

Fabulous 2017

3rd EAI International Conference

**Telco network evolution for the
future 5G services**

Horizon 2020

Development & Innovation

Marius Iordache



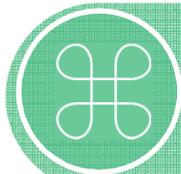
Orange digital (re)evolution



1st country in Europe
ultrafast broadband adoption (>100 Mbps)



10th country in Europe
average peak connection speeds (Q4'16: 16.1 Mbps)



- Heavy network investments:**
- > 50% fixed internet connection with >100Mbps speeds (FTTH/B most widely used technology)
 - 1 in 5 mobile internet connections are 4G



- Further opportunities to be explored:**
- as RO accounts the lowest level of digitalization in EU
 - broadband coverage @ national level is 57%



Orange Romania key figures

10 million
mobile
subscribers

orange™

> 3000
employees

#1 mobile telecom
provider
in Romania for 11
consecutive years

#4th place
In top 100 most
valuable companies
in Romania

most trusted brand
4 times in a row – Readers'
digest

bn
CAPEX investments in
networks
and telecom solutions

top employer
4th year in a row

€987m
revenues in
2016

#1 4G network
100% urban coverage
- fastest network

5G Vision

”5G is an **end-to-end ecosystem** to enable a **fully mobile** and **connected society**. It empowers **value creation** towards customers and partners, through existing and emerging **use cases**, delivered with consistent experience, and enabled by **sustainable business models**”



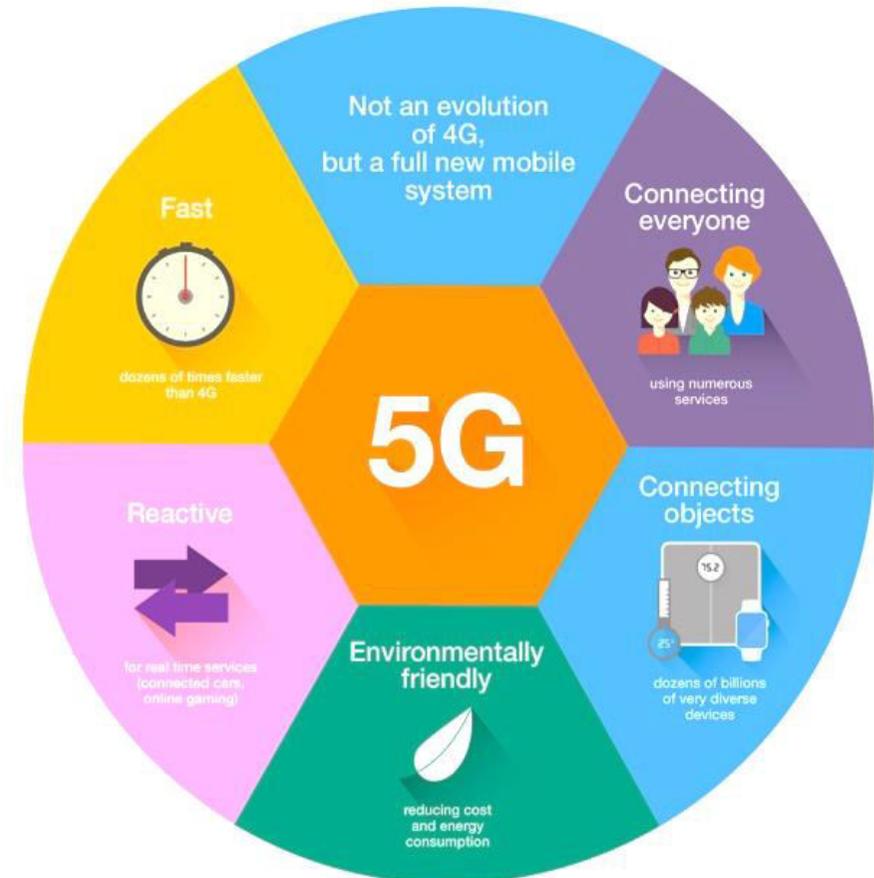
5G Mission

5G is intended to deliver **solutions**, **architectures** and **technologies** for the next coming decades with huge potential of creating **new markets**, **business** models and **innovation** opportunities and actions in areas such as **Smart Cities**, e-Health, Intelligent Transport, **Education**, **Agriculture**, Media and Entertainment.



5G key requirements

- ❑ Low power consumption
- ❑ Homogenous user experience
- ❑ Support ultra low cost networks
- ❑ Cost efficiency with variable cost model
- ❑ Security and privacy
- ❑ Flexibility for future evolutions
- ❑ Fixed-mobile convergence
- ❑ New radio and new architecture/core

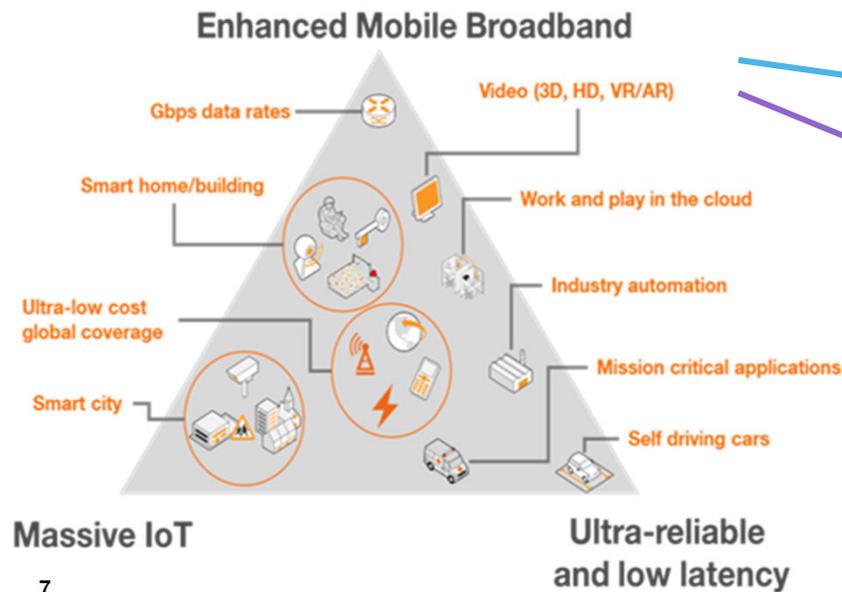


Orange 5G

- ❑ new standard => new spectrum, new radio, new features
- ❑ new way of thinking about mobile network design => virtualisation, slicing

5G means :

- ❑ have more capacity
- ❑ deploy with more flexibility
- ❑ Opportunities to launch new services



eMBB : enhanced Mobile BroadBand

- ❑ New spectrum / new features
- ❑ Better coverage, more capacity and speed

Fixed Wireless Access

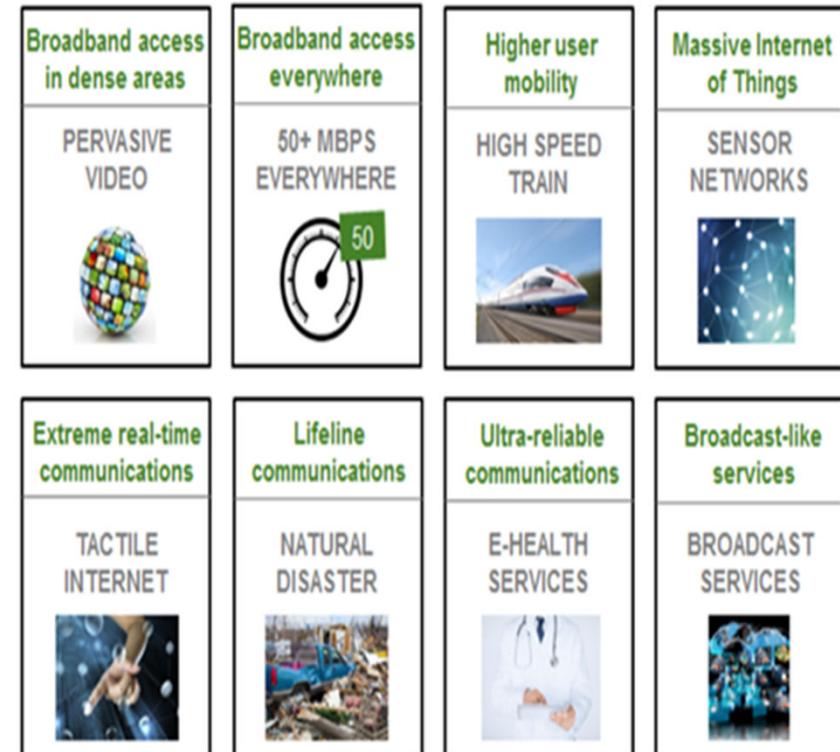
- ❑ New spectrum / new features

Specialised Services : V2X , Robotic , ...

- ❑ New feature URLLC : Ultra Reliable & Low Latency Communication
- ❑ Better latency, better reliability

5G Use Cases family

- ❑ **Broadband Access in Dense Areas**
 - ❑ service availability in densely-populated areas
- ❑ **Broadband Access Everywhere**
 - ❑ 50+ Mbps everywhere at ultra-low cost
- ❑ **Higher User Mobility**
 - ❑ services at speeds greater than 500km/h
- ❑ **Massive Internet of Things**
 - ❑ huge number of devices
 - ❑ @low-cost/long-range/low-power
- ❑ **Extreme Real-Time Communications**
 - ❑ autonomous driving & natural disasters
- ❑ **Ultra-reliable Communications**
 - ❑ robots control
 - ❑ e-Health



Orange Innovation Ecosystem

Orange Educational Program 1997 - 2017

+400K Euro scholarships
+270K Euro Lab @ UPB
33% alumni became Orange employees

Pre-accelerator program

4 Years main partner at Innovation Labs
3 solutions integrated in Orange Portfolio

R&D

European founded projects on research and innovation: 5G, Smart Cities & IoT



1st Smart City

Alba Iulia Smart City Pilot Project
14 integrated smart city solutions, 3 Innovation Labs projects integrated

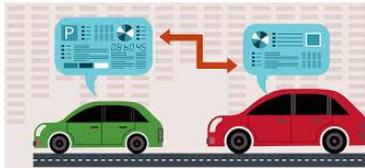
New services on Romanian market

VoLTE, VoWi-Fi, 4G+, Gigabit mobile internet trials

New Products

Smart Home
Robots
Latest flagship handsets
Smart Stores

5G Use cases requirements



5ms
99.999%

DL:100Gbps/km²
UL50Gbps/km²
500km/h



DL: 300Mbps
UL:60Mbps
200.000 devices/km²

1ms
99.999%



200.000 devices/km²
0.3-20Mbps
0.1-10Mbps/m²



What do 5G for customers ?

**50Mbps or 100 Mbps cell edge
coverage outage
indoor versus outdoor**

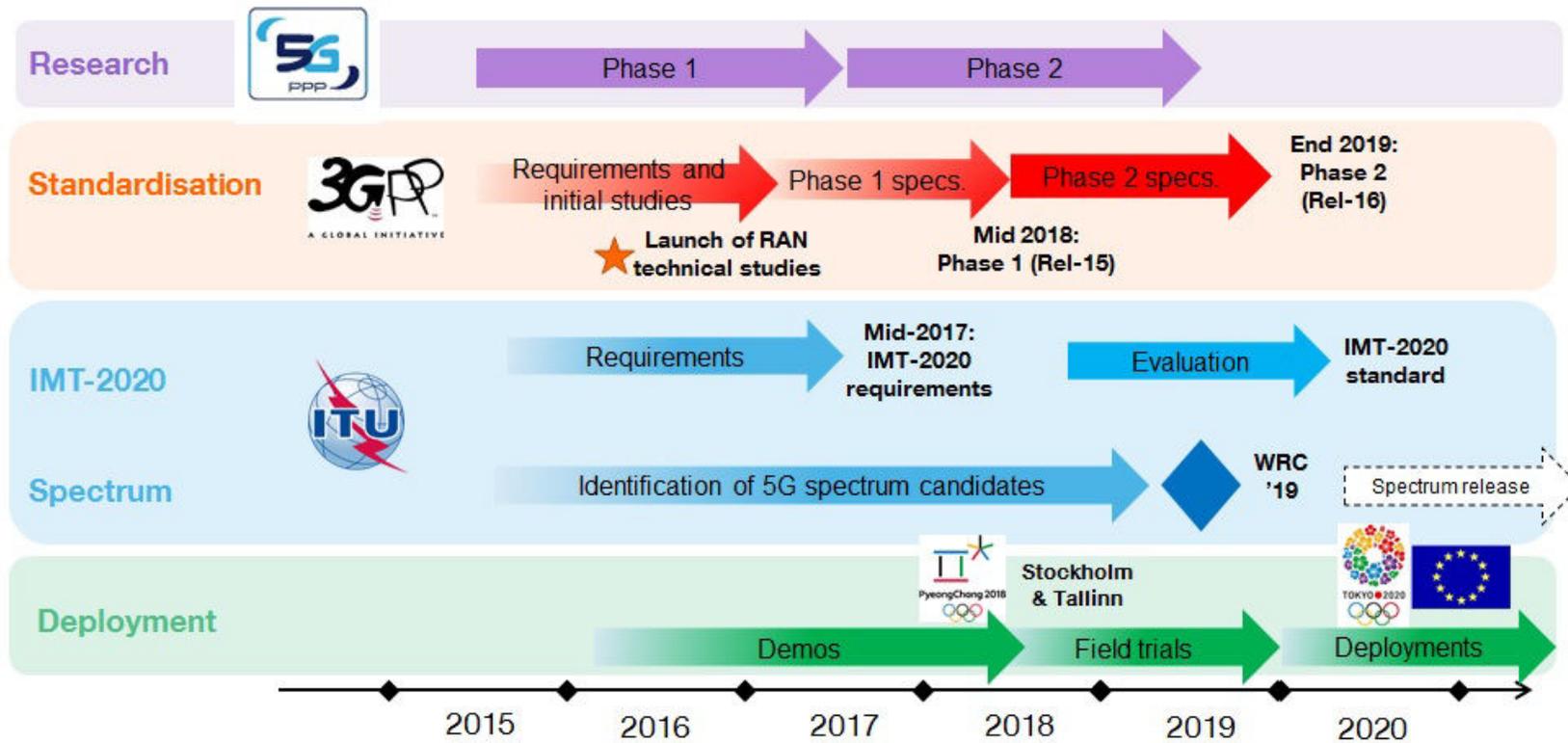
connect things to super-networks

5G requirements

**1 ms latency compared to 10 ms
99.999% reliability**

provide these performance everywhere

Road to 5G



5G Value Creation



Understanding 5G



5G the business customers

To fulfill the requirements:
every where & every time & for
every body

**Technical architecture
and the customer
experience**

Understand the technical
architecture
“LEGO” structure
Driver to re-think the network

**Costs of technology
implementation**

- Cost of implementation
- Regulation & security
- Revenues

5G Design Principles

Radio

- Leverage spectrum
- Dense deployments, mMIMO, CA
- Dynamic Radio topology
- New Radio Interface
- Efficiency (latency, power, interference)

Network

- Common Core
- Network Slicing
- Facilitate XaaS, NGCN
- Exposed Network APIs
- CUPS
- Transport (SDN/NFV)

O&M

- Simplified O&M
 - Automation
 - Monitoring
 - Orchestration
- Programmability
- Security and Privacy
- Service Based Architecture(SBA)
- FCAPS

Cloud

- Native Environment
- Radio Cloud, Edge
- D-RAN, C-RAN
- MEC
- IoT platforms
- Cloud Packet Core
- Network Automation

RAN Transformation

Frequency Bands

- ❑ Sub 1GHz: 700 MHz (FDD)
- ❑ Between 1-6 GHz: 3.4-3.8 GHz (TDD)
- ❑ Above 6GHz: 26 GHz (TDD)
- ❑ Others LTE bands

Hardware baseband

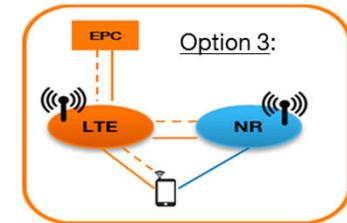
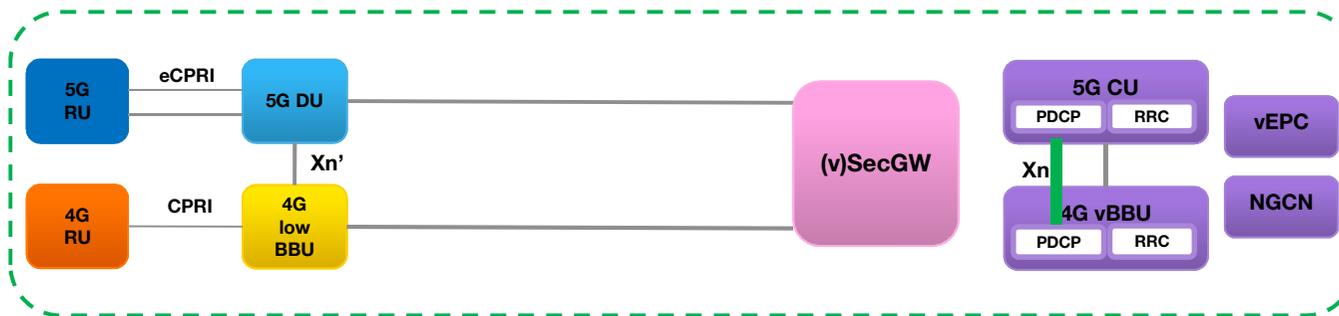
- ❑ Distributed Unit
- ❑ Central Unit

RAN virtualization

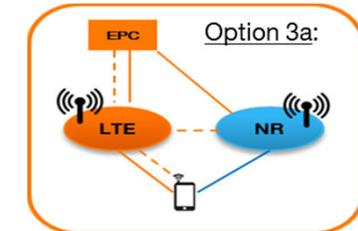
- ❑ 5G RAN virtualization
- ❑ 4G legacy RAN
- ❑ 4G virtualized RAN
- ❑ VNF integration in NGPoP
- ❑ Slicing

Carrier Aggregation

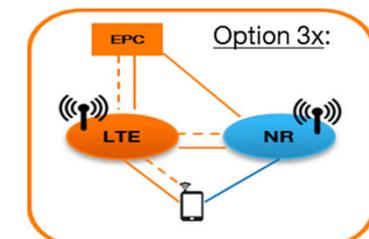
- ❑ Scenarios as CA and DC
- ❑ LTE-NR coexistence



managed by the LTE EPC has no view of the 5G RAN

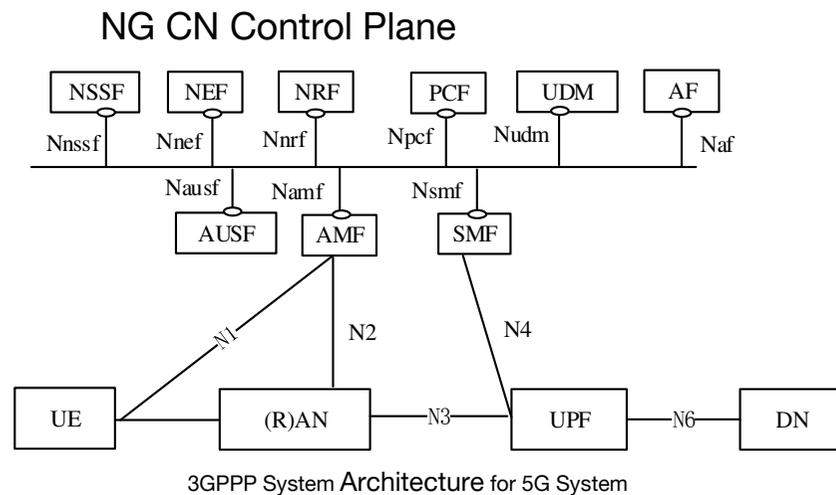


CP managed by tLTE EPC connected to 5G RAN



CP managed by LTE EPC connected to t 5G RAN for UP. LTE manages the 5G traffic in mobility

Core Transformation



5G Control Plane Network Functions

AUSF	Authentication Server Function
AMF	Core Access and Mobility Management Function
DN	Data network
NEF	Network Exposure Function
NRF	NF Repository Function
NSSF	Network Slice Selection Function
PCF	Policy Control function
SMF	Session Management Function
UDM	Unified Data Management

□ Main Requirements

- Service Based Architecture
- Interfaces and Protocol stacks
- Slicing and Virtualization
- PCF functions and procedures
- 5G QoS Model based on flows
- QoS Flow Indicator
- Flexibility adaptability, fast deployment
- Services discovery, on demand networks
- Interoperability
- Green solutions

□ Key principles

- Network Control Functions
- Network Control Entities
- API & Interfaces

Core Transformation

From dedicated network functions



to Software network functions



service configuration



Automation



Business Model

Online Self Services
Real time customer journey
Transformation through automation

Network

Fast deployment
Reduce Time-to-Market
Savings-> reducing costs of operations

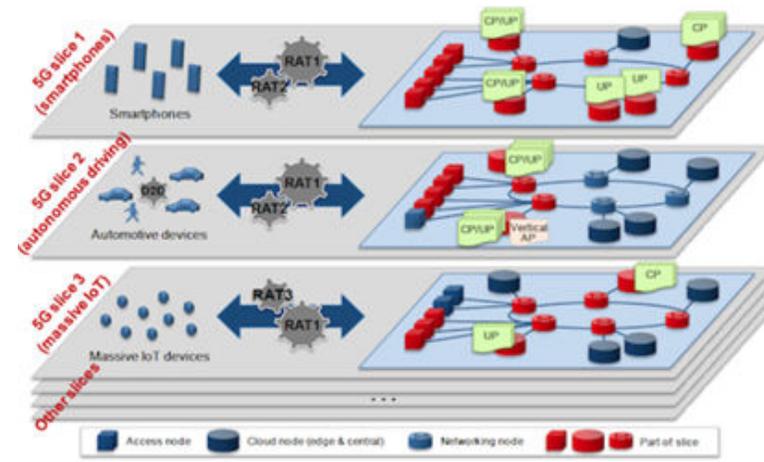


**ITN
Virtualization
&
Automation**

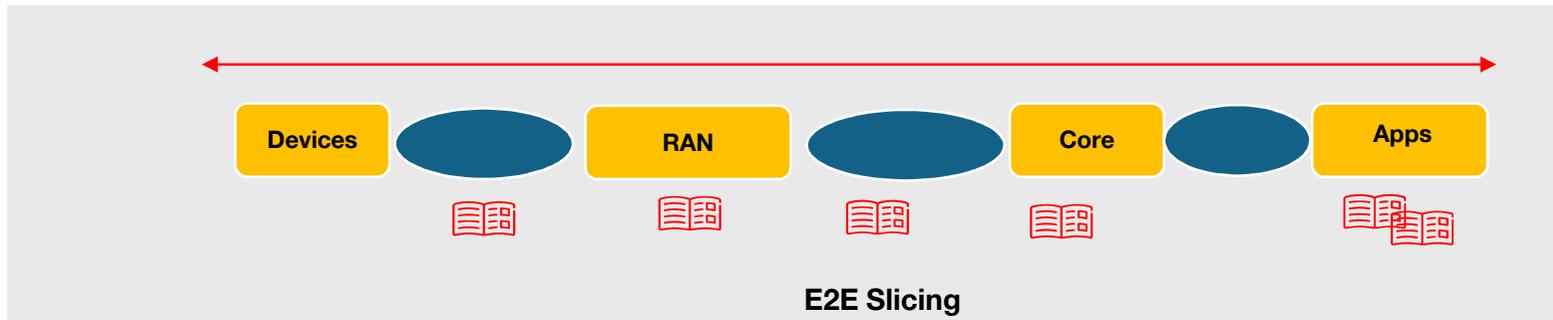
5G Network Slicing

❑ Economic context for deploying

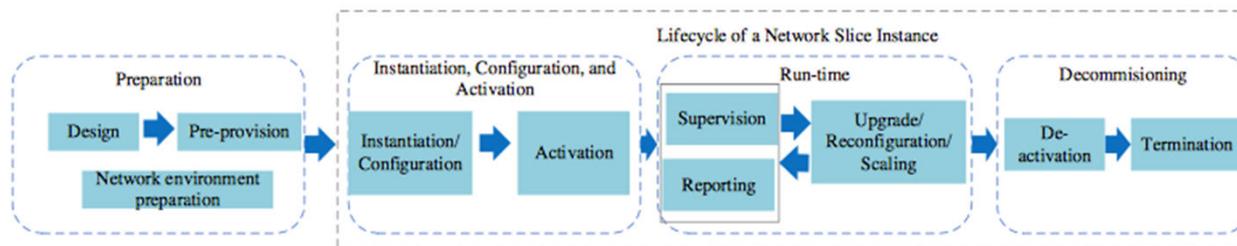
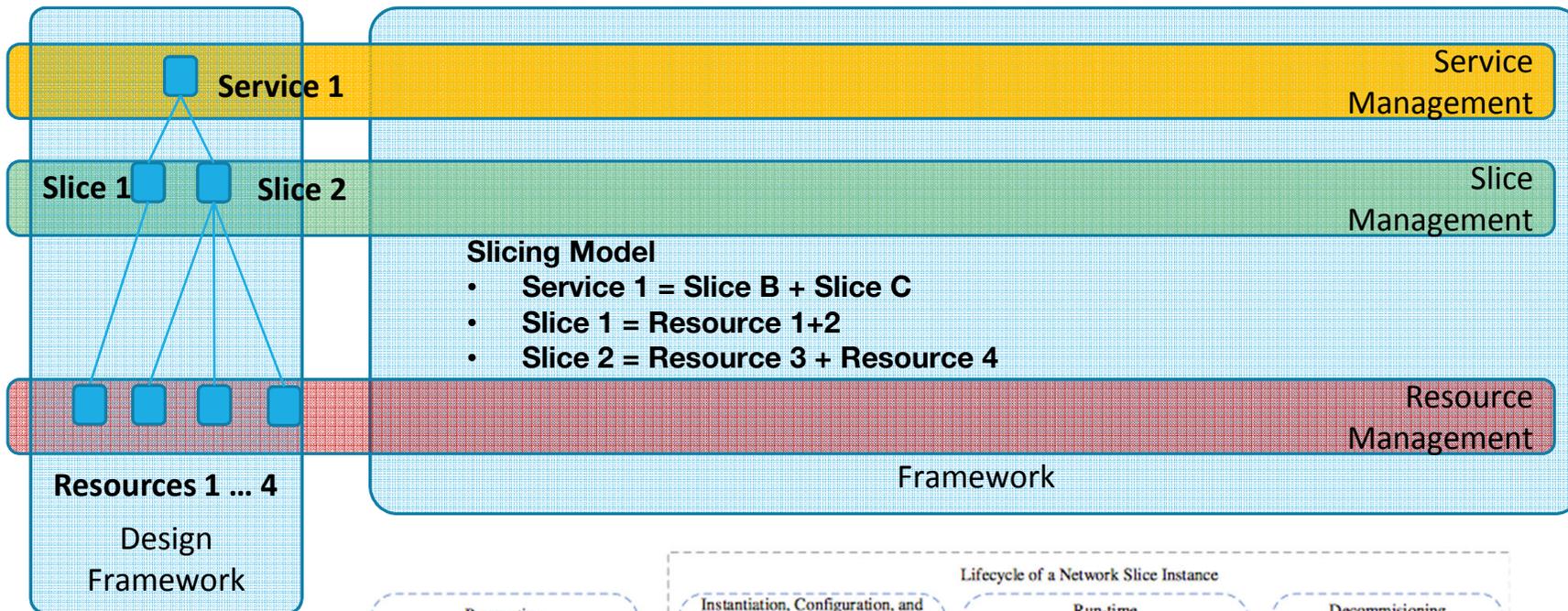
- ❑ One big network for all services types
 - ❑ Separate dedicated core networks per service type
 - ❑ Network slice per service type (Service n slice)
-
- ❑ E2E network resources to fulfil the connectivity requirements for service categories (eMBB, mMTC, URLLC)
 - ❑ Network slice at Core Network Control Plane and User Plane Network Functions
 - ❑ 5G Radio Access Network



NGMN



5G Slicing model



3GPP TR 28.801



5G – PPP Research Activities

H2020



SLICENET

End-to-End Cognitive Network Slicing and Slice Management Framework in Virtualised Multi-Domain, Multi-Tenant 5G Networks

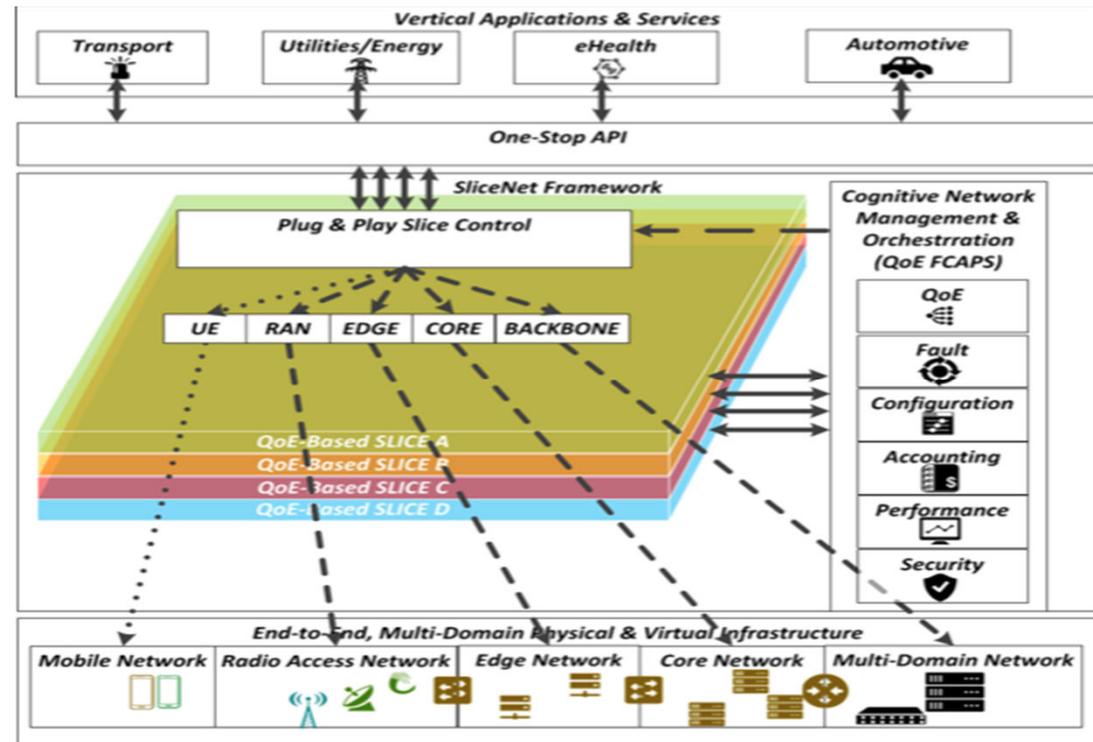


Design, prototype and demonstrate an innovative, verticals-oriented, QoE-driven 5G network slicing framework focusing on cognitive network management and control for end-to-end slicing operation and slice-based/enabled services across multiple operator domains in SDN/NFV-enabled 5G networks

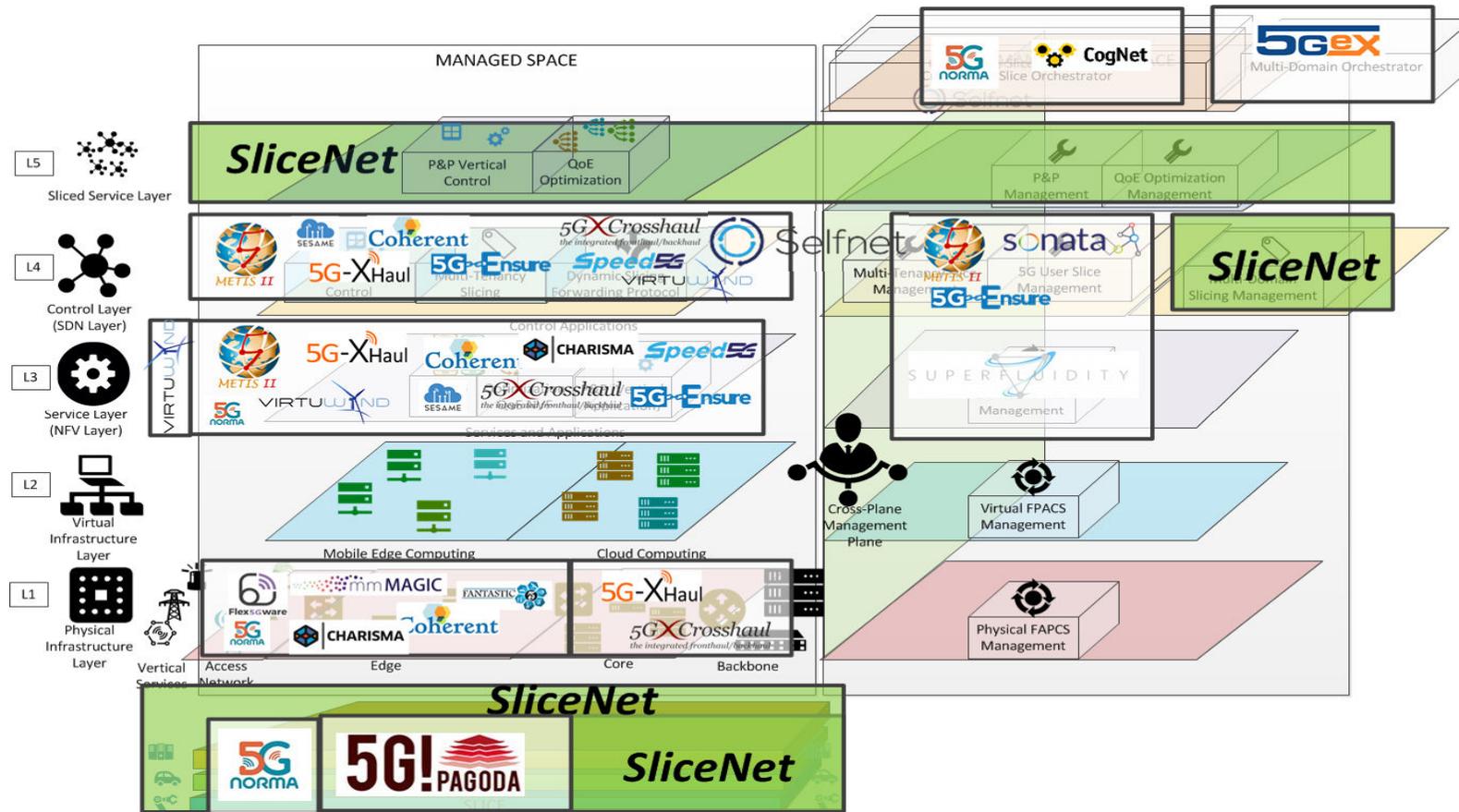
H2020 Project, Grant no: 761913, with 15 partners from 11 countries, the total project budget is 8M Euros and ORO total effort through 36 months of project work is 83PMs (<https://slicenet.eu/>)

SLICENET Architecture

1. Achieve an innovative, cognitive, integrated **'one-stop shop' 5G slice management framework** for **vertical businesses** and co-designed by vertical sectors
2. Enable extensible, **end-to-end slice FCAPS management** across multiple planes and operator domains
3. Establish **cognitive, agile QoE management of slices** for service assurance of vertical businesses
4. Empower **orchestration** for cross-plane coordination of management, control, service and data planes to achieve **system-level slicing** control and slice operation



SLICENET 5G-PPP working group



Alba Iulia Smart City



Smart city enablers



Internet gratuit în mișcare
în **Orange Wi-Fi Zone**



Environmental Monitor
0.18
80.67
BICK

Air Quality Monitoring



CIVICALERT

Azi la Innovation Labs, mâine în Silicon Valley

Tehnologie

Mentorat și workshopuri

Dezvoltare și testare de prototipuri

Înscrie-ți proiectul până pe 3 martie
www.innovationlabs.ro

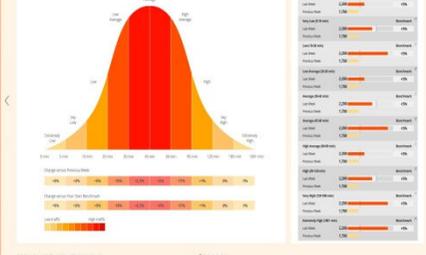
orange It's all about what matters to you

Orange Joins LoRa Alliance™



SEMTECH A World of Solutions™

Engagement Segments **City Analytics**



Segment	Value	Unit
Segment 1	1.2M	USD
Segment 2	0.8M	USD
Segment 3	1.5M	USD
Segment 4	0.9M	USD
Segment 5	1.1M	USD
Segment 6	0.7M	USD
Segment 7	1.3M	USD
Segment 8	1.0M	USD
Segment 9	0.6M	USD
Segment 10	1.4M	USD

Beacons for Smart Cities



Effective public services & interactive experiences for citizens
by using micro-location, presence detection

My business? Safe!

Security

Business Internet Security

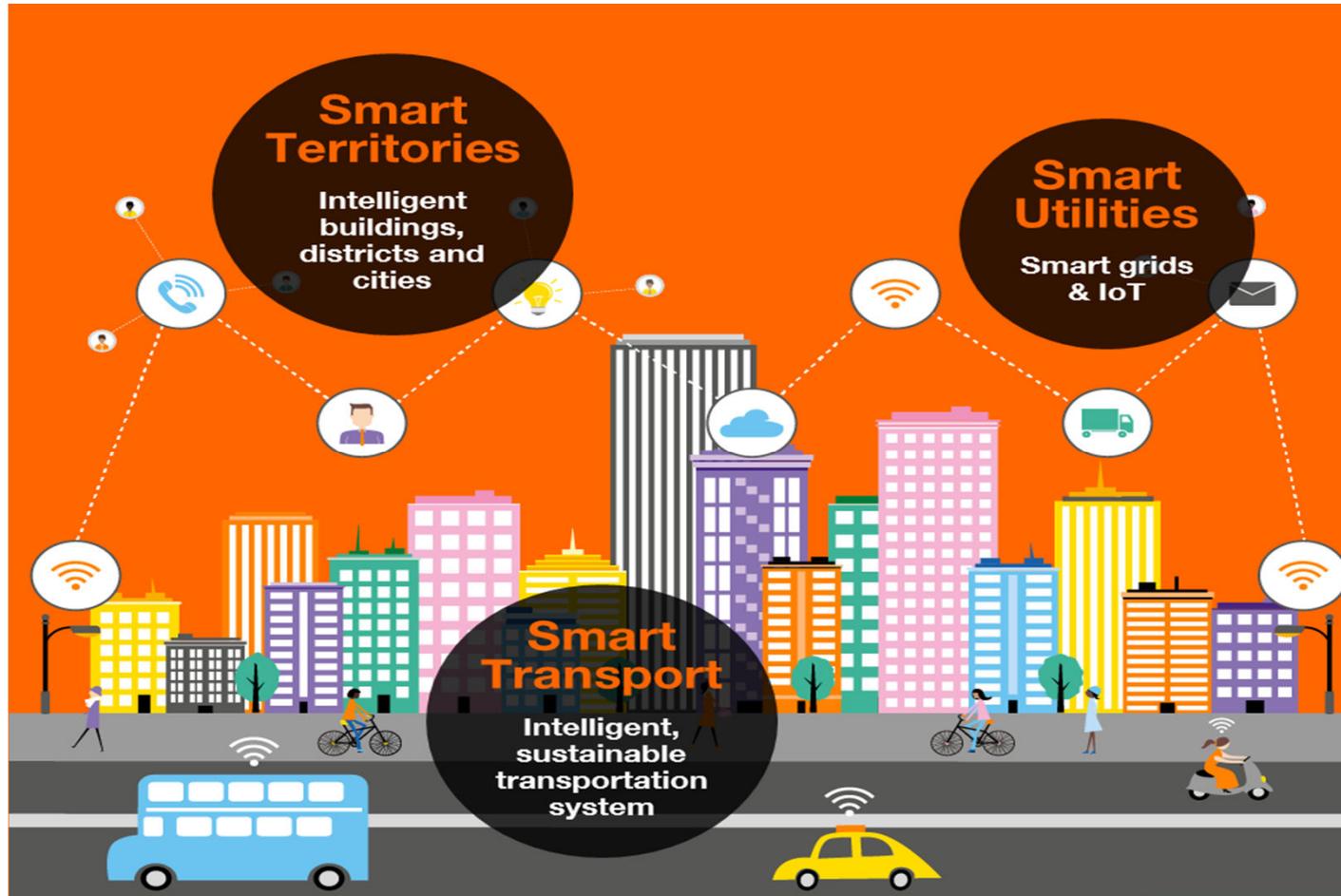
- Identifying threats
- Blocking attacks
- Safe web

Control and protect your internet connection against cyber attacks.
orange.ro/business-internet-security

orange It's all about what matters to you



Paths to 5G Smart City



**Development & Innovation
Engineering Department
Orange Romania**

Thank you!

