



SliceNet Webinar

“System Architecture”

SliceNet System Definition

WEBINAR HOST: MARIUS IORDACHE, ORANGE ROMANIA

DATE: 07 APRIL 2020

TIME: 11:00 CET

slicenet.eu
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Introduction: Webinar Purpose, Presenter

❖ Webinar Purpose:

- ❖ Disseminations of SliceNet Technical Achievements and Innovations with focus on the **System Architecture definition and use cases**

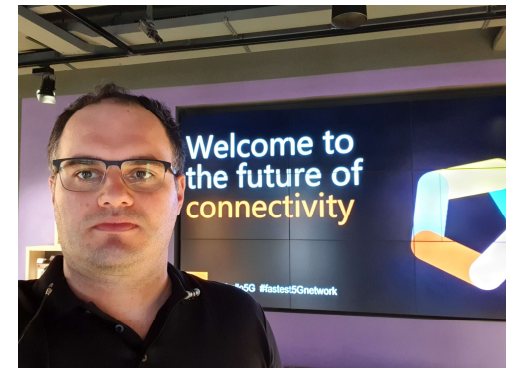
❖ Presenter:

- ❖ Marius Iordache, Orange Romania
Orange Romania representative in SliceNet



Webinar Agenda

- ❖ Introduction
- ❖ Requirements & Challenges
- ❖ Vertical Requirements identification
- ❖ Architecture design and functional decomposition
- ❖ End-to-End slicing friendly reference architecture
- ❖ Industry Vertical use cases
- ❖ Q&A, References



Marius Iordache
Orange Romania

Approach

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

Introduction



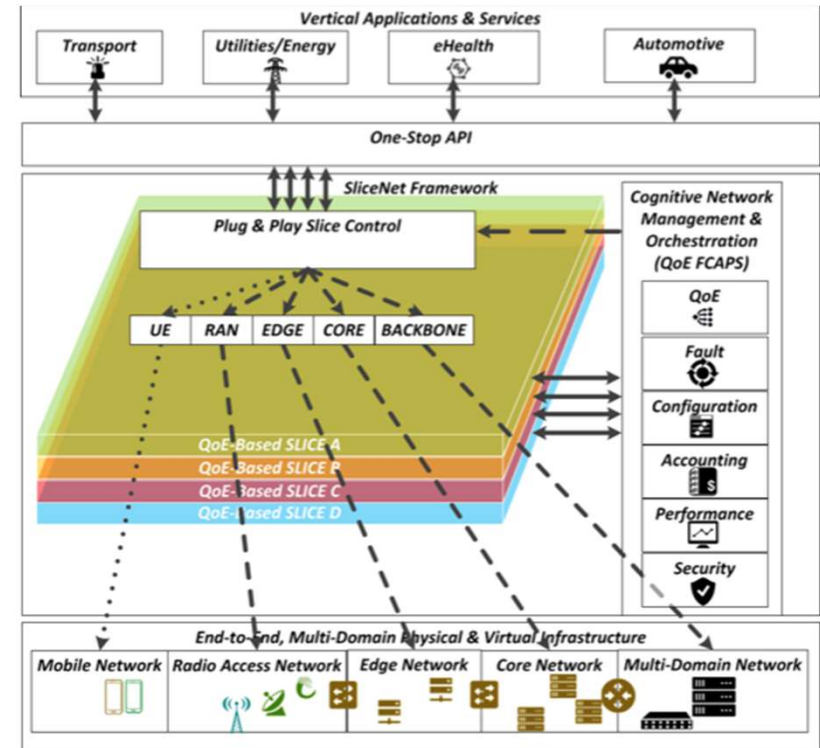
End-to-End Cognitive Network Slicing and Slice Management Framework in Virtualized Multi-Domain, Multi-Tenant 5G Networks

❖ Project Objectives

- Achieve an innovative, cognitive, integrated **'one-stop API'** 5G slice management framework for vertical businesses and co-designed by vertical sectors
- Enable extensible, **E2E slice FCAPS management** across multiple planes and operator domains
- Establish **cognitive, agile QoE management** of slices for service assurance of vertical businesses
- Empower **orchestration** for cross-plane coordination of management, control, service and data planes to achieve system-level slicing control and slice operation

❖ Today Focus

- **System Architecture**



WP2 Goals

Define the end-to-end slicing-friendly reference architecture

→ clean-slate approach

- Identification of main multi-domain slicing challenges
- Vertical requirements identification and use cases definition
- Architecture design and functional decomposition
 - Principles for slicing control plane over 5G/4G infrastructures
 - Role based management and orchestration in multi-domain setups

Main challenges

- ❑ High heterogeneity in slicing concepts definition
 - Several ongoing research activities and efforts
 - 5G-PPP projects, open source projects, standardization process
 - Proliferation of standards tackling slicing without consensus and common vision
- ❑ Alignment with ongoing 3GPP specifications development
- ❑ QoE metrics not well defined in standards and state of the art
- ❑ Cognition and artificial intelligence techniques still to be adopted in network and service management platforms
- ❑ Lack of verticals involvement in service design and lifecycle management

Slicenet use cases

5G Smart Grid Self-Healing Use Case



5G Smart City Use Case



5G eHealth Smart / Connected Ambulance Use Case

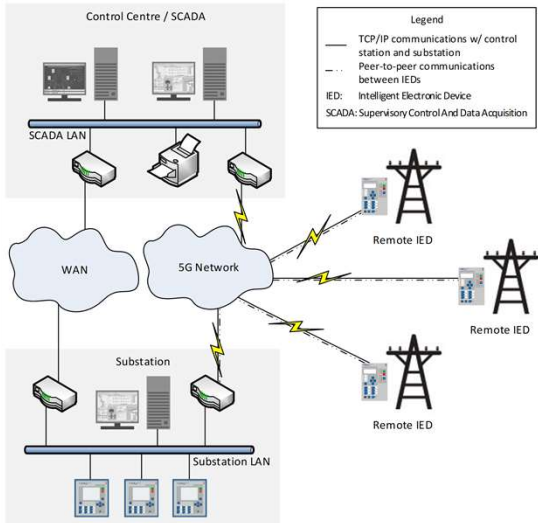


System Requirements and Definition of the Vertical UCs

- Use case definitions and requirements
 - Verticals involvement in requirements collection and identification process
 - Identification of 5G service and technical requirements

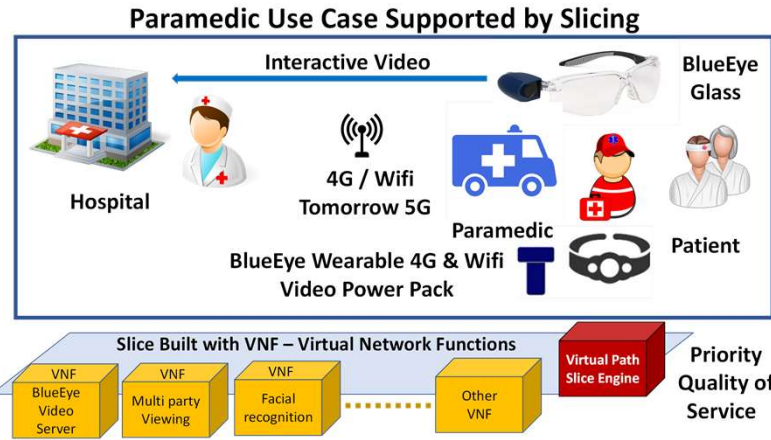
Requirements	Smart Grid	e-Health	Smart City
Availability/reliability	99.999 %	99.999 %	99.999 %
Wide-area coverage	Yes	Yes	City area
Connection density	< 0.5 device/km ²	Low	200000 users/km ²
Traffic volume density	Very low	Low	700 Gbps/km ²
Multi-domain slicing/Security	Yes	Yes	Yes
End-to-end latency	≤ 10 ms (GOOSE); ≤ 5 ms (SV)	30-100 ms	Seconds to hours
Data rate, per device	≤ 20 Mbps (GOOSE); ≤ 2 Mbps (SV)	60 to 150 Mbps	Very low

Slicenet Vertical UCs



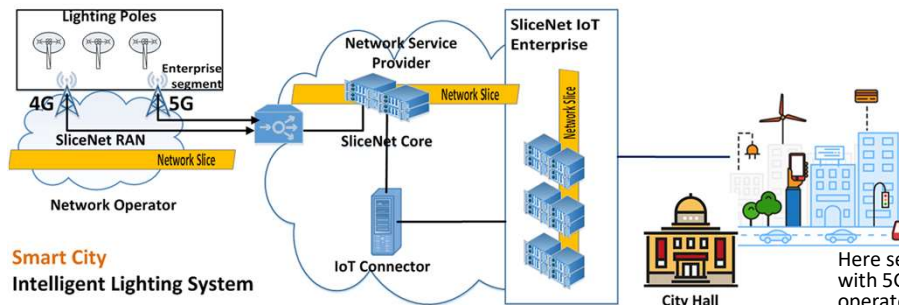
5G communications for Smart Grid Self-Healing

self-healing and automation in energy distribution with 5G network slicing solutions will enable system operators to benefit from a significant reduction in the outage duration



5G communications for eHealth

5G slicing could be leveraged to provide one-stop shop end to end services for offering enhanced Quality of Service and Quality of Experience for the health scenarios



Smart City Intelligent Lighting System

5G communications for Smart City

Here self-healing and automation in energy distribution with 5G network slicing solutions will enable system operators to benefit from a significant reduction in the outage duration

5G System overview

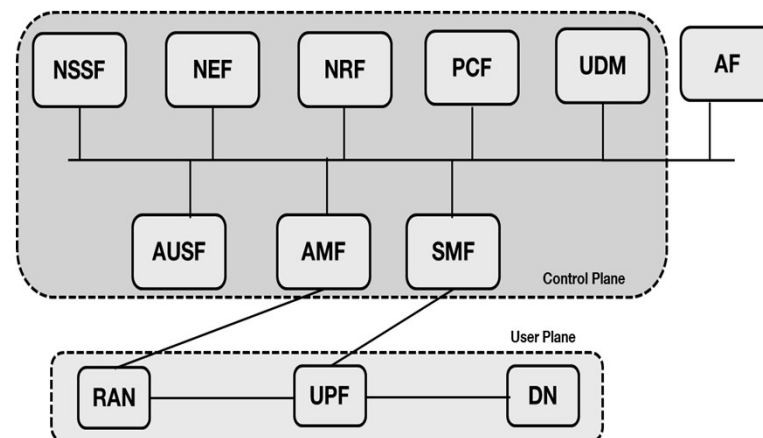
- **5G System is a 3GPP system consisting of 5G Access Network (AN), 5G Core Network** (as specified in 3GPP TS 23.501) **and UE.** 5G Access Network (AN) comprises a NG-RAN and/or non-3GPP AN connecting to a 5G Core Network
- **5G system** needs also to support stringent KPIs for latency, reliability, 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 : 5G system is mainly based on a virtualized network, including also physical components

5G Service Based Architecture: modularized services, flexible and adaptable, on-demand networks, fast deployment cycles, dynamic services launch in the network

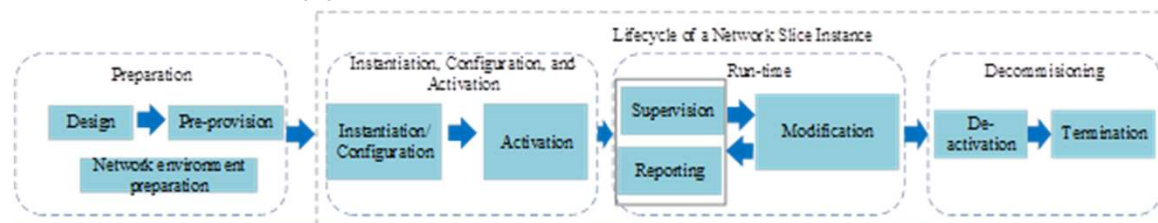
Virtualization capabilities: introducing the slicing concepts with the ability of adapting to the services as network slices for each type of usage, with support of Network Function

5G network slicing: 5G Slices are based on Network Slice Selection Assistance Information(NSSI)



Use case

- ❑ Network slicing definition
 - ❑ framework for provisioning flexible, cost-efficient, scalable and tailored services in software-networking based 5G networks
 - ❑ “Vertical-In-The-Loop” approach
 - ❑ network slicing is a paradigm where logical networks/partitions are created, with appropriate isolation, resources and optimized topology to serve a purpose or service category(mMTC; eMBB; URLCC)
- ❑ Technical use-cases requirements
 - ❑ slice creation,
 - ❑ slice configuration,
 - ❑ slice FCAPS management,
 - ❑ Self-Optimized Network (SON) applied to Slices
 - ❑ multi-domain slicing,
 - ❑ customization of slice management exposure (Plug&Play)
 - ❑ cognition-based slice management

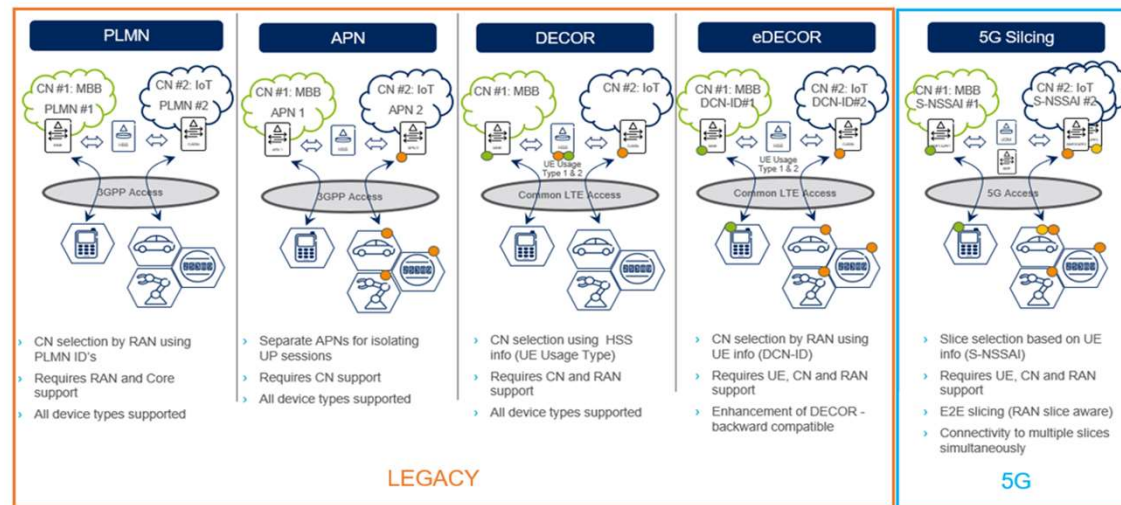


Core Network Slicing

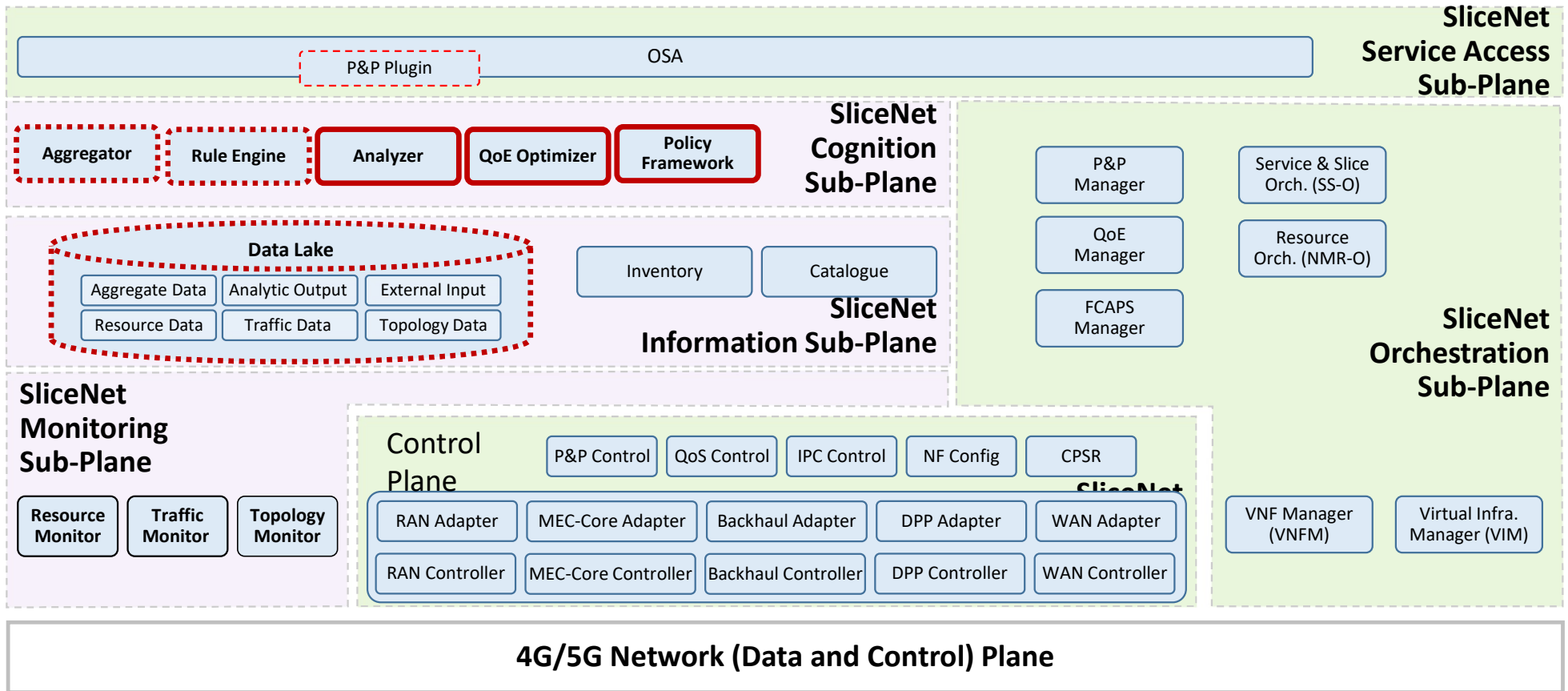
4G LTE

- Multi-Operator Core Network (MOCN, TS 23.251 [11]): Multiple operators jointly use eNodeBs and connect them to their (non-shared) core networks
- Dedicated Core Network (DECOR, TR 23.707 [12]): The Home Subscriber Server (HSS) contains an additional field "usage type". It is possible to define multiple CNs to be used for certain usages, thus leading to specialized CNs for special needs.
- Enhanced Dedicated Core Network (eDECOR, TR 23.711 [13]): This requires UE signaling to route to the correct CN and thus UE interaction is required
- APNs based slicing
- S1-FLEX connect two or more core networks of multiple operators

5G - 3GPP TS 23.501

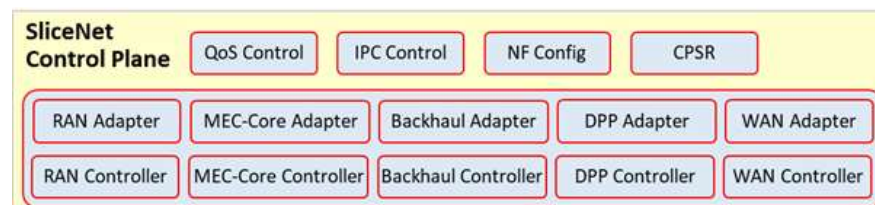
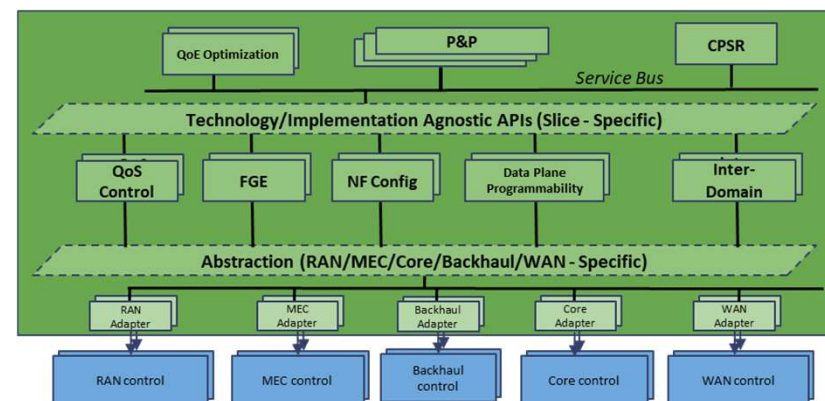


SliceNet Architecture



SliceNet control plane principles and definition

- ❑ SliceNet SBA CP builds on top of infrastructure pillars
 - ❑ RAN/MEC/Backhaul/CORE/WAN
- ❑ Two levels of abstraction are defined (+ high level APIs)
 - ❑ Extensibility and technology/implementation flexibility
 - ❑ Slice tailored view and access
- ❑ P&P control of slices
 - ❑ Allows for dynamic and vertical tailored slice control exposure
- ❑ QoE optimizer
 - ❑ SLA maintenance and enforcement
- ❑ Slice specific workflow execution engines pertaining to:
 - ❑ QoS Management (PCF/PCRF), Inter-PoP forward graph control, functions configuration, DP Programmability, Inter-domain configuration



SliceNet management and orchestration plane principles

- ❑ End-to-end Slice Orchestration

 - ❑ Two levels: Vertical Service/Slice and NFV/MEC/RAN Orchestrations

 - ❑ Inter domain interactions

- ❑ Information management

 - ❑ Service and Slice Templates, Descriptors and Instances

- ❑ QoE optimization

 - ❑ Per slice/service quality optimization processing

 - ❑ Per slice/service data collection

- ❑ Cognitive management, machine learning techniques, analysis and model processing



Business roles and relationships

Business Roles

associated roles & responsibility

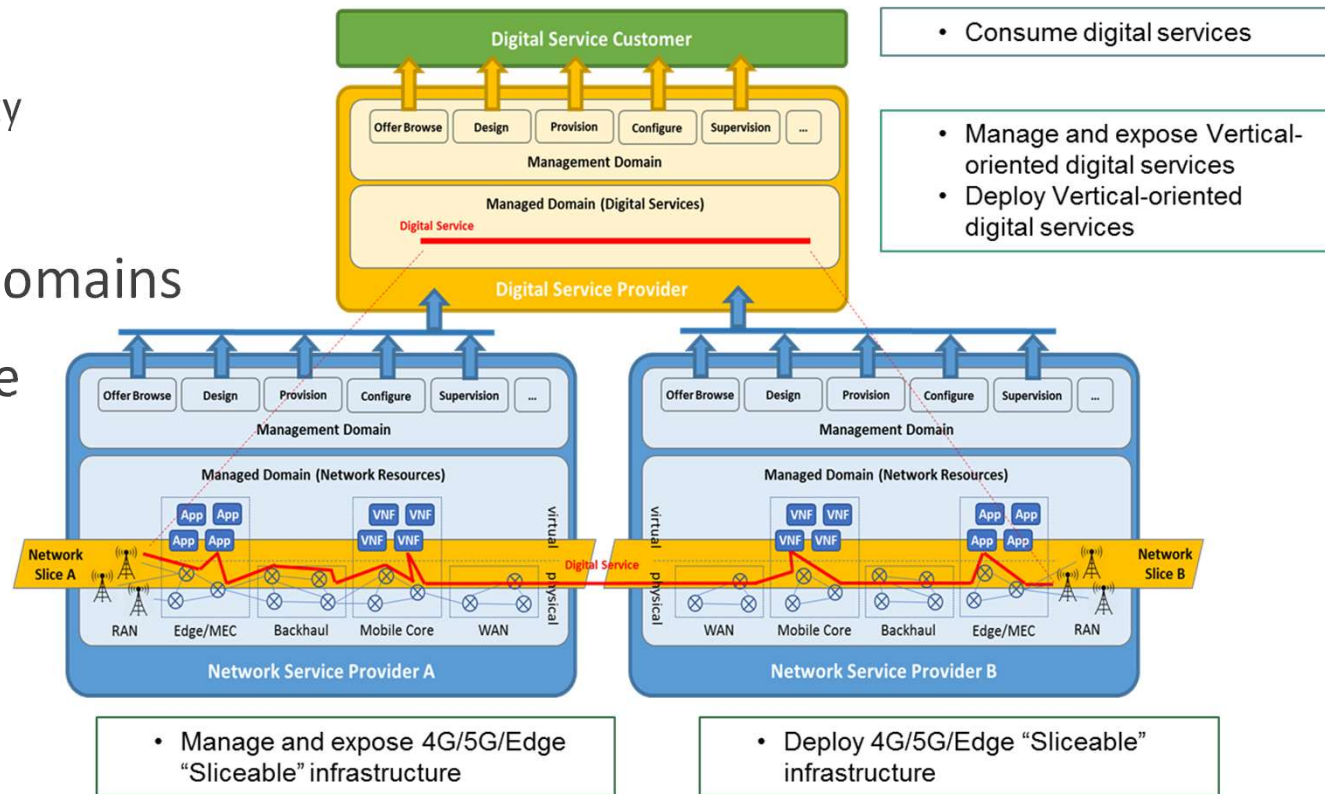
NSP, DSP, DSC

Multiple-administrative domains

Management architecture

DSP & NSP Standalone Actors

DSP & NSP Combined Actors



Zoom on SliceNet Information Model

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Zoom on SliceNet Information Model:

- ❑ IETF: abstraction representation entities in the managed environment
- ❑ TMF: business concepts, characteristics and relationships
- ❑ 3GPP: properties and relationships of the entity types, rules and constrains

Why an information model for SliceNet?

- ❑ **Consensus** of Networking Slice paradigms among partners
- ❑ Define the **objects manipulated** by the management modules
- ❑ Enabling machine readable format of slice templates towards **applying mining techniques**



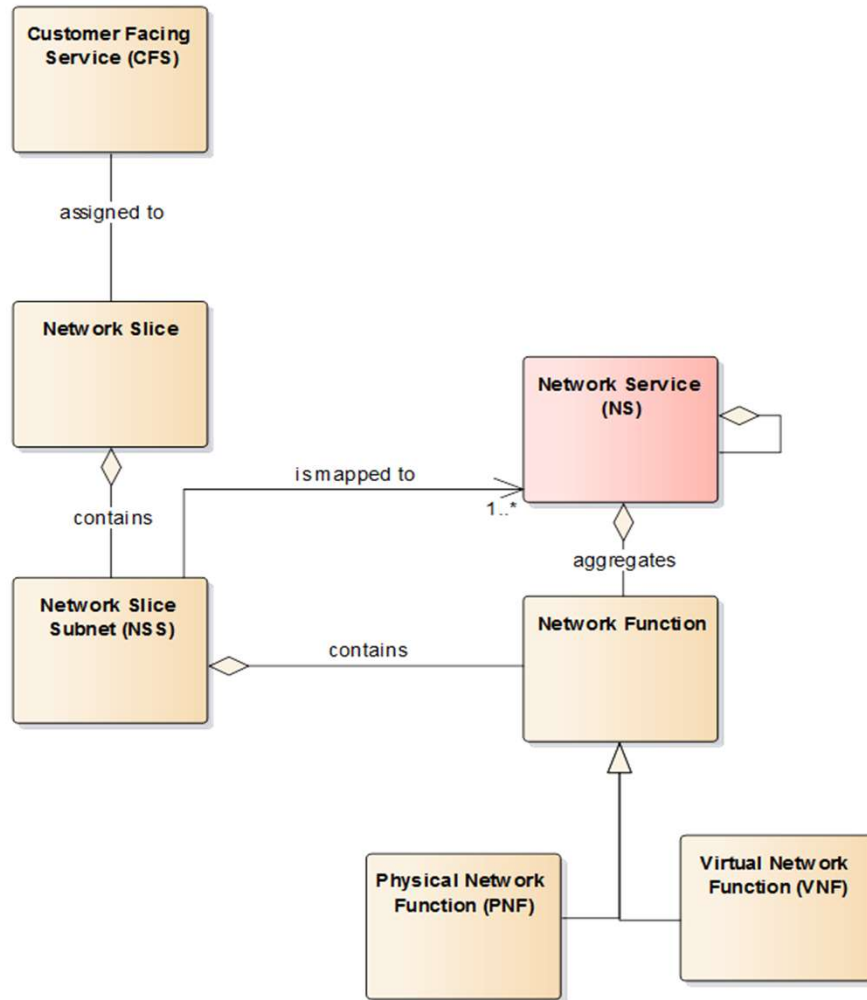
Information Model Concepts & levels

Concepts	Concept
	URLLC
	eMBB
	mMTC
	Slice Service Type(SST)
	Customer Facing Service (CFS)
	Customer Facing Service Instance (CFSI)
	Customer Facing Service Template (CFST)

Concept
Network Slice(NS)
Network Slice Template(NST)
Network Slice Instance (NSI)
Network Slice Subnet (NSS)
Network Slice Subnet Instance (NSSI)
Network Slice Subnet Template (NSST)
Network Function (NF)

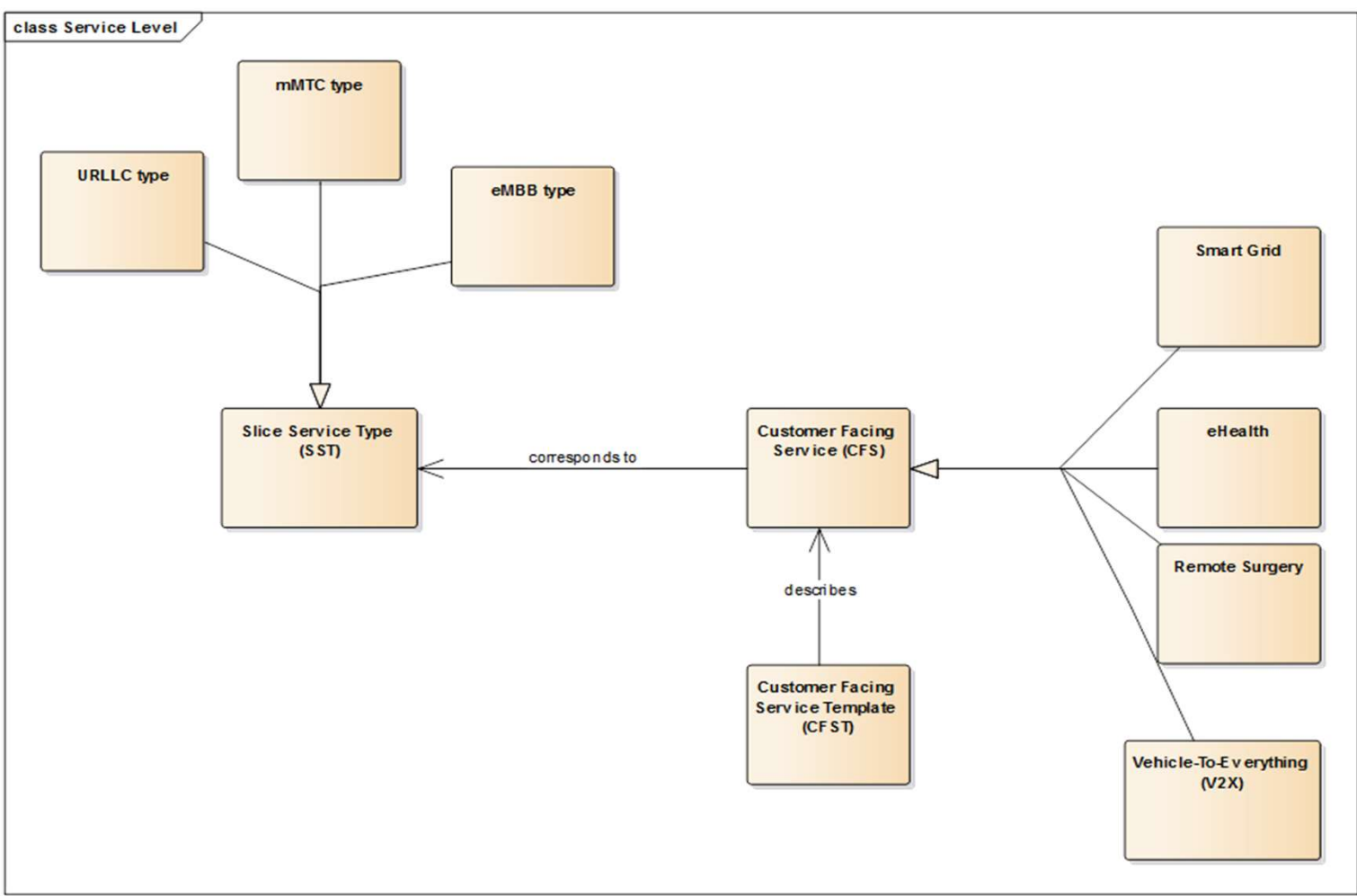
Levels	1) Service → Slice → Resources
	2) Service Level
	3) Service → Slice Level
	4) Slice → Resource Level

class Service-Slice-Resource view



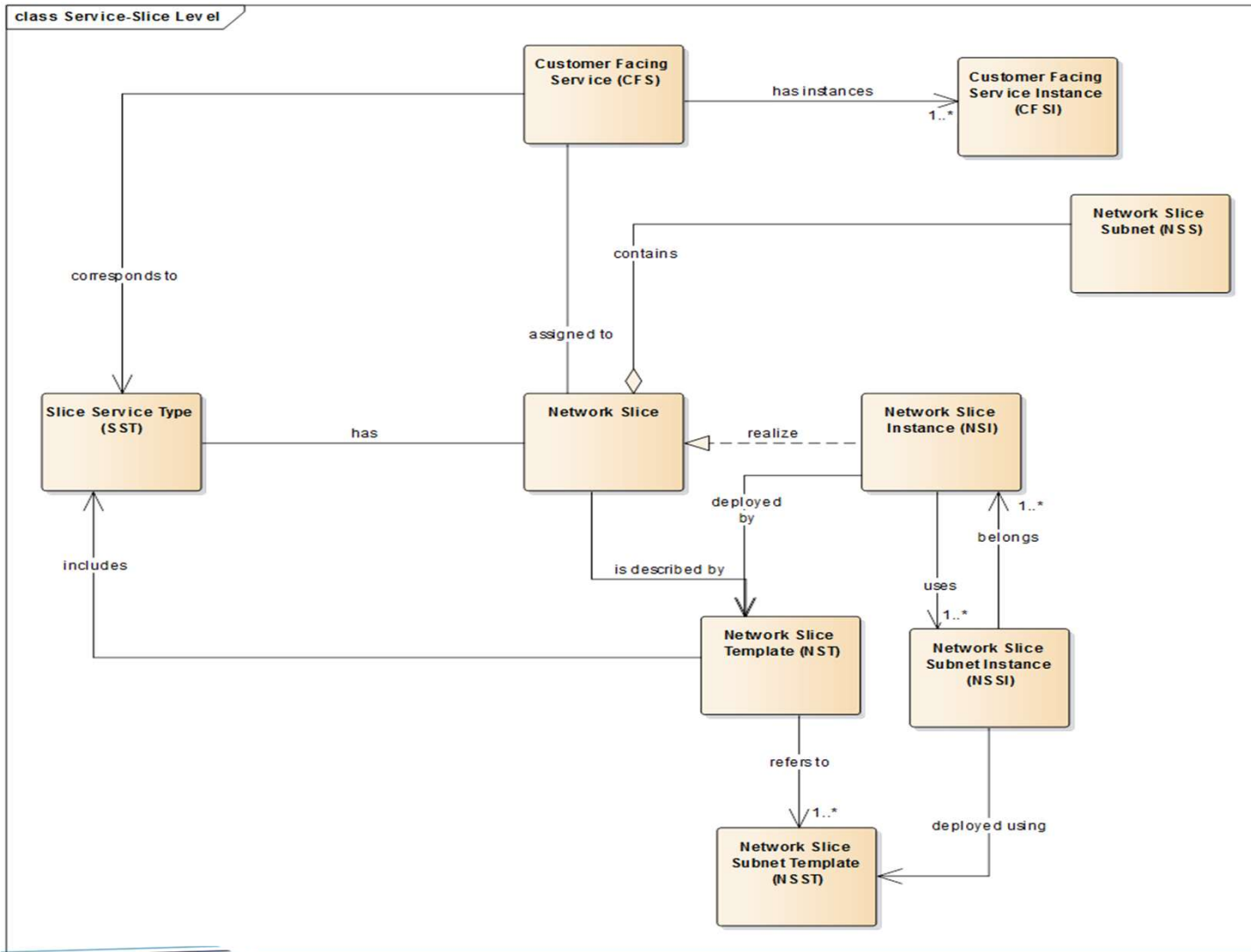
Nesting classes are classes that are composed of themselves and/or other classes. e.g. Network Service or Network Slice.

- 1) Service → Slice → Resources
- 2) Service Level
- 3) Service → Slice Level
- 4) Slice → Resource Level

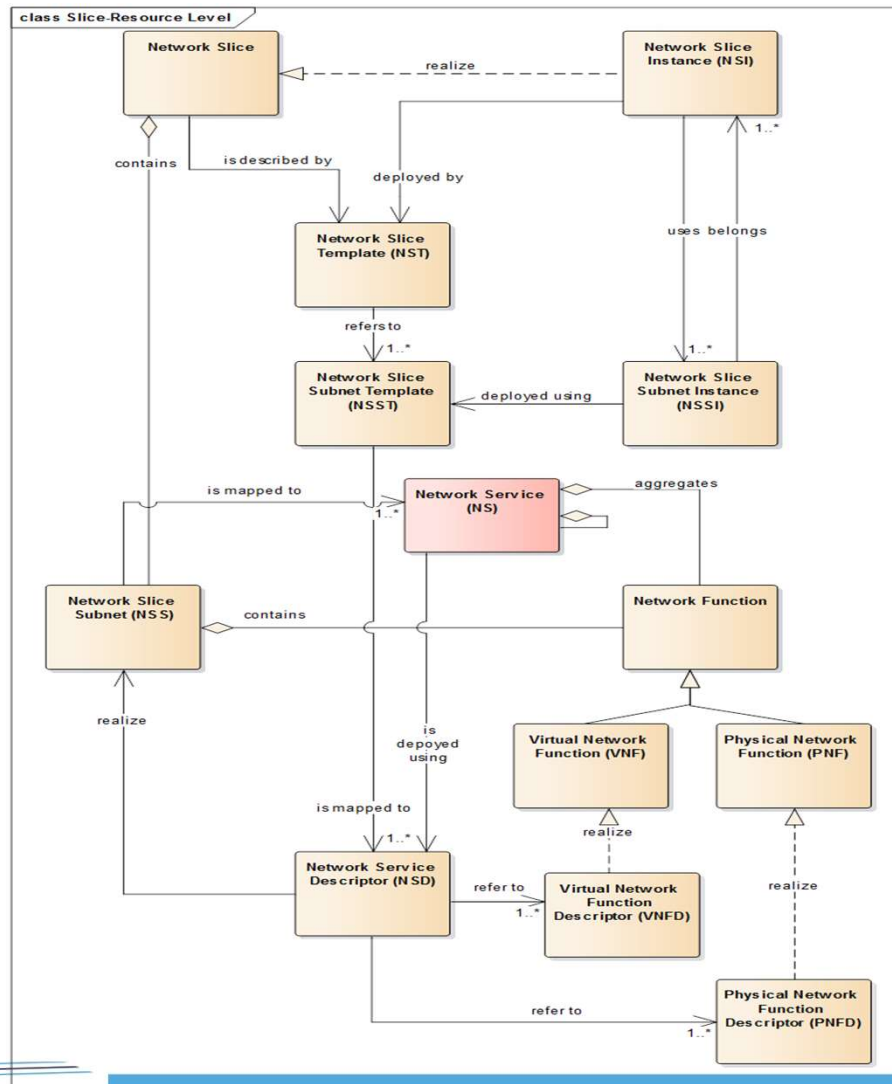


- 1) Service → Slice → Resources
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- 1) Service → Slice → Resources
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- 1) Service → Slice → Resources
- 2) Service Level
- 3) Service → Slice Level
- 4) Slice → Resource Level

Summary of innovations

- ❖ Vertical driven technical requirements decomposition
- ❖ Vertical centric multi-layer and multi-domain slicing control and management
- ❖ Business roles alignment with multi-domain slicing
- ❖ Information model ruling service and slice orchestration logic
- ❖ Cognitive slice management definition for QoE tailored optimization
- ❖ Plug & Play control for verticals and customized control exposure



Further Information

Website: <https://slicenet.eu/>

Email: contact@slicenet.eu

Further information: <https://slicenet.eu/publications/>

SliceNet Open source contributions:
<https://slicenet.eu/software-contributions/>

Questions ?



Thank you!



SLICENET IS FUNDED BY THE EUROPEAN UNION HORIZON 2020 PROGRAMME
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Questions ?

backup



Zoom on SliceNet Slice Template

Class name

Slice Type

eMBB, mMTC, URLLC

Network Topology

P2P

P2MP

MP2P

Mesh

Endpoints

Max number of configured endpoints

Max number of attached endpoints

Max number of active endpoints

Dynamic Session support

Nomadicity support

In-country Roaming support

Seamless handover (session continuity)

Mobility and networking features

Max end-point speed - intra-cell

Max end-point speed - inter-cell

Max end-point speed - inter-domain

International Roaming support

Multicast support

Zoom on SliceNet Slice Template

Class name	
Security features	Authentication Encryption
VAS	Firewalling NAT Parental control
Network Performance	Committed Bandwidth per endpoint - DS Committed Bandwidth per endpoint – US Total Slice Bandwidth – DS Total Slice Bandwidth – US
Priority levels	Latency – peak Latency – mean Jitter – peak Jitter – mean Packet loss - without

Zoom on SliceNet Slice Template

Class name

Plug & Play feature

Monitoring only
NFs configuration
QoS/QoE control
SDN forwarding
NFs lifecycle
Slice lifecycle

Plug & Play view

Service level
Slice level
NF level
