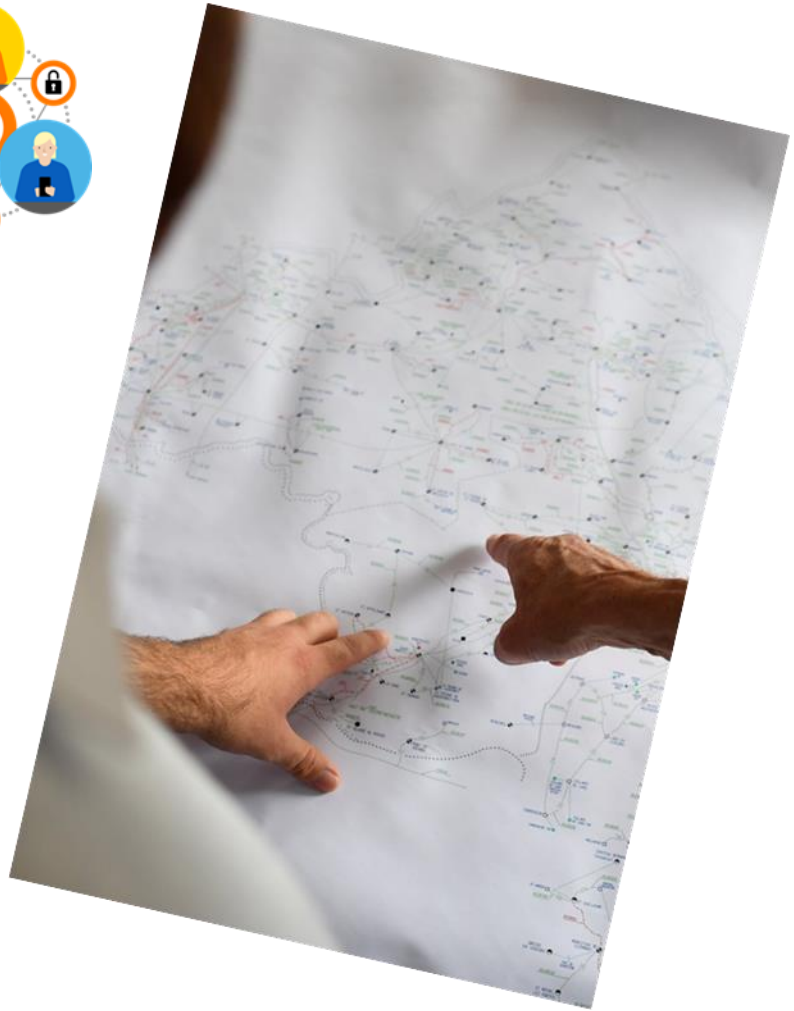

# 5G evolution
# A telco perspective

**Authors:**
**Dr. Ing. Horia Stefanescu – Head of IT operations**
**Ing. Marius Iordache – E2E Architecture Manager**

# Agenda

1. Towards 5G
2. 5G ecosystem overview
3. 5G key technology enablers
4. Phase 3 5G PPP EU projects
5. Key takeaways


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# Towards 5G

**5G networks have to be operated by intelligent orchestration platforms able to support end- to-end applications and services provisioning over a programmable network, compute and storage infrastructure. By leveraging virtualization and softwarization technologies, developers and operators will better match needs and capabilities, building application-aware networks and network-aware applications.**

**The integration of verticals is being considered one of the key differentiators between 4G and 5G systems to open truly global markets for innovative digital business models.**

# 5G ecosystem overview

# Global Market overview

## Unique mobile subscribers

2017
**5.0bn**

66% PENETRATION RATE 71%
(% of population)

2025
**5.9bn**

2.1%
YoY 2017 -2025

## Mobile Internes users

2017
**3.3bn**

43% PENETRATION RATE 61%
(% of population)

2025
**5.0bn**

5.3%
YoY 2017 -2025

## SIM connections

2017
**7.8bn**

103% PENETRATION RATE 110%
(% of population)

2025
**9.0bn**

5.3%
YoY 2017 -2025

*GSMA

# Mobile technology timelines

## The next revolution is here

**1980s**
**1G**

mobile voice

**1990s**
**2G**

mobile coverage
voice plans

**2000s**
**3G**

smartphone adoption
data usage
segmented data plans

**2010s**
**4G**

unlimited voice / SMS
the smartphone is king
same network for all
multi SIM
multi screen
family offers
convergent bundles
Wi-Fi for intensive use

**2020s**
**5G**

Connectivity
Internet of Things

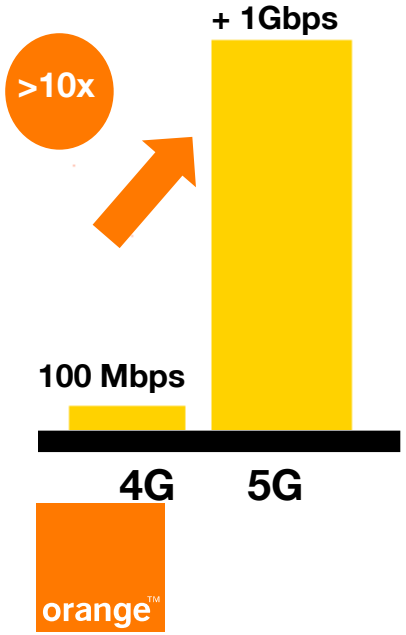
Business Models
Agility

Technology
Programmability

# 5G promises: faster, higher

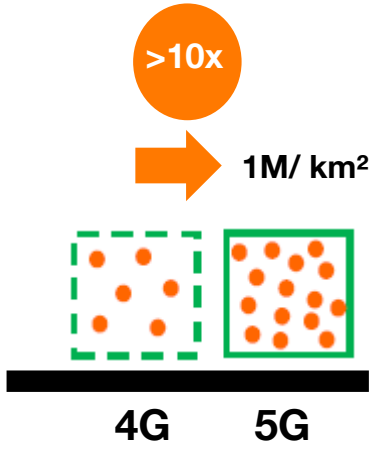
## Faster data rate

5G wireless speeds compared with fiber



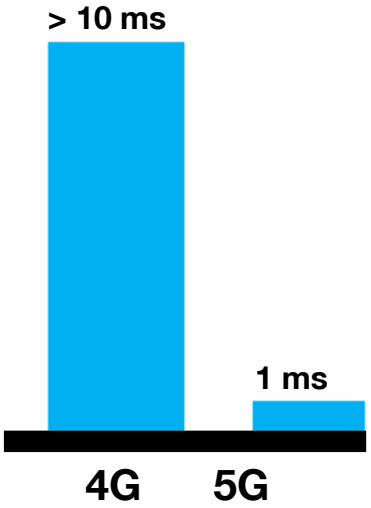

## Higher device density

IOT enabler




## Reduced latency

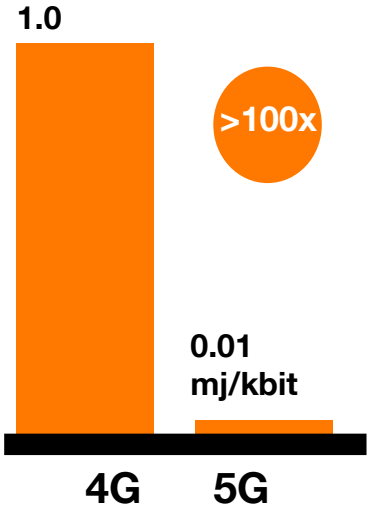
Real-time application




## Lower Energy

Network Efficiency

Network slicing

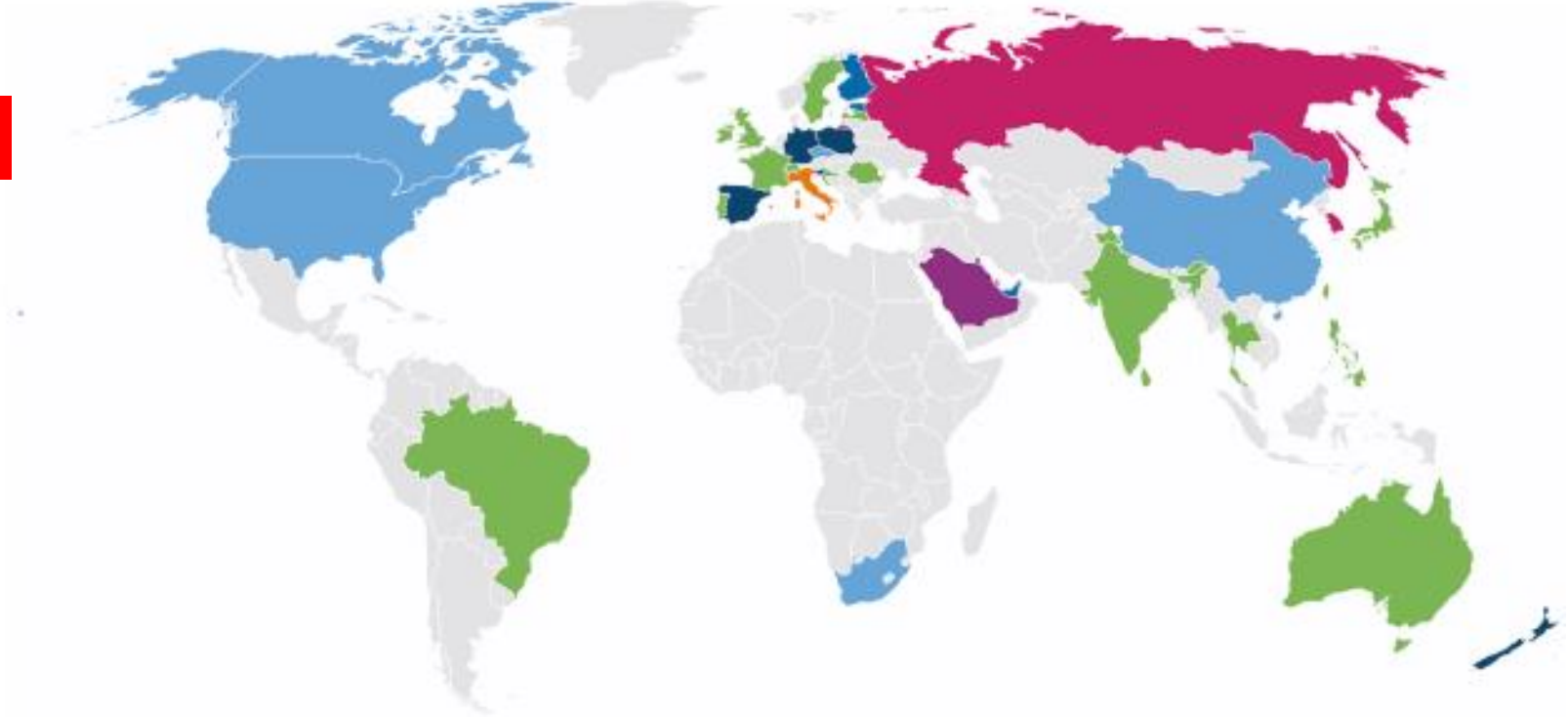



*www.bain.com

# 5G worldwide deployments plans

**2025**

**14%**
**of connections**



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- Expected 2020
- Expected 2019
- Expected 2021
- Event services

*https://uk5g.org GSA Report August 2018

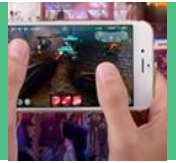
# 5G new services panel

- High Reliability
- High Capacity
- High Speed
- Low Latency
- Massive Connectivity

**Broadband Access in Dense Areas**
service availability in densely-populated areas

**Higher User Mobility**
services at speeds greater than 500km/h

**Broadband Access Everywhere**
50+ Mbps everywhere at ultra-low cost



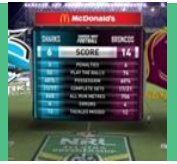
**Ultra-reliable Communications**
robots control
e-Health

**Lifeline Communications**
natural disasters

**Massive Internet of Things**
low-cost / long-range / low-power

**Extreme Real-Time Communications**
autonomous driving & AI

**Broadcast-like Services**
8K & mobile TV
AR / VR



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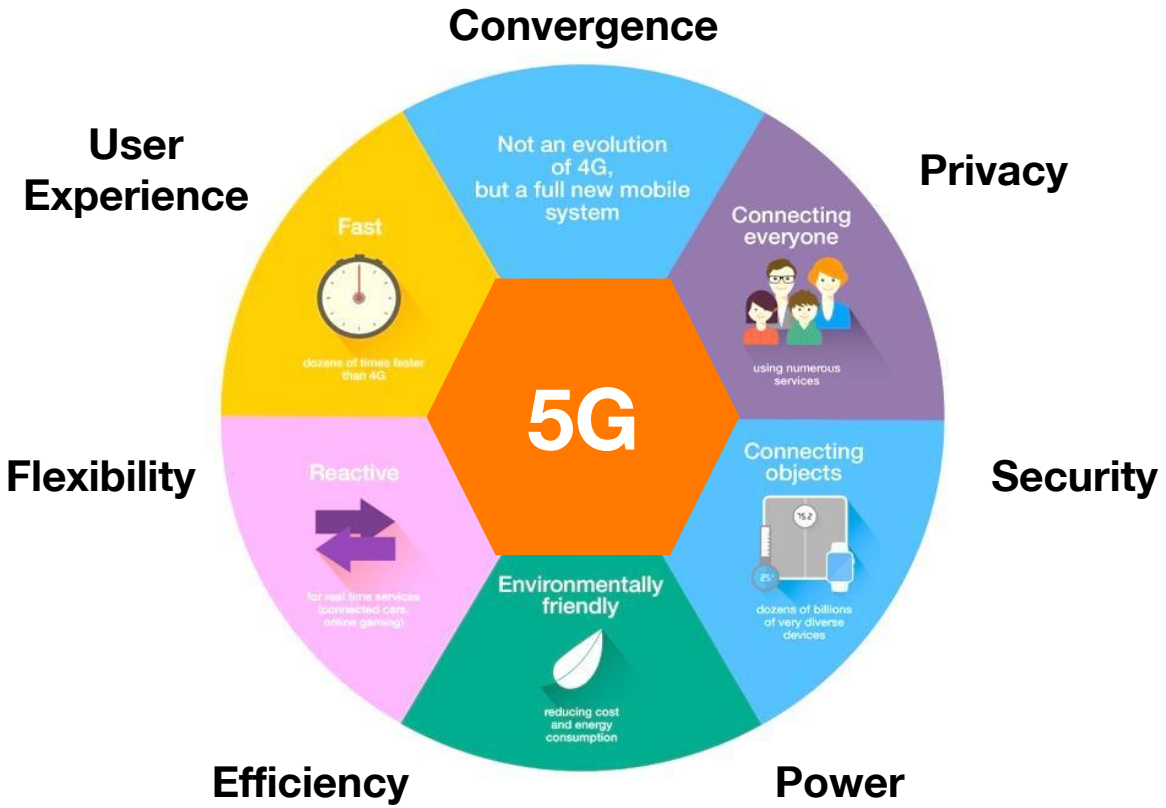
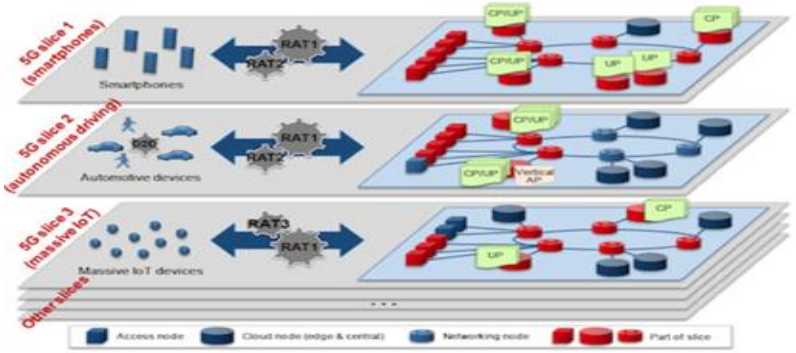
# 5G key features



# 5G network slicing

## Economic context for deploying

- One big network for all services types
- Separate dedicated core networks per service type
- Network slice per service type (Service n slice)




*NGMN

**Slicing motivation**

**Less Opex**

**Increase revenue**

**Benefits Services**

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# 5G Intelligent Connectivity

## Fusion of 5G, AI and IoT

Smart Platforms with AI

5G Network

IoT – Everything Connected

## Smarter and productive

- Applicability
- Entertainment - Gaming
- Autonomous Transportation
- Enhanced Public Services
- Industry
- Sustainability
- Connectivity

# 5G System – Goal and Services

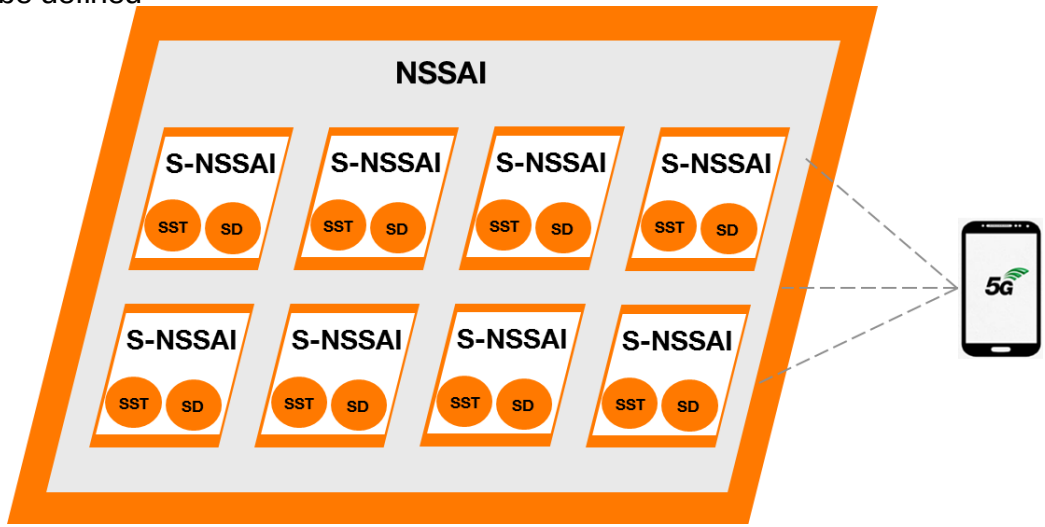
- **5G system** needs also to support stringent KPIs for latency, reliability, throughput, etc. Enhancements in the air interface contribute to meeting these KPIs as do enhancements in the core network, such as network slicing, in-network caching and hosting services closer to the end points.
- **5G system** shall enable the user of a single terminal to establish and maintain several connections simultaneously. It shall be possible for a user to be associated with one or a number of user profiles and be active simultaneously.
- **A subscription** describes the commercial relationship between the subscriber and the service provider. A Subscription shall identify the set of services, within particular domains, to which the user has access; each subscription may specify a different set of services.
- **5G system** shall efficiently cater for applications which have variable requirements relating to specific QoS parameters (e.g. throughput) whilst meeting other QoS targets. It shall also cater for applications which are able to take adapt to a range of variations in QoS.

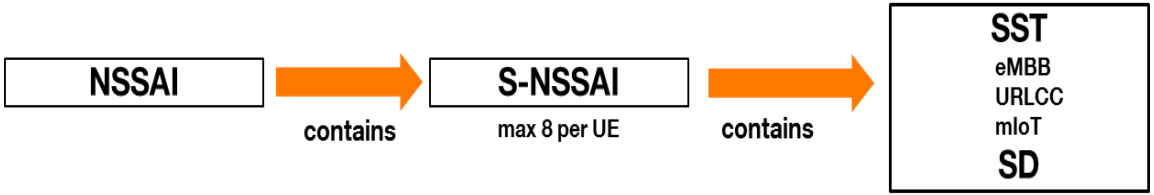
# Characteristics of 5G systems

**Network slicing selection**: slice groups (NSSAI) containing single slice identification(S-NSSAI). The S-NSSAI contains the slice template(SST) and the service/slice descriptor(SD)

**Slice SST standardized values**: eMBB; mMTC; URLLC

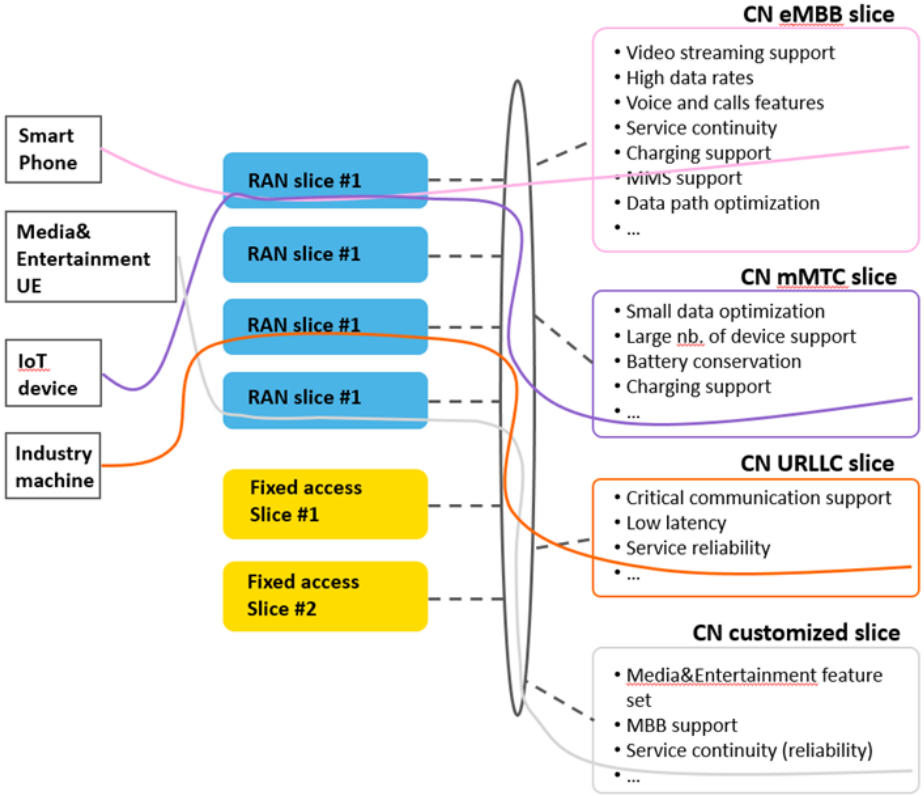
- Others specific values may be defined



# Slicing and verticals

- **Slicing framework**: provisions customized, cost-efficient, scalable services in software-networking to assure different telco services (eMBB; mMTC; URLLC) needs with guaranteed resource isolation
- **Vertical in the loop**: provides Vertical Services according to vertical customer specifications, through customized sliced capable networks
- **5G multi-domain slicing**: the resources are shared between different telco services across multiple administrative (tenants) and technological domains (Radio, Transport, Core).



# Services and Network slices

| Slice/Service type | SST value | Characteristics |
|---|---|---|
| eMBB | 1 | Slice suitable for the handling of 5G enhanced Mobile Broadband. |
| URLLC | 2 | Slice suitable for the handling of ultra- reliable low latency communications. |
| MIoT | 3 | Slice suitable for the handling of massive IoT. |

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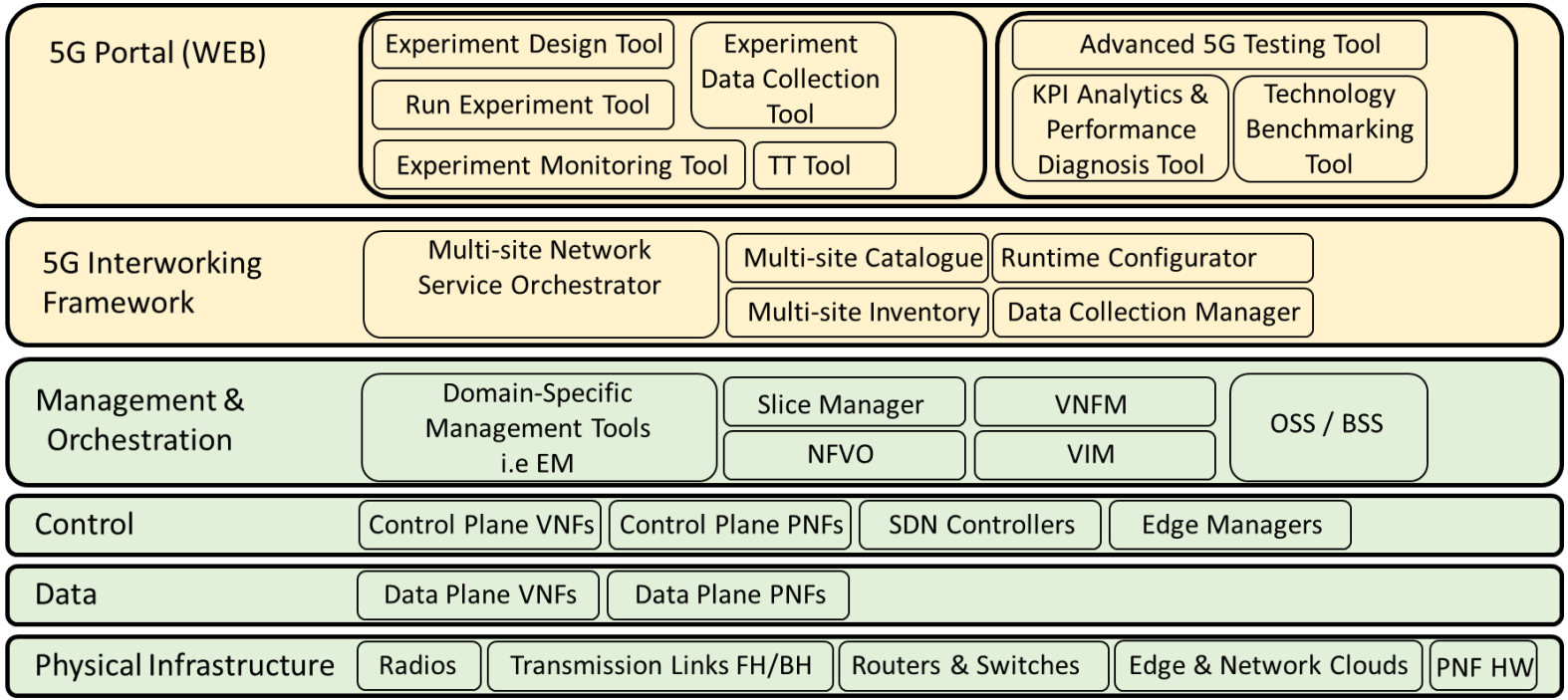
# 5G system components

- 5G Platform architecture Functional View – Blocks and Components




# 5G Key technology enablers

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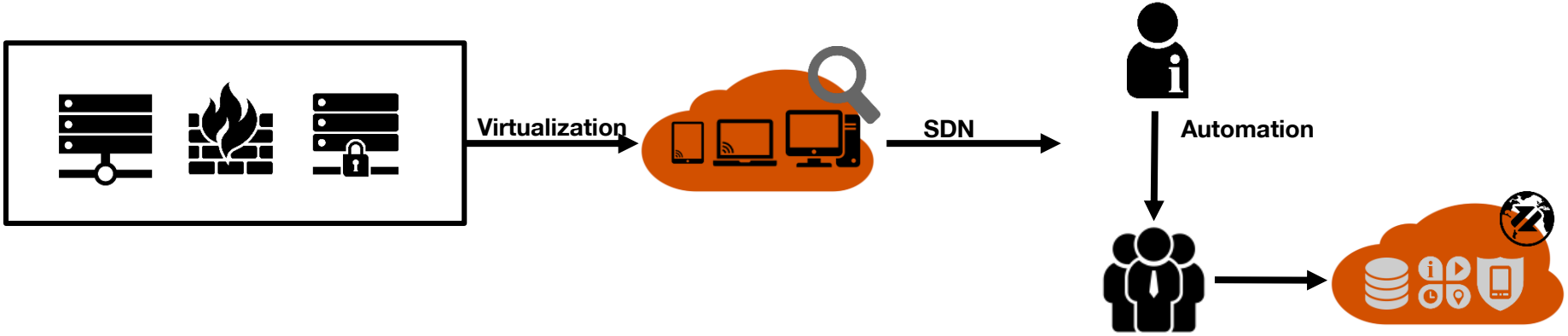
# Network transformation

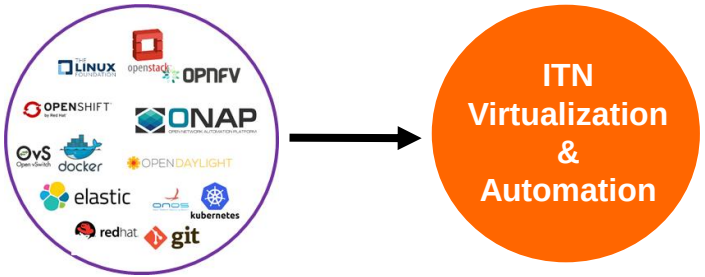
From dedicated network functions

to Software network functions

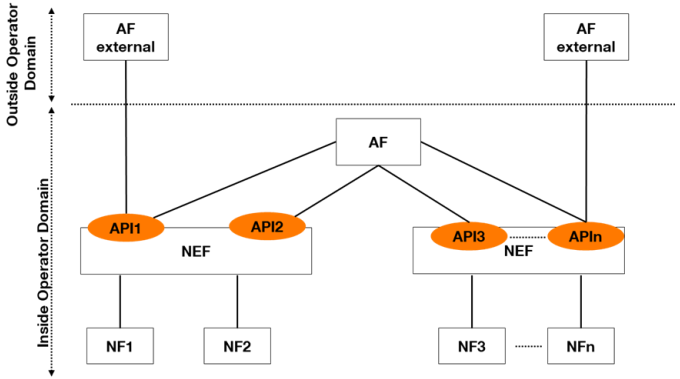
service configuration




| | |
|---|---|
| **Business Model** | Accessibility through APIs/marketplace<br>Real time customer journey<br>Transformation through automation |
| **Network** | Fast deployment<br>Reduce Time-to-Market<br>Savings-> reducing costs of operations |

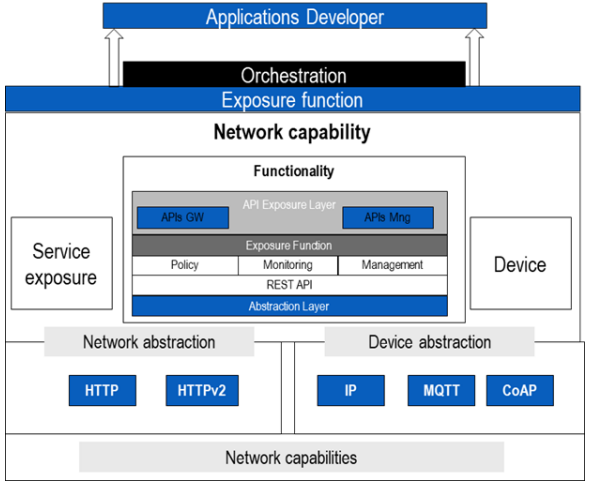


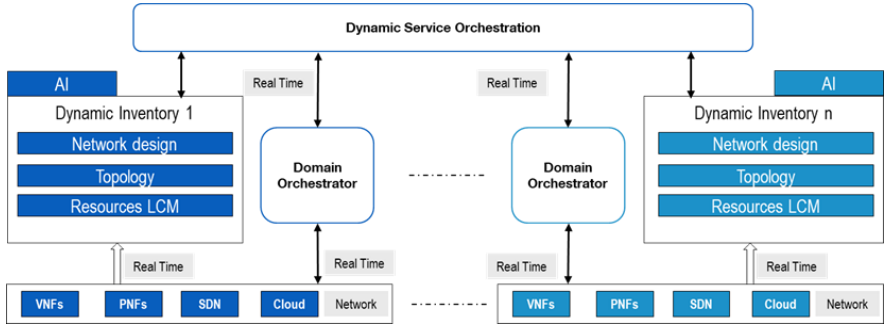
# 5G system key components




**When?**

**Mid 2021**

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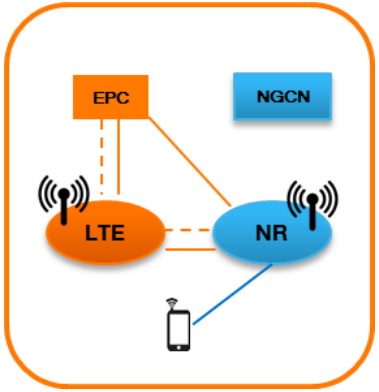
# 5G implementation steps

## Start Arch




### Non Stand Alone(NSA)

Commercial deployment for most of the operators

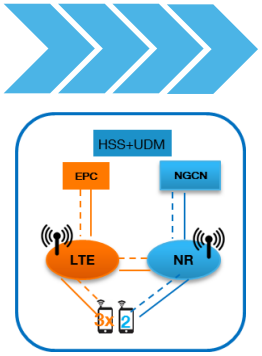
5G eMBB (5G OC)

Voice and SMS

Mobility outside 5G area

NSA-only devices

## *Intermediate*



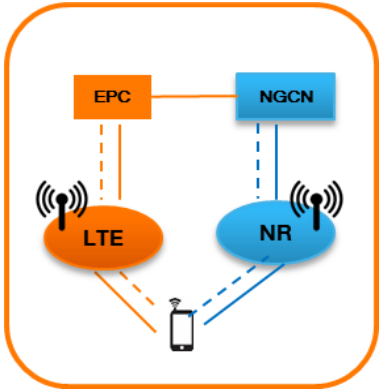

### Migration to target

NSA and SA coexistence

Different options for analysis

Best decision to be taken accordingly

## Target Arch




### Stand Alone(SA)

Commercial deployment

5G eMBB and FWA

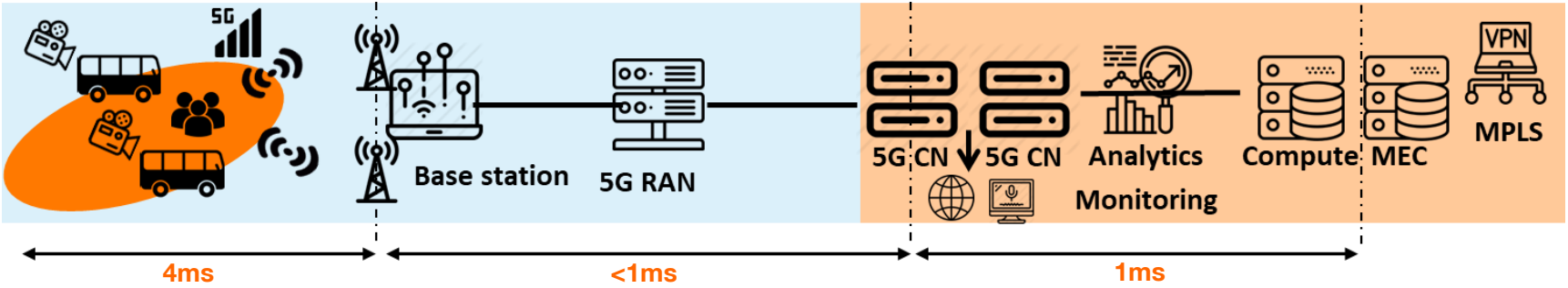
5G NR voice

Full mobility

New B2B2C services(slicing)

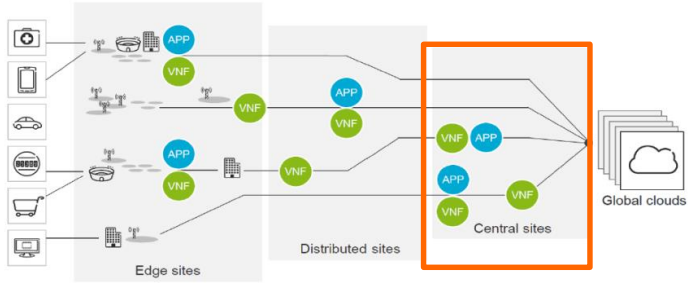
# MEC: Orange Romania approach

**Today's 5G NSA implementation for use cases development**




**Possible deployments**

1. MEC and the local UP CN collocated with the Base Station
2. MEC collocated with a transmission node, possibly with a local UP CN
3. MEC and the local UP CN collocated with a network aggregation point
4. MEC collocated with the Core Network functions (in the same DC)




**Orange proposal: MEC servers & apps collocated with dedicated User Plane CN in same DC**

# ONAP Adoption is key (1/2)

1. open-source software platform; vendor agnostic
   AT&T Orange Vodafone;  Cisco Huawei Ericsson Nokia; IBM

2. comprehensive platform for real-time, policy-driven orchestration
   automation of physical and virtual network functions

3. enable software, network, IT and cloud providers and developers
   automate new services and support lifecycle management.

4. accelerate the development
   implementation for network automation

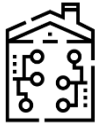
# ONAP adoption is key

## Design-time

development environment with tools, techniques, and repositories for defining/describing resources, services, and products

## Run-time

executes the rules and policies distributed by the design and creation environment controllers that manage resources corresponding to their assigned controlled domain



## Automation

Closed Loop Automation

## Data Collection Analytics and Events

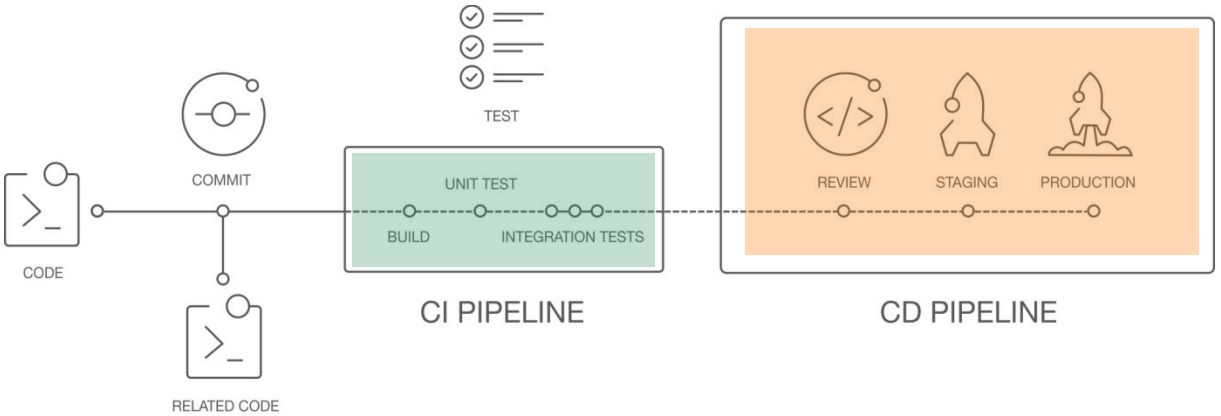
role of Data Collection, Platform Components and Services

## Network Services

deliver differentiated network services on demand

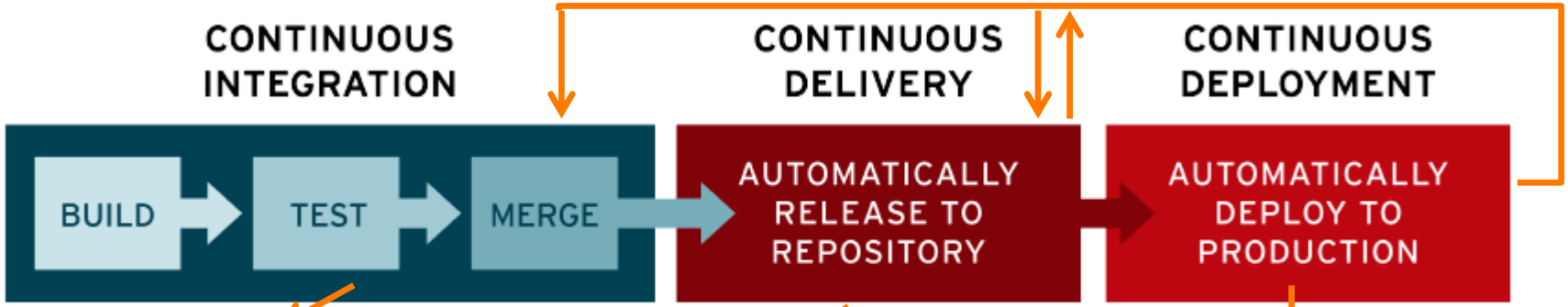
# CI/CD

**We need to automate everything that we can in the VNFs delivery process and run it in a CI/CD pipelines.**




***Source GitLab.com (cc)***

# CI/CD Challenges




**The job of Continuous Integration** is to produce an artifact that can be deployed. The role of automated tests in CI is to verify that the artifact for the given version of code is safe to be deployed.

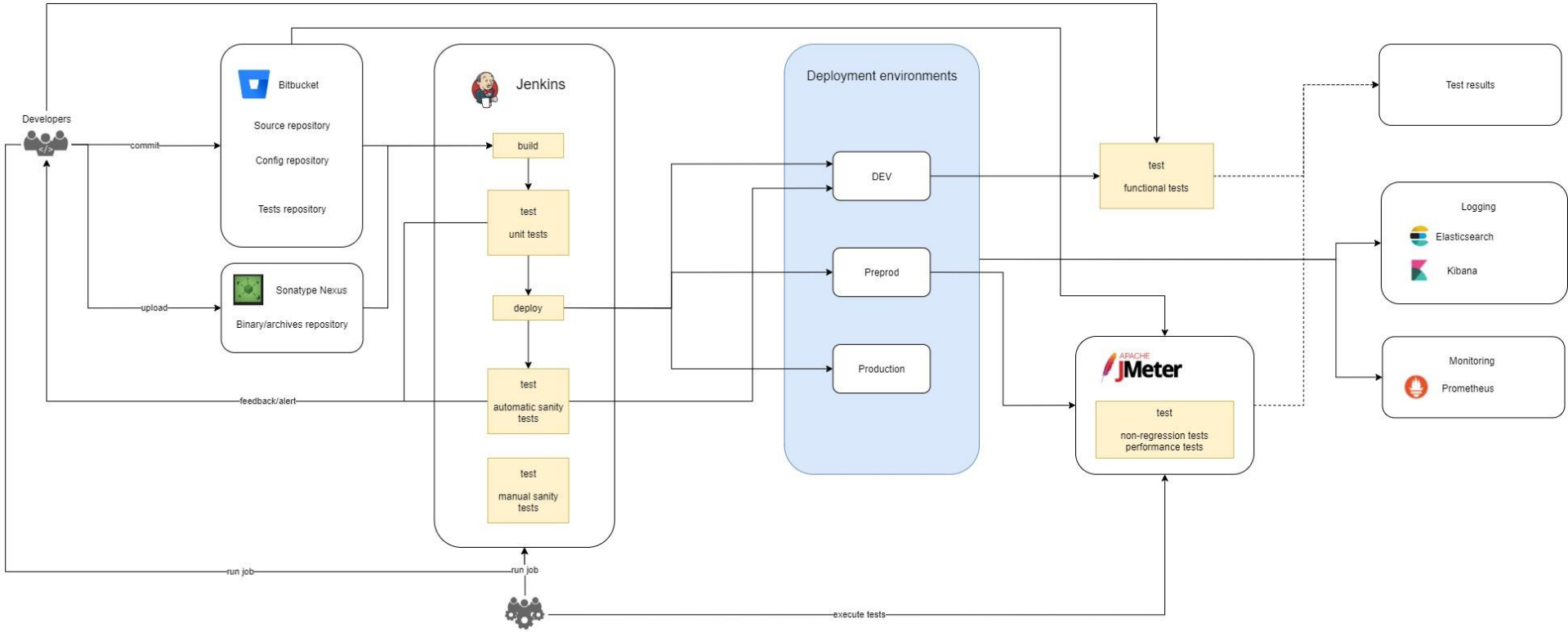
**Continuous Delivery challenges are to store multiple information on repositories:**

- Software images received from different suppliers
- Artifact & vNFs configuration received from CI chain
- Tenant configuration and networking coming from LLD & CI
- Test frameworks, binaries, results, … coming from CI (Xtesting)

**Continuous Deployment challenges:**

- Automatized the deployment (staging)
- Automatized the release management
- Automatized the change management

# CI/CD Pipeline example for one the VNFs deployed in Orange




| Integration | | | | | Delivery/deployment | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Source repository | Config repository | Integration tool | Compile, build, test | Artifact repository | Deployment tool | Dev deployment | UAT/PREPROD/PROD deployment | Functional Tests | Operational Tests |
| Bitbucket | Bitbucket | Jenkins | Manually triggered, automated unit tests | Nexus | Jenkins | manual, Jenkins job | manual, Jenkins job | auto sanity tests, manual functional on DEV | manual non-regression, performance on Preprod |

# Adopting the operational model from IT world in network – few thoughts

1. **Functional DevOps teams formed around VNFs having end to end responsibilities for the VNF in scope.**

2. **The VNFs are deployed and ran over common production platforms (as the monolithically approach disappears). This platforms are not in scope of DevOps team. This is where Platform Ops comes into picture.**

3. **Platform Ops is therefore responsible for engineering and operating the production platforms which are supporting DevOps VNFs.**

4. **NoOPS – does not really mean that there will be a time when no operational activities will be necessary (even if most of them will be automated), it means that operations & engineering/dev tasks are not segregated anymore.**


# Phase 3 5G PPP EU projects

## where ORO in involved for accelerating 5G development

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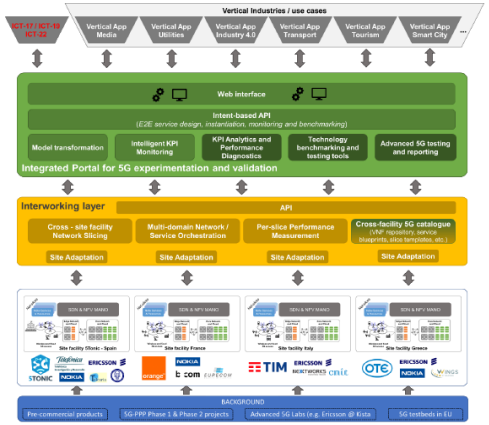
# 5G-EVE

## 5G European Validation platform for Extensive trials





**5G-EVE creates the foundations for a pervasive roll-out of end-to-end 5G networks in Europe by offering to vertical industries and to all 5GPPP Phase3 projects facilities to validate their network KPIs and their services.**

**H2020 grant no. 815074, 28 partners from 7 countries, 36 months**
**https://www.5g-eve.eu**

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5G EVE

5G PPP
PUBLIC-PRIVATE PARTNERSHIP

# 5G-EVE

## 5G Track for start-ups & academia

Timisoara

COWORK TIMISOARA

Universitatea Politehnica Timișoara

Iasi

FABLAB IAȘI

Working space
Co-innovation methodology
Access to Orange infrastructure
Integrate solutions within Orange portfolio
International product validation
Recognized mentors & workshops
Demo days
Proof of concept with Orange customers

techhub

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA ROMANIA

Cluj Napoca

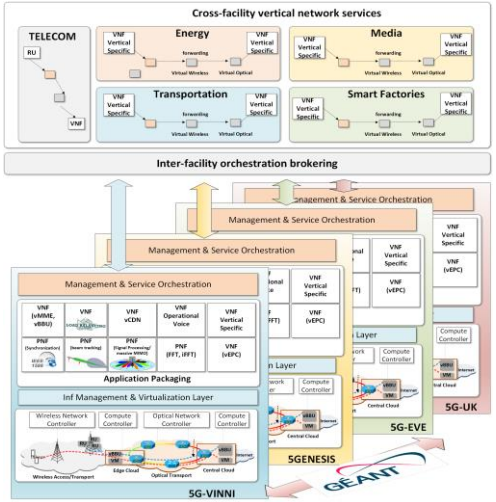
SILICON FOREST

POLITEHNICA UNIVERSITATEA DIN BUCUREȘTI

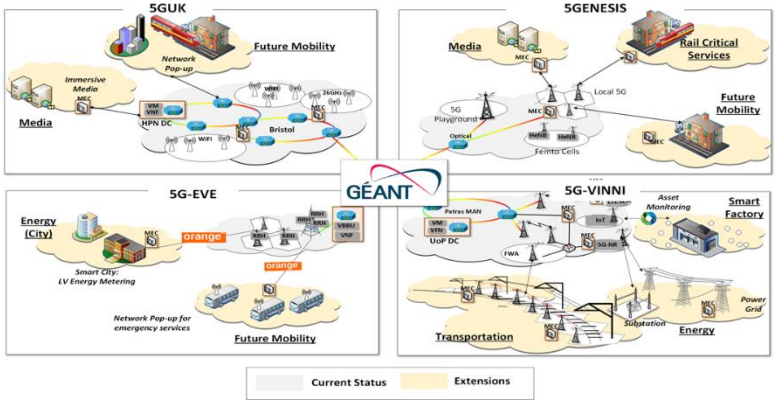
Bucuresti

# 5G-VICTORI

VertIcal demos over Common large scale field Trials fOr Rail, energy and media Industries




**5G-VICTORI conducts large scale trials for advanced vertical use case verification focusing on Transportation, Energy, Media and Factories of the Future and cross vertical use cases.**




**It leverages 5G network technologies developed in 5G-PPP phase 1 and 2 projects 5G-XHaul and 5GPICTURE and exploits extensively existing facilities interconnecting main sites of all ICT-17 infrastructures, and exploits extensively existing facilities interconnecting main sites of all ICT-17 infrastructures i.e. 5G-VINNI, 5GENESIS and 5G-EVE and the 5G UK test-bed in a Pan-European Infrastructure**

https://www.5g-victori-project.eu

**H2020 grant no. 857201**


# Key takeaways

# Key takeaways

1. 5G changes this paradigm introducing IT concepts in the telco world: (1) APIs that facilitate access to the network; (2) virtualization of the network functions (Virtual Network Functions – VNFs) decoupling therefore the software from the hardware; (3) automated deployment and in life management of different VNFs over an IT programmable infrastructure.

2. 5G slicing is the key mechanism (fully available in the target architecture) enabling the integration of verticals

3. The 5G ecosystem is much more complex and requires the development of an advanced automation ecosystem (ONAP, CI/CD tools, etc). The ambition is to automate whatever is possible!

4. 5G will not be possible w/o adapting the operational model and organization (this is a hot subject for most of the operators and it is a lengthy process that will take in average 3 years)

# Thank you