Steps towards the future of telecom

Development & Innovation

Technology/Engineering

Marius Iordache

Cristian Patachia

Orange Romania key figures

10+ million
mobile subscribers

> 3000
employees

#1 mobile telecom provider
in Romania for 14 consecutive years

over €3bn
CAPEX investments in networks
and telecom solutions

€1,07bn
revenues in 2017

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

top employer
6th year in a row

#7th place
in top 100 most valuable companies in Romania in 2017
(ZF)

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

Orange Innovation Ecosystem

**Orange Educational Program**
1997 - 2018
- +430K Euro scholarships
- +270K Euro Lab @ UPB
- 33% alumni became Orange employees

Programs for start-ups
- 5 Years main partner at Innovation Labs and 1 Year of Orange Fab accelerator
- 5 solutions integrated in Orange solutions portfolio

R&D
European founded projects on research and innovation: 5G, Smart Cities & IoT; Cyber Security; Emergency
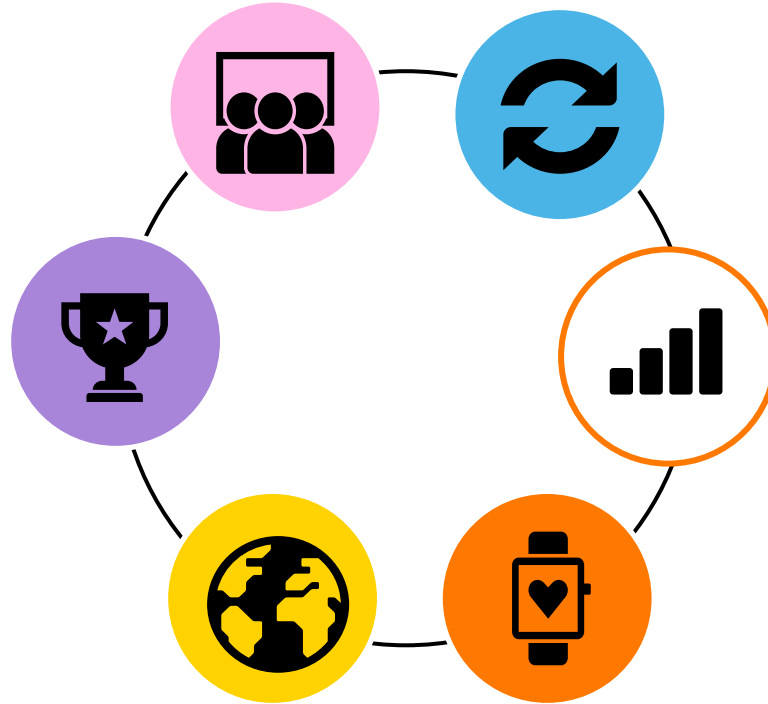
1st Smart City
- Alba Iulia Smart City Pilot Project
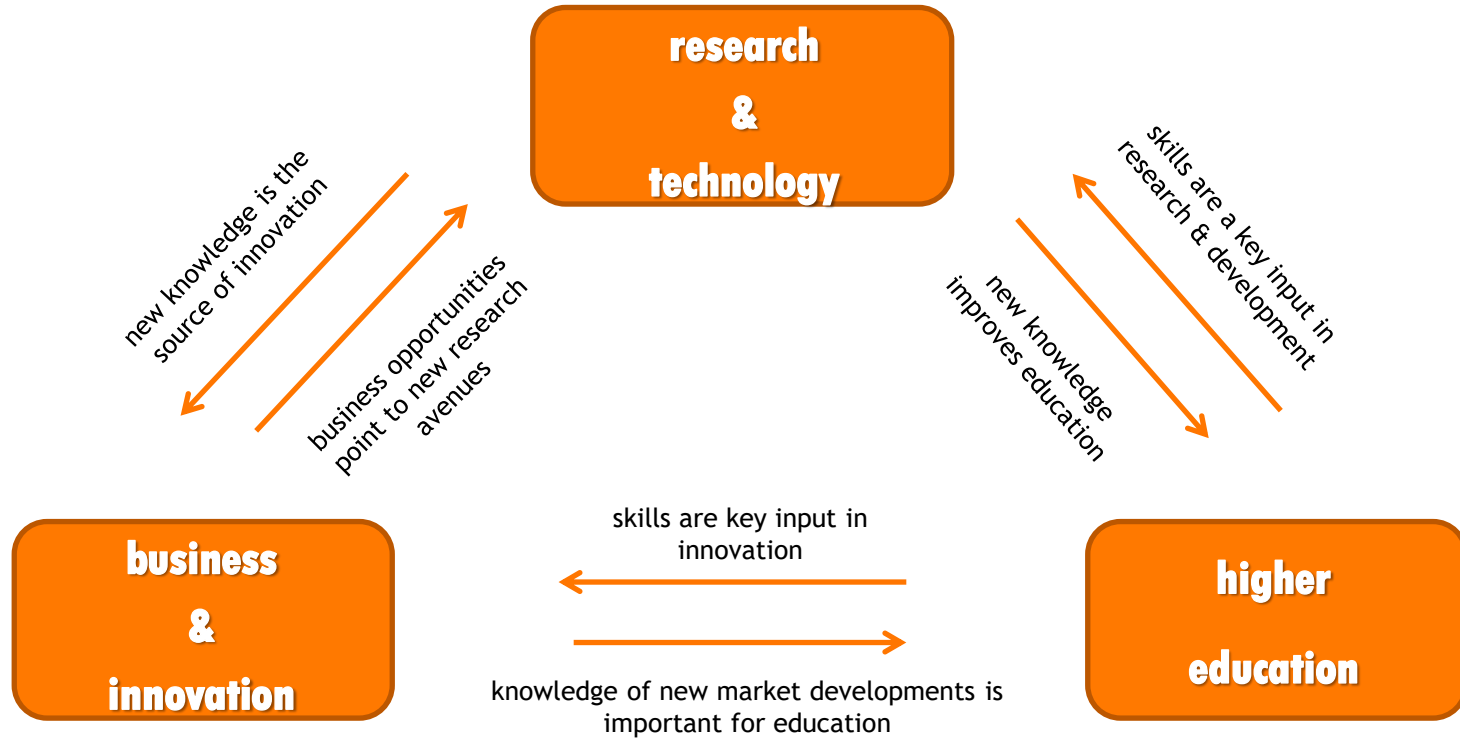- 14 integrated smart city solutions, 3 Innovation Labs projects integrated

New services on Romanian market
VoLTE, VoWi-Fi, 4G+, Gigabit mobile internet trials

New Products
- Smart Home
- Robots
- Latest flagship handsets
- Smart Stores

Orange and Academia collaboration

research & technology

business & innovation

higher education

new knowledge is the source of innovation

business opportunities point to new research avenues

skills are a key input in research & development

new knowledge improves education

skills are key input in innovation

knowledge of new market developments is important for education

Orange and Academia collaboration

associate with IT cluster, high-tech companies, universities, research entities, public institutions and SMB/SME to access research funding

EC FP6, FP7 and Horizon 2020 framework

RO MENCS UEFISCDI framework

5G, IoT/M2M, smart city, open data, cyber security, retail, ICT in agriculture, next generation emergency services

pool of experts, data science and PhDs

advanced technology and infrastructure

co-development ideas that may boost the usage of digital services for citizens and businesses access to open data, infra API, IoT/M2M development kits, mentorship real life prototyping environment

accelerator programs for entrepreneurs: Innovation Labs (5y), Mobil PRO (4y) and Orange Fab (1y)

co-working place and incubators

secure Internet: Cyber Security Threat Map, Cyber Security Challenge, Orange Bug Bounty programs, better internet

professional development programs for university students Orange Educational Program (16y)

ICT trainings and hands-on, joint publications and conferences

continuous education (MSc, PhD, MBA)

9 technology partners

Orange First Step (8y)

entrepreneurship & intrapreneurship
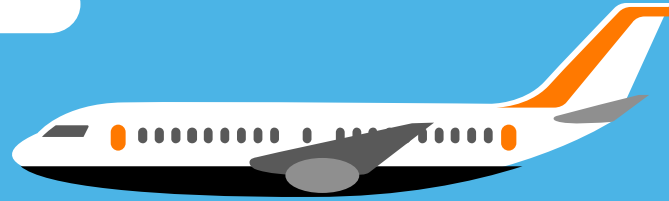## generating innovation

Innovation Labs

Orange Fab

224
Accelerated start-ups
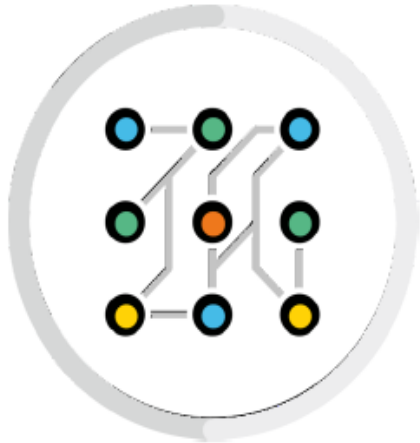
37
seasons

15
countries

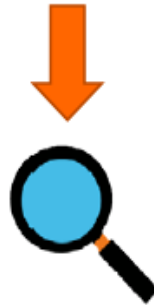# Orange Fab
From Silicon Valley to Bucharest

Orange finds, supports and **promotes** the best digital talents of today who will influence the way we will live what's essential in our life tomorrow

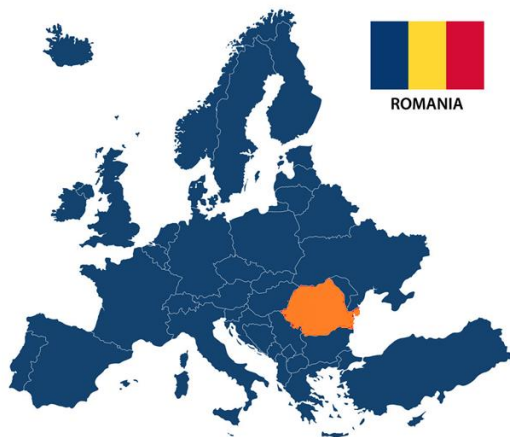Orange, partnering with startups

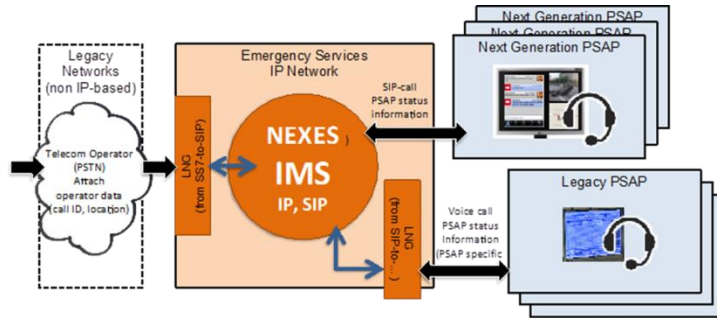Identifying

Supporting

Promoting

Orange R&D Activities

RESISTO

MATILDA

neXes
4.5G MultiPath
TCP

SLICENET

5G EVE

NEXES

## NEXt generation Emergency Services

The NEXES Research and Innovation Action aims to research, test and validate the promising integration of IP-based communication technologies and interoperability into the next generation emergency services, so that they attain increased effectiveness and performance.

H2020 Project, Grant no: 653337, with 17 partners from 10 countries, the total project budget being at 5.8M Euros and ORO effort evaluated at 500k Euros (http://www.nexes.eu/)

MATILDA

A holistic, innovative framework for the design, development and orchestration of 5G-ready applications and network services over sliced programmable infrastructure.
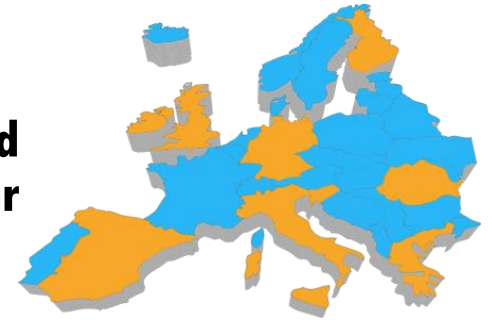

The vision of MATILDA is to design and implement a holistic 5G end-to-end services operational framework tackling the lifecycle of design, development and orchestration of 5G-ready applications. 5G network services over programmable infrastructure, following a unified programmability model and a set of control abstractions.

H2020 Project, Grant no: 761898, with 18 partners from 11 countries, the total project budget being at 6.6M Euros and ORO effort evaluated at 383K Euros (http://www.matilda-5g.eu/)

SLICENET

End-to-End Cognitive Network Slicing and Slice Management Framework in Virtualised Multi-Domain, Multi-Tenant 5G Networks.
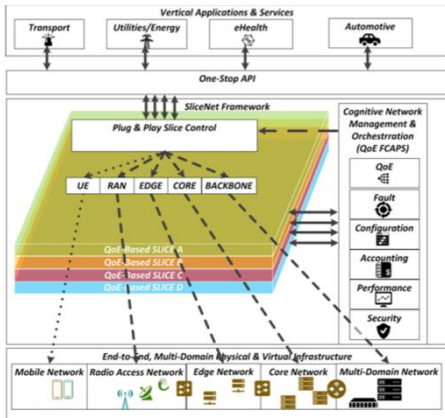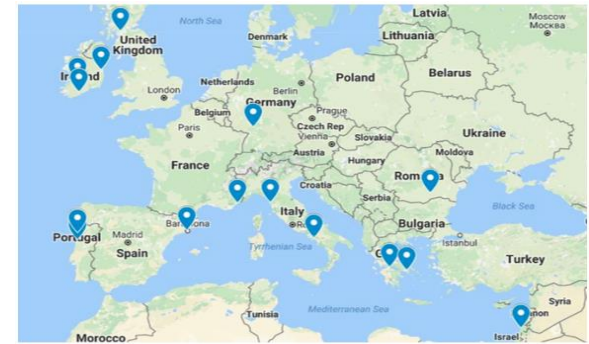
Design, prototype and demonstrate an innovative, verticals-oriented, QoE-driven 5G network slicing framework focusing on cognitive network management and control for end-to-end slicing operation and slice-based/enabled services across multiple operator domains in SDN/NFV-enabled 5G networks.

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 660k Euros (https://slicenet.eu/)

5G-EVE

5G European Validation platform for Extensive trials
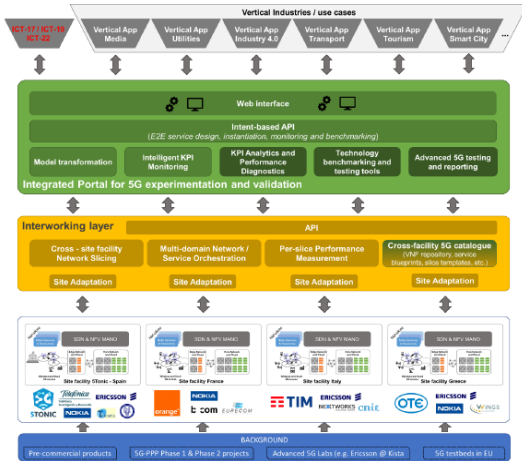
5G-EVE creates the foundations for a pervasive roll-out of end-to-end 5G networks in Europe.

5G-EVE supports this fundamental transition by offering to vertical industries and to all 5GPPP Phase3 projects facilities to validate their network KPIs and their services.
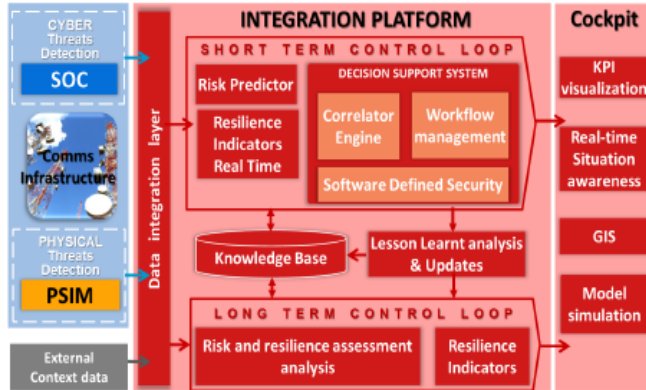
H2020 Project, Grant no: 761913, with 28 partners from 7 countries, the total project budget is 16M Euros and ORO total effort through 36 months of project work is 240k Euros

RESISTO

RESIlience enhancement and risk control platform for communication infraSTructure Operators

RESISTO is an innovative solution for Communication Infrastructure providing holistic situation awareness and enhanced resilience.

Help Communications Infrastructures Operators to take the best countermeasures and reactive actions exploiting the combined use of risk and resilience preparatory analyses
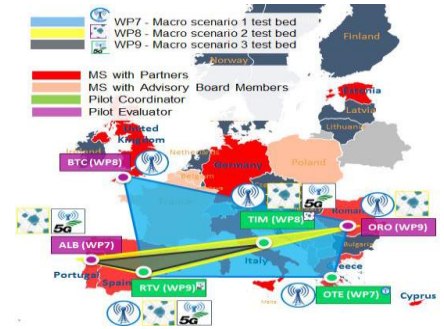

H2020 Project, Grant no: 786409, with 19 partners from 9 countries, the total project budget is 10M Euros and ORO total effort through 30 months of project work is 571k Euros

4.5G service based on MPTCP

Develop an innovative mobile data service at the mobile network operator Orange Romania to implement MPTCP on a fleet of mobiles, and develop a proof of concept 4.5G service that will let users use several radios seamlessly with all current applications and all servers.

3G/4G celltower

MPTCP Proxy

TCP

MPTCP

WiFi Access point
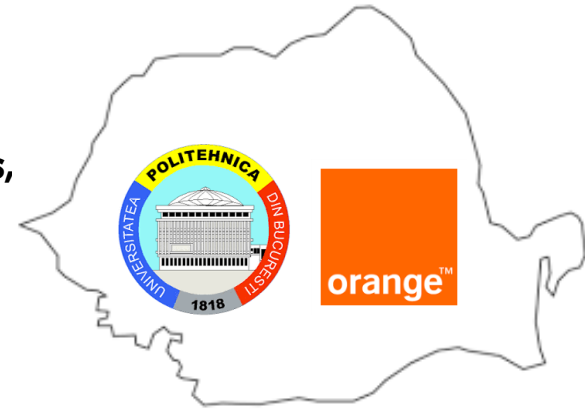
Targets high density urban areas and involves bonding of existing 3G/4G services and WiFi, with substantial advantages for the users and the network operator
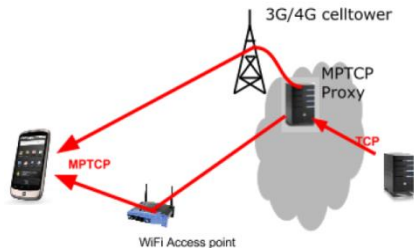
UEFISCDI Project, PN-III-CERC-CO-PED-2016, with 2 partners from Romania (UPB and Orange), with a total budget of 746k Ron

Mobile technology timelines

The next revolution is here

2020s
5G

Connectivity
Internet of Things

Business Models
Agility

Technology
Programmability

5G vision & mission

"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 is intended to deliver solutions, architectures and techs for the next coming decades with huge potential to revive existing verticals and create new markets such as Smart Cities, e-Health, Intelligent Transport, Education, Agriculture, Media and Entertainment.

*NGMN

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

5G key features

Convergence

Privacy

Security

Power

Efficiency

Flexibility

User Experience
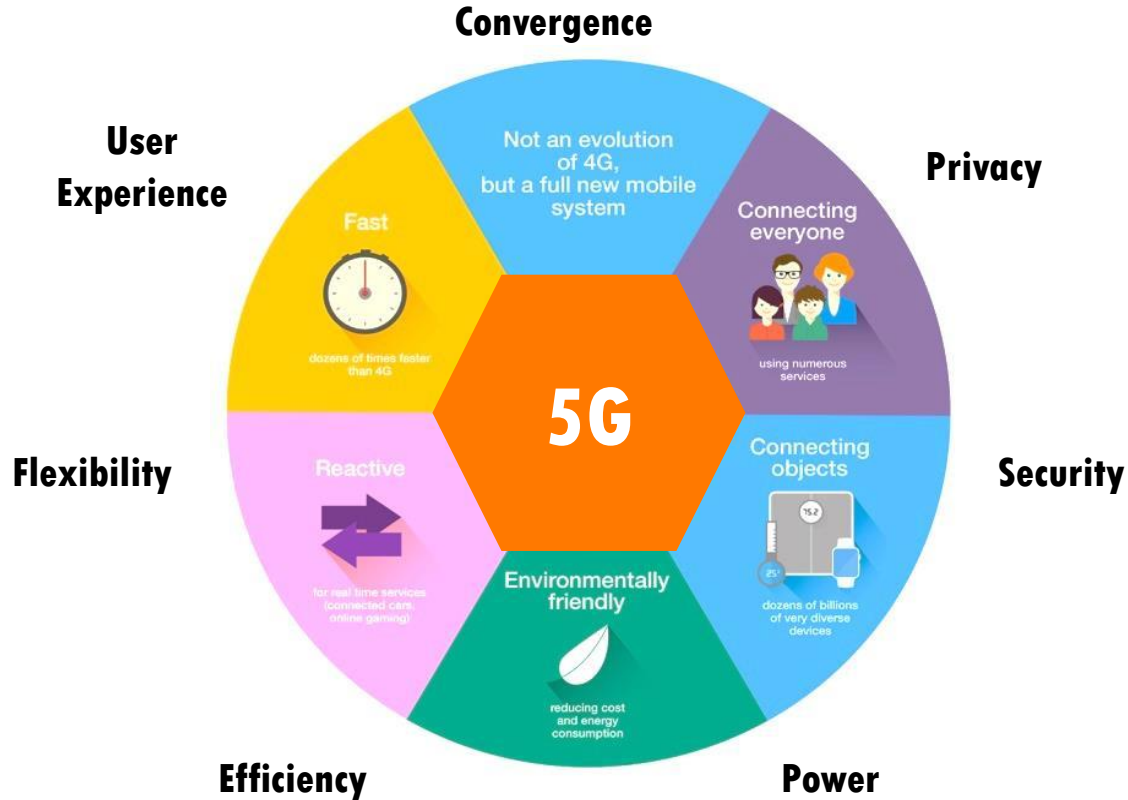
5G principles

Radio	Network	Operation	Cloud

1 eMBB
(High to Very High Broadband Mobile Access)

2 FWA
(Fixed Wireless Access)

3 Specialized Services

URLLC
(Ultra Reliable, Low Latency Communications)

Massive IoT
(Low Power, Long Range / M2M Communications)

Standards	Devices	Spectrum

Efficiency: Power, Latency, Resiliency, Secured ICT, Costs

Future network transformation

From dedicated network functions

to Software network functions

service configuration
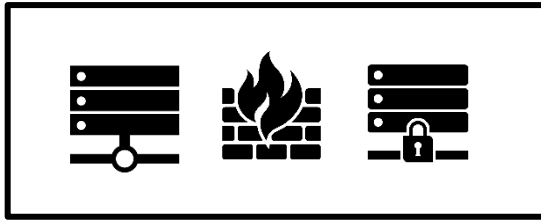
Virtualization

SDN

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
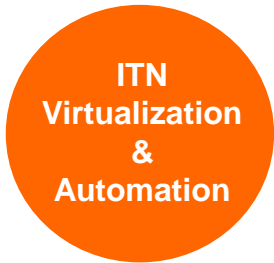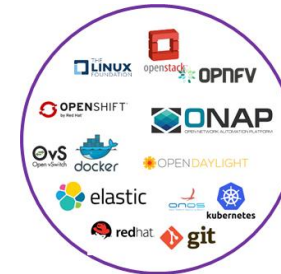
5G security threats & mitigation

Device	RAN	Core	External
Malware	MEC Vulnerability	Malicious Apps	API vulnerabilities
DDoS Attacks	Rogue nodes	CP & UP Sniffing	App vulnerabilities
Firmware Hacks	Jamming	API vulnerabilities	IoT Apps
Device Tampering	MitM attacks	Slice&Virtualizatio n	
MitM attacks			

DDoS attacks

Orchestration	Infrastructure	Users	Network	Application

Identity	Authentication	Confidentiality	Integrity	Availability	Privacy

Smart City as a 5G Ready Application

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Orange Romania
51-53 Lascar Catargiu Blvd, Bucharest, Romania
Bogdan.Rusti@orange.com, Horia.Stefanescu[...]

Abstract – 5G is developed around its capability to in[...] support different industry verticals (health, man[...] media, automotive, IoT, smart cities) requirem[...] becoming a key enabler for new business opport[...] digital transformation. In the current paper we [...] unique theoretical concept for the development, depl[...] in-life management of a network aware Smart Cit[...] native application using a three layer architecture. T[...] of a marketplace is a key innovation of the architectu[...] and facilitates the development and managem[...] applications that will be instantiated over the progra[...] infrastructure using the Service Mesh concept. T[...] Service Mesh is deployed in the form of a network s[...] aware of the available network resources and tightly c[...] Orchestration Layer to the OSS/BSS from the Netwo[...] layer. By deploying this unified programmabi[...] augmented by the creation of an open development e[...] for the application and virtual network functions [...] Matilda EU project facilitates the 5G adoption.

Keywords—5G; Smart City; Network Slice; I[...] Sensor; 5G-ready application; Verticals; NFV; VNF[...] VIM; NFVO; UE

5G Network Architecture, Functional Model and Business Role for 5G Smart City Use Case: Mobile Operator Perspective

[...]teanu[1], Cristian Patachia[1]
[...]omania
[...], Bucharest, Romania

[...] the cost reduction for deployments [...]menting the reach use cases families, [...]ity use case.

[...]perator and as entity involved in H2020 [...]ed on 5G networks- Slicenet ("End-to-[...]ork Slicing and Slice Management [...]ized Multi- Domain, Multi-Tenant 5G [...]tly very interested in studying the main [...]d requirements for the implementation [...] paper contain results from our research [...]licenet project (some parts are including [...]erables) and from our internal activity [...]who is preparing intensely to develop a [...] future.

[...] present a general architecture for 5G [...]erspective. We also describe our first [...]at we intent to have in our 5G network: [...]th a particular solution, Smart Lighting.

5G Fixed Wireless Access –Mobile Operator Perspective

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elena-madalina.oproiu@sdettib.pub.ro

Abstract—Nowadays the demand of capacity, performance and reliability for telecommunications services is increasing a lot. The telecom operators are facing with the increasing traffic demand, new solutions in their network to accommodate the growth must be found. One solution could be the use of 5G Fixed Wireless Access to deliver to the customers a fast and affordable broadband service with a very high performance, more capacity for data traffic, greater download speeds and low latency. In this paper we will provide an overview of such a FWA solution; main advantages, technical characteristics, used spectrum, high level depiction of such system. For the creation of this we've analyzed existing studies and trials that have been performed on this solution, around the globe. Our interest in this solution is high mainly as we see this as an opportunity to achieve convergence fixed mobile in an easier way and secondly as this summer we will be part of the first multi-vendor 5G fixed wireless access

in certain suburban areas, it can be difficult to deploy fiber all the way through to end customers, with technicians facing a range of technical challenges that can prove to be particularly time-consuming. In this area 5G FWA could be the right solution that will permit to develop complementary offers and bring very-high speed broadband to its customers.

The paper is organized as follows: Subsection 2.A presents 5G FWA overall roadmap, subsection 2.B presents the main goals, advantages and key differentiating characteristics of a 5G FWA and Subsection 2.C presents the spectrum used by 5G FWA (frequencies bands, bandwidth). In Section 3 we presented the 5G FWA technology and the roles of this technology (services oriented). Finally, Section 4 draws the conclusions.

Thank You