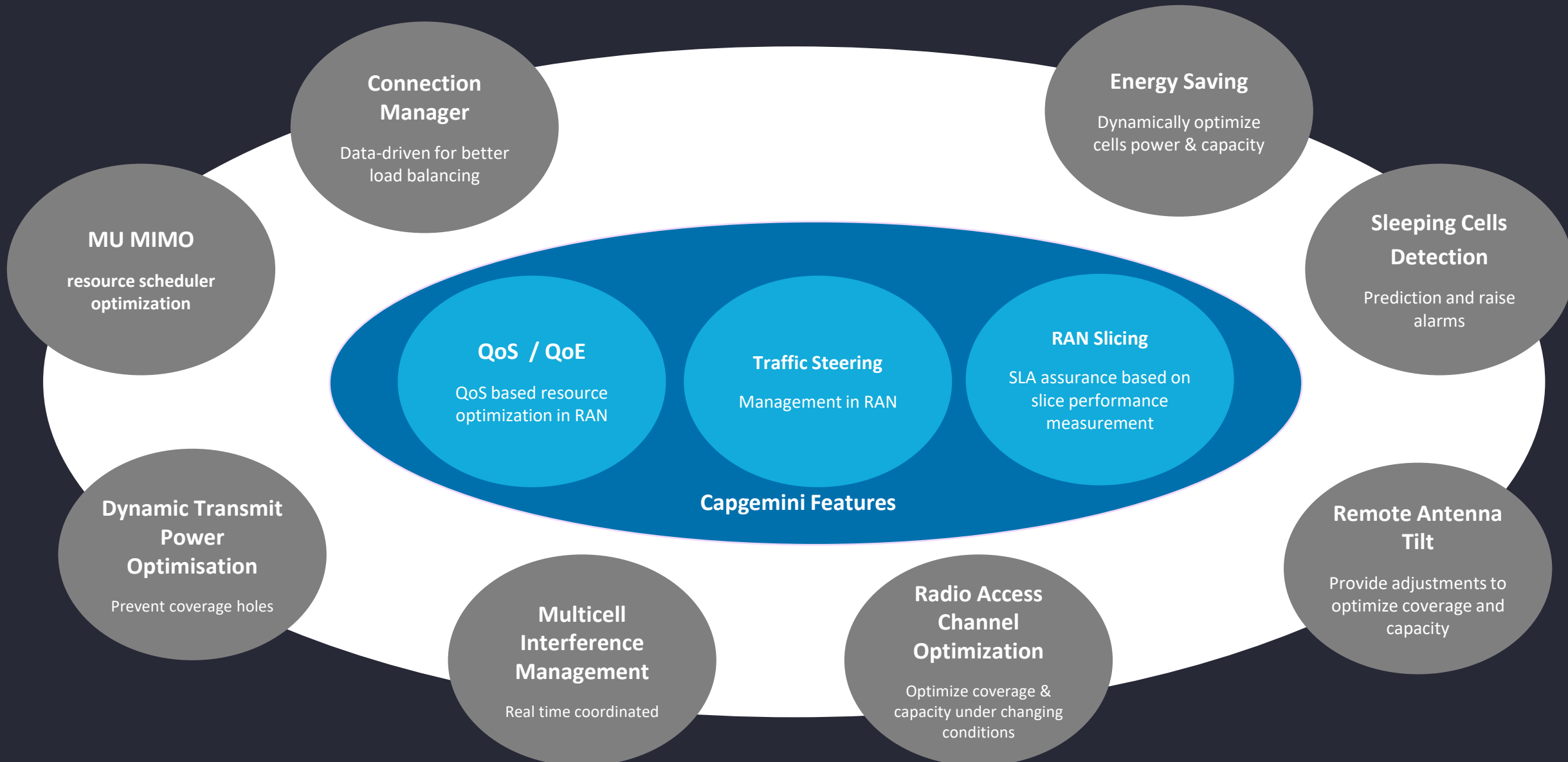
Intelligent Service Rollout

Radio & Fiber Optics Network Planning

NETWORK AUTOMATION USE CASES: UNDER POCS AND TRIALS



INTELLIGENT RAN USE CASES





In Collaboration With Intel

PROJECT MARCONI

ML Infused RAN Performance Optimization

Capgemini Engineering, along with its 5G partner Intel, has developed cognitive 5G Medium Access Controller (MAC), which is first in a series of activities planned as part of Capgemini's Project Marconi.

By introducing ML-infused link adaptation, we observed 15% gains in the spectral efficiency resulting in cell throughput gain of 11.76%.

Project Marconi also demonstrated that ML could be deployed for intelligent decision-making as part of RAN L2 time critical functions, on standard Intel Xeon processors, without introducing any additional hardware requirement on CSPs.

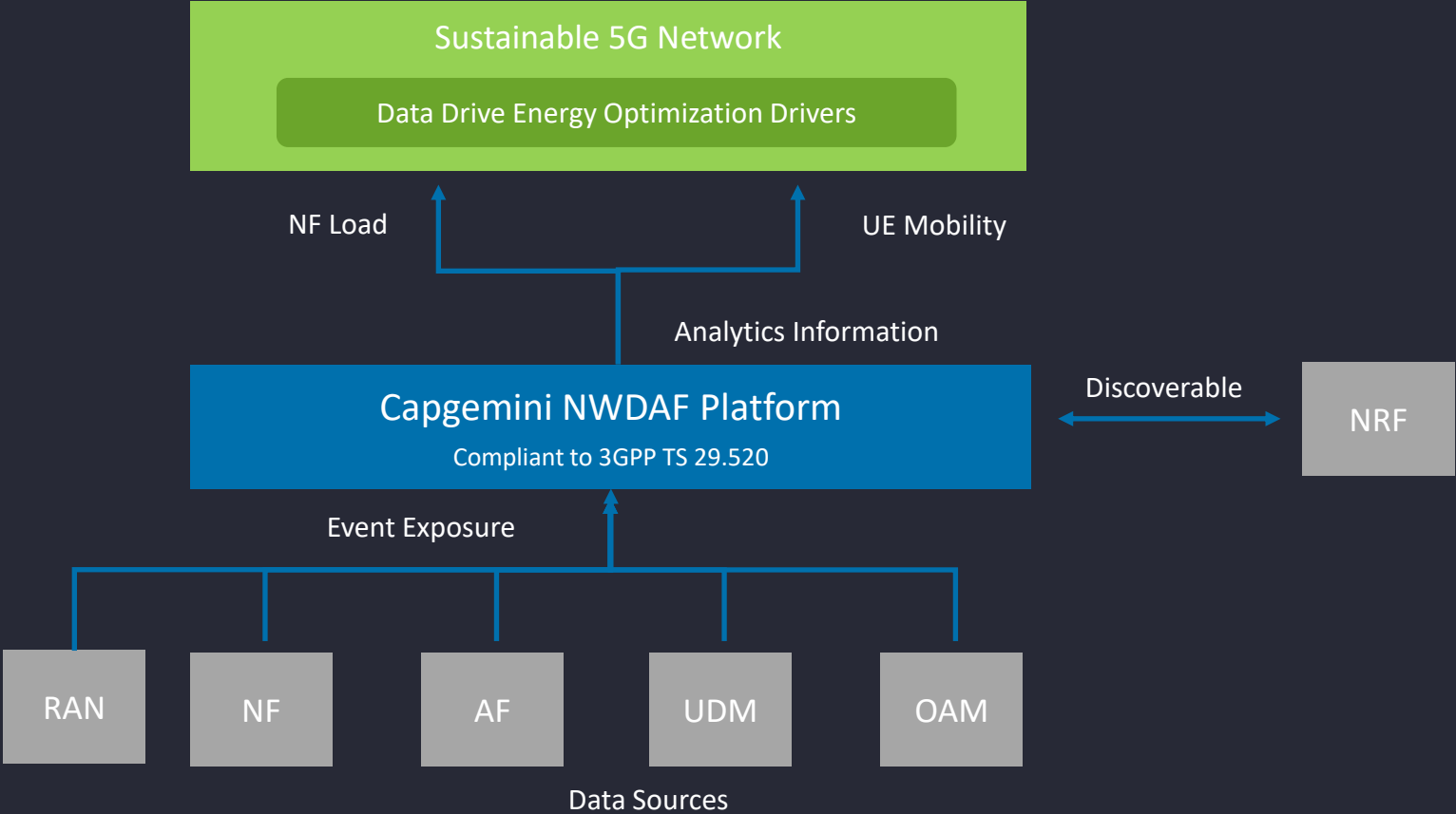
Key features:

- Intelligent AI/ML based CQI Adjustments
- Inference time within <1 msec on Intel Xeon cascade-lake processor without any GPU or HW accelerators
- Implemented as per ORAN xApp standard

PROJECT BOSE

NETWORK AI ENABLED SUSTAINABLE 5G AND BEYOND NETWORKS

NWDAF enabled five energy saving levers work in tandem to significantly reduce energy consumption of the 5G network and the associated IoT devices, resulting in considerable CO2 emission reduction and cost saving, with no negative impact end user's QoE.



Energy Optimization Drivers

Directional UE Paging

Optimize paging decision in AMF based on UE mobility analytics

MICO Mode

Decide Mobile Initiated Connection Only (MICO) mode parameters based on UE analytics

Energy Aware Placement

Optimize NF placement based on load prediction to minimize energy consumption

Smart UPF Selection

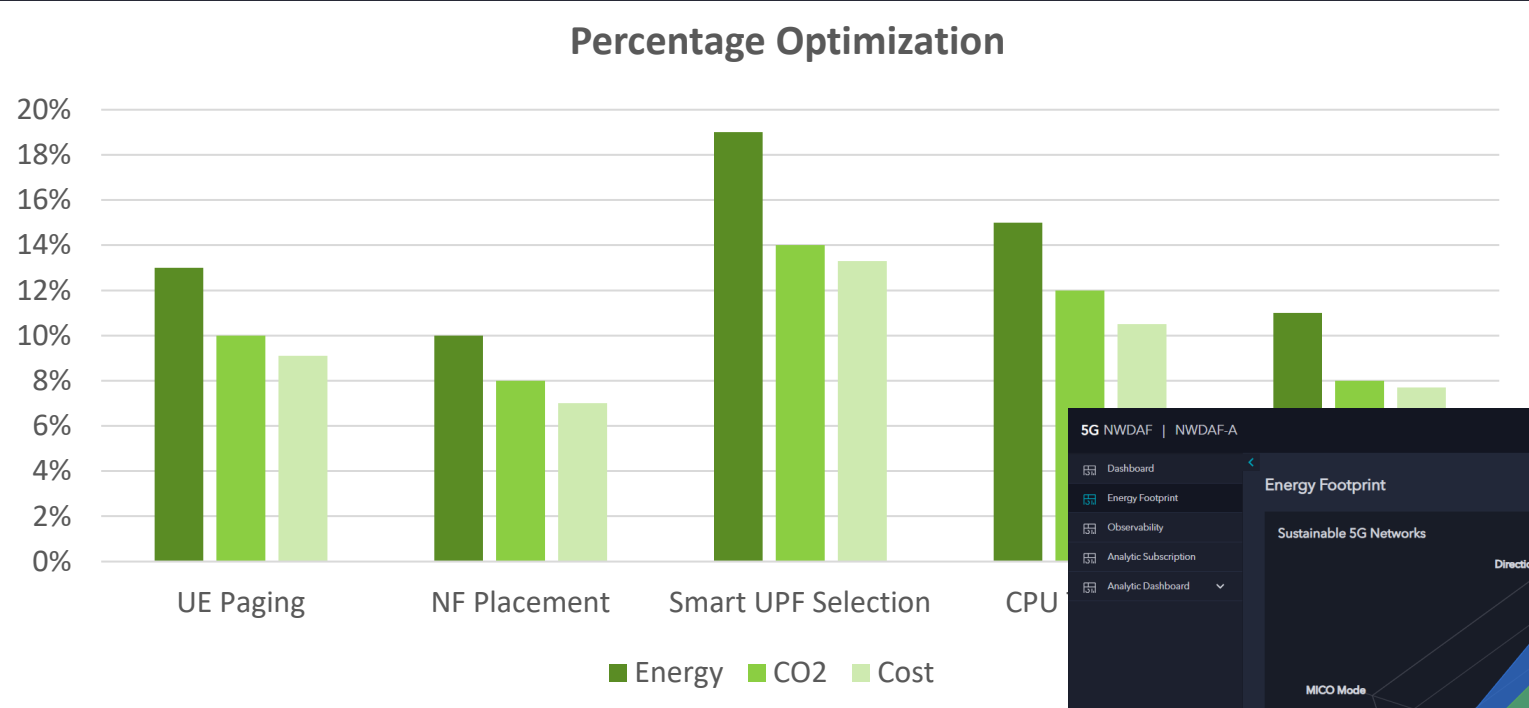
Optimize energy consumption by smartly selecting UPF through load analytics.

CPU Tuning

CPU frequency tuning based on load prediction in the server

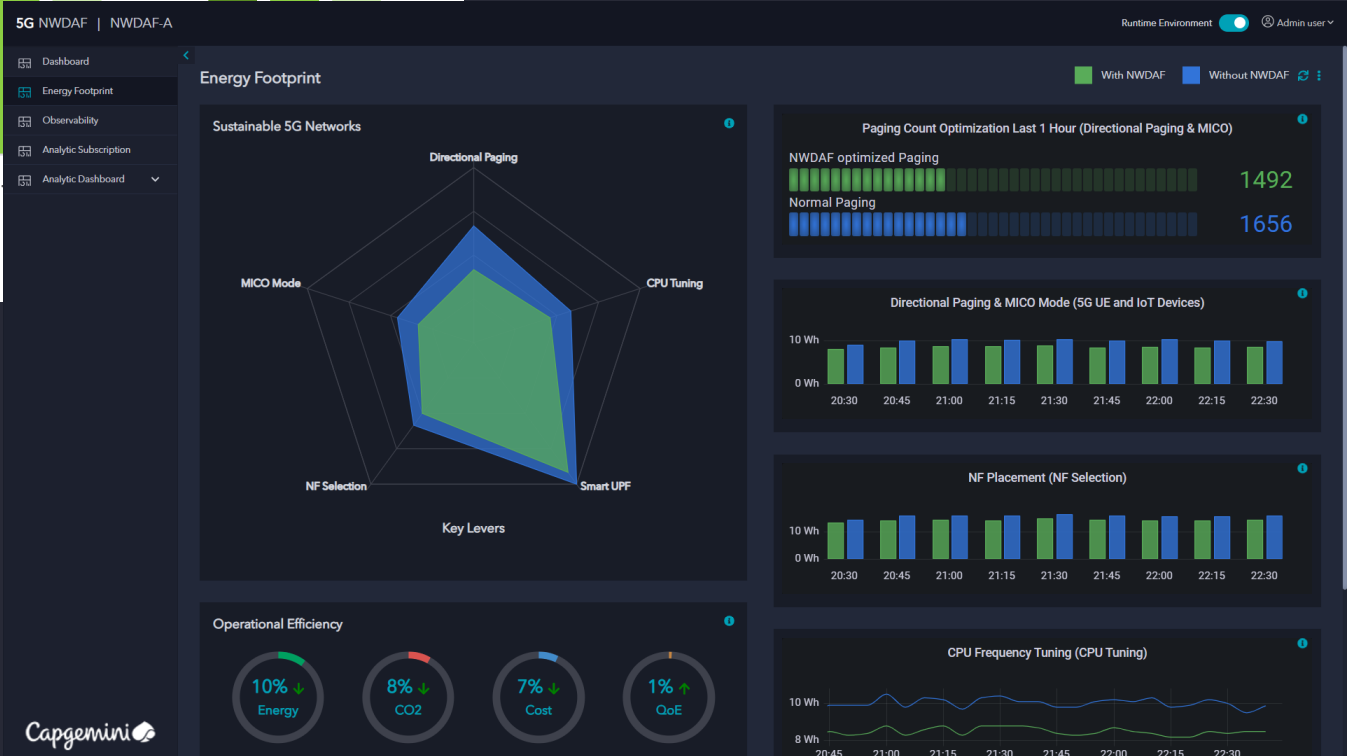
PROJECT BOSE ENERGY OPTIMIZATION RESULTS

THIS IS JUST THE BEGINNING, AND WE WILL SEE MORE IMPROVEMENTS IN THE FUTURE



18%
Energy Saving

14%
CO2 Reduction



A large, thin, light blue arc curves from the top right towards the bottom left, passing behind the central text.

**GET THE
FUTURE
YOU WANT**



Thank You!