Future of **Smart City vertical** in the context of 5G

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Agenda

1. Orange Romania (ORO) brief overview
2. R&D EU projects where ORO is involved
3. 5G overview
4. High level view on smart city 5G implementation (MATILDA use case)
5. Takeaways

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

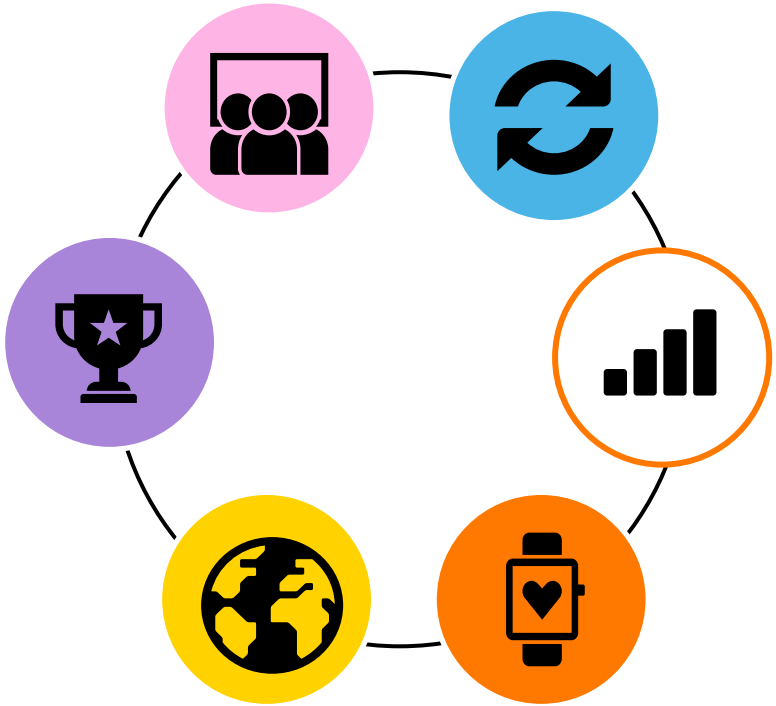
- +430K Euro scholarships
- +270K Euro Lab @ UPB
- 33% alumni became Orange employees

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

Towards 5G

5G networks have to be operated by intelligent orchestration platforms able to support end- to-end applications and services provision 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.

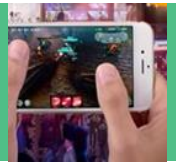
5G new services panel

- 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



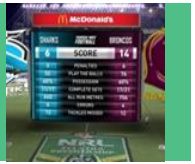
Ultra-reliable Communications
robots control
e-Health

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

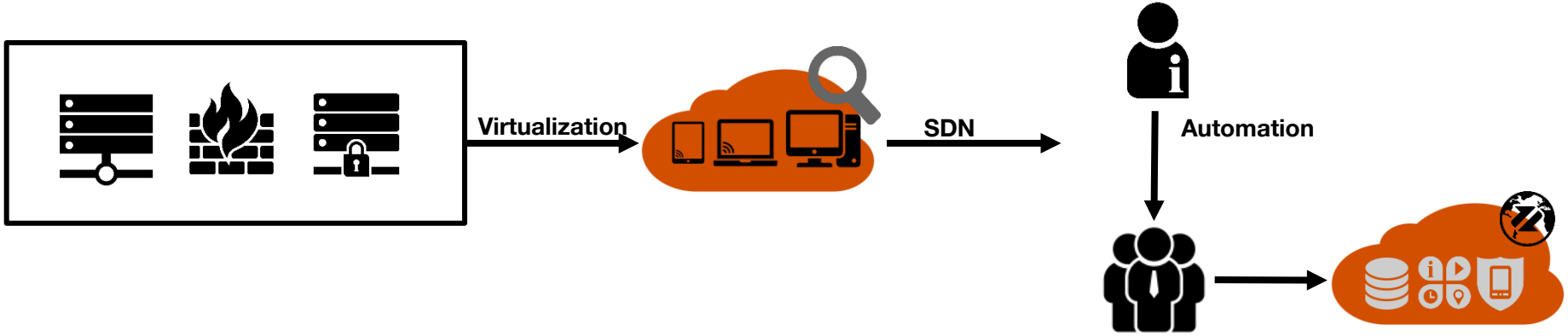


Future network transformation

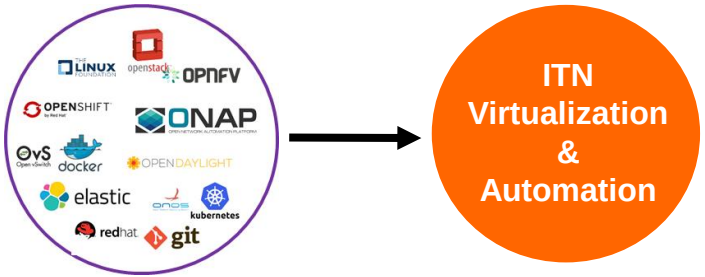
From dedicated network functions

to Software network functions

service configuration

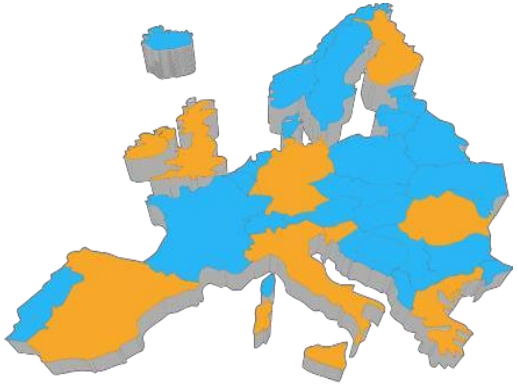


Business Model	Accessibility through APIs/marketplace Real time customer journey Transformation through automation
Network	Fast deployment Reduce Time-to-Market Savings-> reducing costs of operations



MATILDA

A H2020 5GPPP phase2 project for the design, development and orchestration of 5G-ready applications and network services over sliced programmable infrastructure



High performance and reliability

- optimally deploy and manage 5G-ready applications over application-aware network slices through the definition of open APIs for interaction among service providers and telecommunication infrastructure providers
- dynamically create and manage application-aware network slices by the telecommunication infrastructure providers, supporting the 5G-ready application needs

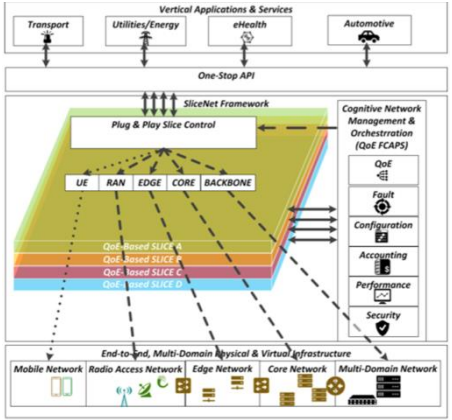
New business opportunities and business models

- enable vertical industries to take advantage of 5G technologies through the provision of a development kit for 5G-ready applications and a 5G-ready applications orchestrator
- support separation of concerns among vertical applications and network services orchestration, enabling the various stakeholders to exploit the MATILDA framework without any prerequisite

Shorten time to market

- tackle the overall lifecycle of the design, development and orchestration of 5G-ready applications and 5G network service over programmable infrastructure

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 key stakeholders

The Service Consumer
- is the first and the last actor in the overall process chain:
  - ✓ **Consultant role** - providing the market specific
  - ✓ **Consumer role** - as consumer of the application offered by the Service Provider

The Service Provider
- is responsible with the service definition
- is responsible with the instantiation of the 5G-ready application

The Application Developer
- is responsible with the development of the:
  - ✓ **Marketplace** (application store)
  - ✓ the **Smart City application component** with all characteristics needed for the application graph composition

The Infrastructure Providers
- assures the infrastructure resources, network, storage, compute during Smart City application graph instantiation.
  - ✓ **Telecom Infrastructure Providers** - assure a programmable (5G) network infrastructure , radio/fixed access, transport and core network;
  - ✓ **Cloud Infrastructure Providers** - operating cloud/edge, offering compute and storage programmable resources.

Smart City MATILDA

5G ready application will be designed to be aware of the network resources and vice versa, a key aspect for 5G.
This implies a paradigm change for the network operators:

1. the operator has to migrate towards a virtualized and programmable infrastructure
2. the operators has to expose APIs to third parties and advertise its resources
3. the operator becomes aware of the applications running through its network using network slices

Smart City Matilda embeds a three layer architecture:

Application layer/Marketplace

- adds the business oriented vision of MATILDA
- it represents both a development environment for application developers but also provides a dashboard for the Service Providers
- enable Service Providers to chain different application components in form of a graph in order to easily deploy and manage vertical use cases that today reside in very specific, time consuming and not very cost efficient implementations

Orchestration Layer

- supports on-the-fly deployment and adaptation of the 5G-ready applications to its service requirements, by using a set of optimization schemes and intelligent algorithms to provide the resources across programmable infrastructure

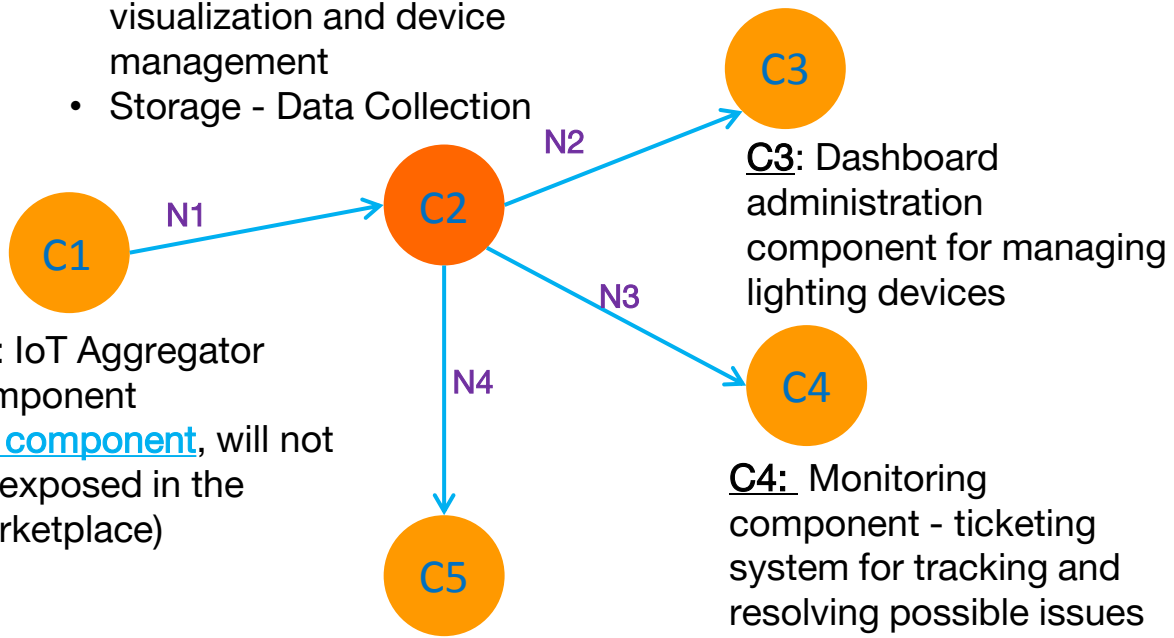
Network function and Resource management Layer

- responsible for setting up and managing the 5G-ready application deployment and operation over an application-aware network slice
- manages the lifecycle of the graph of micro services composing the application
- exposes the computing and storage resources needed during service composing

Smart City MATILDA – application graph

C2: IoT middleware platform component with 3 subcomponents:

- IoT platform - processing, visualization and device management
- Storage - Data Collection



C1: IoT Aggregator component
Fix component, will not be exposed in the Marketplace)

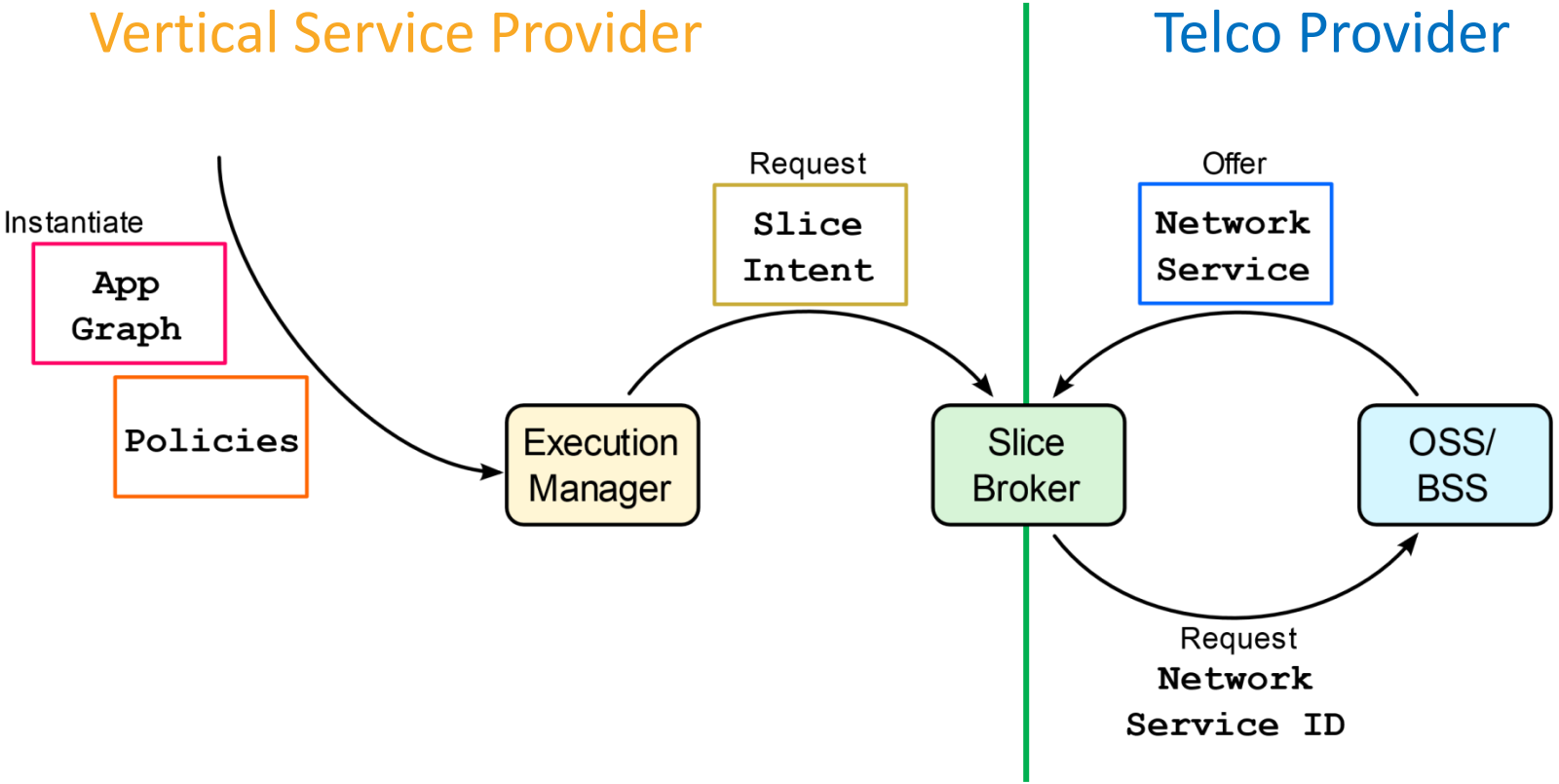
C3: Dashboard administration component for managing lighting devices

C4: Monitoring component - ticketing system for tracking and resolving possible issues

C5: Billing platform component

N1 secured connection between C1 and middleware
N2: graph link connecting C3 and C2
N3: graph link connecting C2 and C4
N4: graph link connecting C2 and C4

Smart City MATILDA – workflow



Takeaways

1. 5G main benefit is not speed but its capability to integrate verticals
2. Operators networks should be based on programmable infrastructure and accessible through APIs
3. To fully exploit 5G potential applications deployed become network aware and vice versa

Thank you!