End-to-end service specification and deployment in 5G-VINNI

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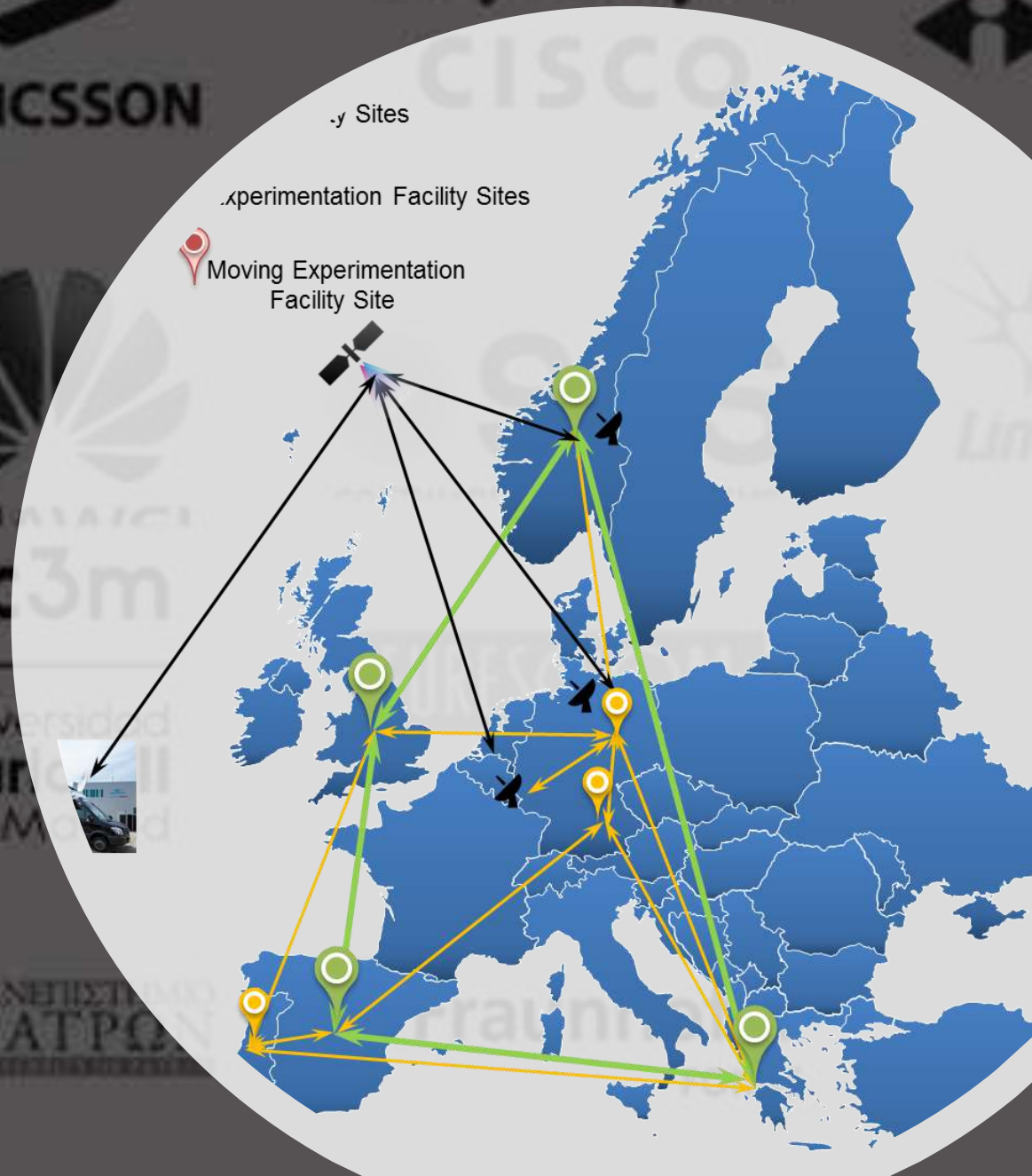
5G-VINNI (5G Verticals INNovation Infrastructure)

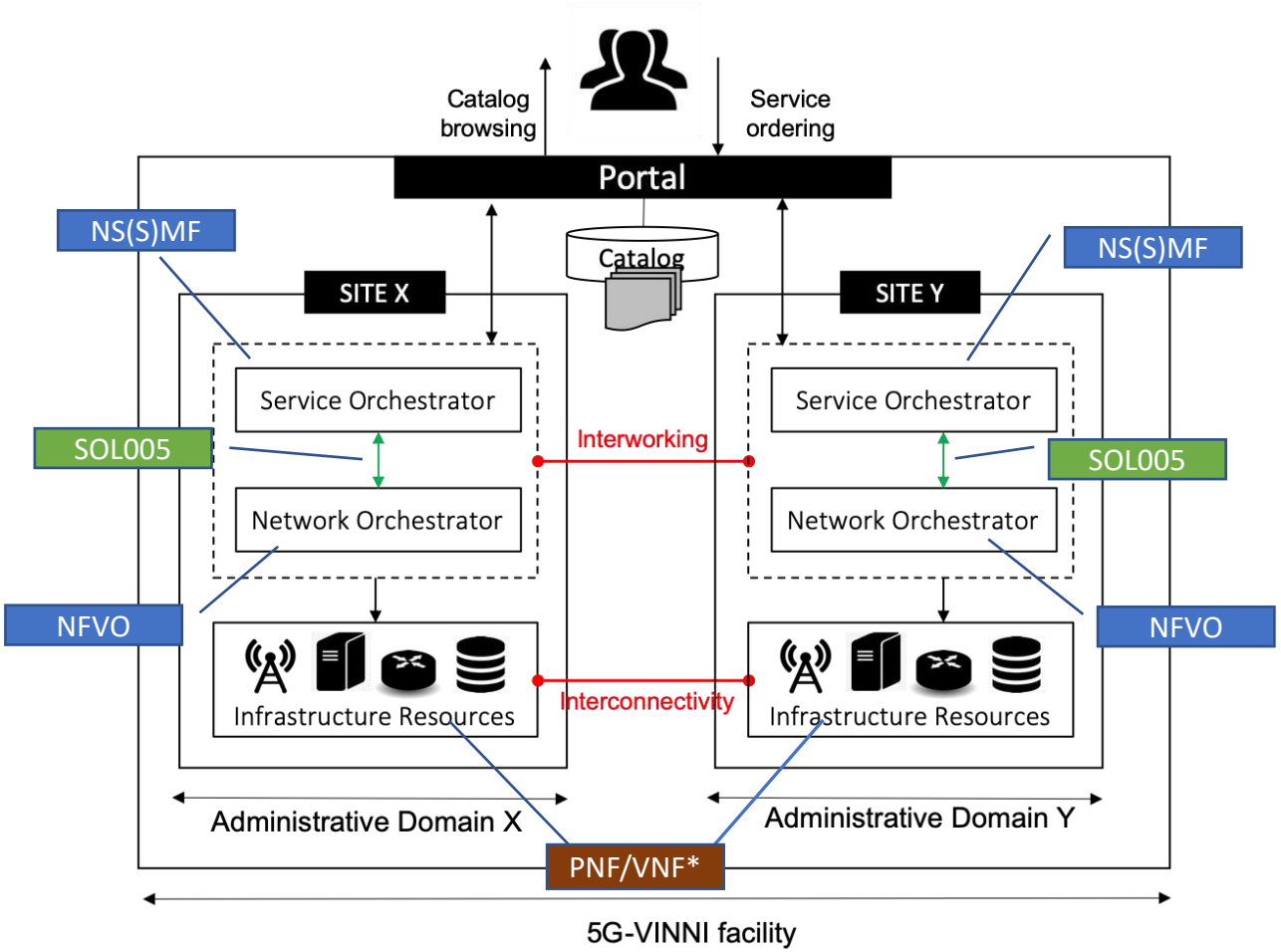
- Build an open large scale 5G End-to-End facility that can
  - demonstrate that key 5G network KPIs can be met
  - be validated, accessed and used by vertical industries (e.g. in ICT-19 projects) to test use cases and validate 5G KPIs.
  - Provide user friendly zero-touch orchestration, operations and management systems for the 5G-VINNI facility.
  - Validate the 5G KPIs and support the execution of E2E trial of vertical use cases for ICT-19 projects.



- Duration: 3 years, budget: 19,998 M€
- Consortium: 23 partners (operators, vendors, academics, SMEs)

https://5g-vinni.eu/

5G-VINNI facility



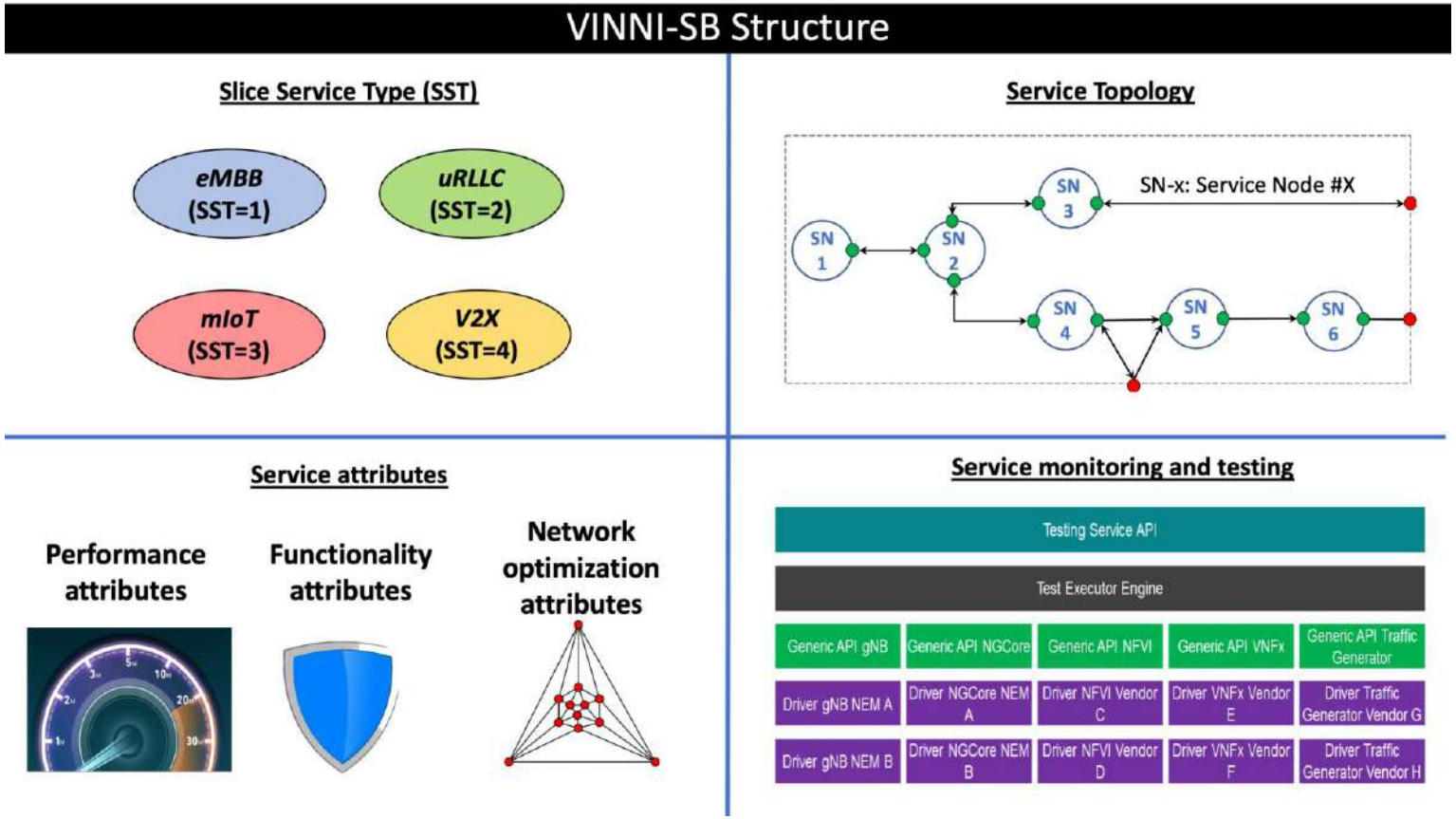
- 5G-VINNI facility site architecture is standards-compliant (e.g. 3GPP; ETSI NFV) to facilitate interoperability in multi-site slicing scenarios
- 5G-VINNI is an E2E facility providing advanced 5G capabilities that are made available to industry verticals for use case trialing.
- 5G-VINNI facility provides every vertical with an isolated service experimentation, in the form of a slice -> Network Slice as a Service (NSaaS).
- 5G-VINNI facility architecture
  - **Catalog:** publication of 5G-VINNI service offerings, i.e. network slice services.
  - **Portal:** single-entry point for the vertical. It allows catalog browsing and service ordering operations.
  - **Multiple interworking sites,** each deployed at a different geographic location and defining a single administrative domain.

This project has received funding from the EU's Horizon 2020 research and innovation programme under grant agreement No 815279.

(*) Multi-Vendor Network Functions across domains, e.g. RAN, CN, TN.

5G-VINNI Service Blueprint (VINNI-SB)

- Model-based service template for service ordering in NSaaS.
- Extending GSMA's Generic Slice Template (GST), including experimentation related attributes:
  - **Monitoring**
  - **Testing**



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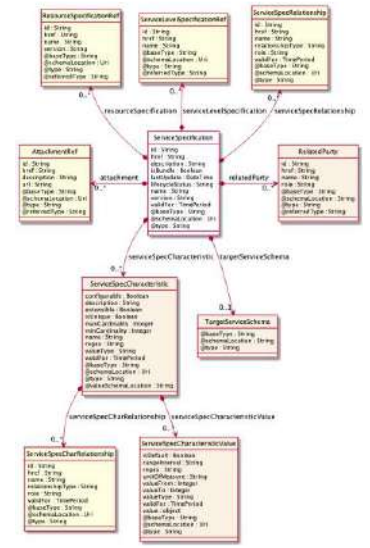
GSMA GST to TMF SID

- Availability
- Area of service
- Delay tolerance
- Deterministic communication
- Downlink throughput per network slice
- Downlink throughput per UE
- Energy efficiency
- Group communication support
- Isolation level
- Location based message delivery
- Maximum supported packet size
- Mission critical support
- MMTel support
- NB-IoT Support
- Network Slice Customer network functions
- Number of connections
- Number of terminals
- Performance monitoring
- Performance prediction
- Positioning support
- Radio spectrum
- Reliability
- Root cause investigation
- Session and Service Continuity support
- Simultaneous use of the network slice
- Slice quality of service parameters
- Support for non-IP traffic
- Supported device velocity
- Synchronicity
- Terminal density
- Uplink throughput per network slice
- Uplink throughput per UE
- User management openness
- User data access
- VX communication mode

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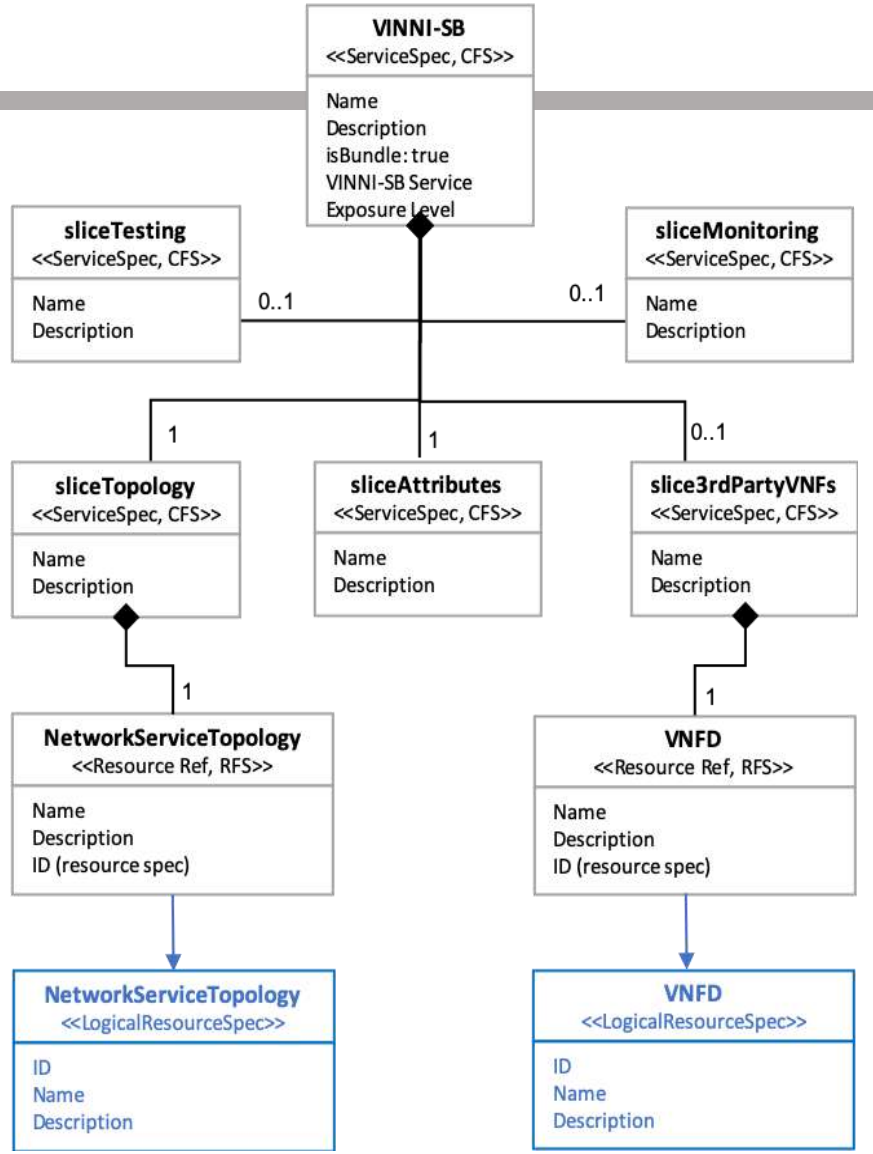
Model of VINNI-SB

- Definition of a common information model for the entire 5G-VINNI facility:
  - **Site-agnostic design of** network slices.
  - Ensures **reproducibility and** facilitates **cross-site slice deployments.**

- Model following TM Forum's information Framework (SID)



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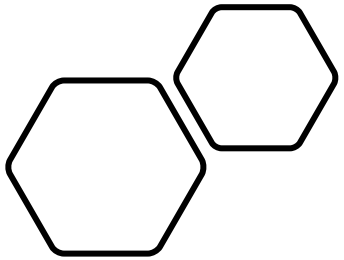
Onboarding a Vertical for 5G experimentation



Onboarding a vertical in a 5G experimentation infrastructure involves various **iterative and parallel steps**. **Different stakeholders** (customer, facility provider) must co-design and co-develop different parts for a successful operation and KPI testing on top of a 5G facility.

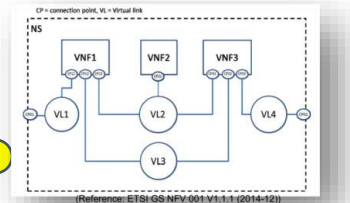
We defined three periods of the onboarding process:

i) **a co-design** period,

ii) an iterative **co-development** period and

iii) the **Operation and Testing KPI** iterative period.

The onboarding process



VNFD/NSD development

- VNF/NSD testing
-Understand/automate measurement points

-Involve Monitoring aaS
-Involve Testing aaS

Pre-validation KPI period Via NFVO

- This cycle might be repeated multiple times
- NFV orchestration is key part to repeatability of NF deployments/testing
- Self service onboarding/off boarding, deployment test and access - Access Level 1
- facility might offer to vertical a staging area (e.g. a private OSM to experiment) or NFVO itself – Access Level 2 and 3
- facility might offer to vertical VIM access – Access Level 4

Co-develop period

VNFD/NSD onboarding

Co-develop period

Vertical and facility co-design period

Operational &Testing KPI period

Network Service Design (RFS)

Service Design (CFS)

Study service specs to network requirements

Study service specs to MaaS & TaaS requirements

Iteratively develop Service and NFV orchestrators "choreography"

Install parts of the use case
If possible, Execute even non automated with manual parts

Design the Service Blueprint
NSaaS Spec with its characteristics

Launch Service Spec
Alpha/beta versions

Pre-Validation KPI period via Service Orchestrator

Service Spec is Launched

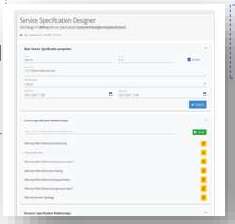
Testing

Assessment

Offer the Service Blueprint to the Vertical community For repeatable deployments

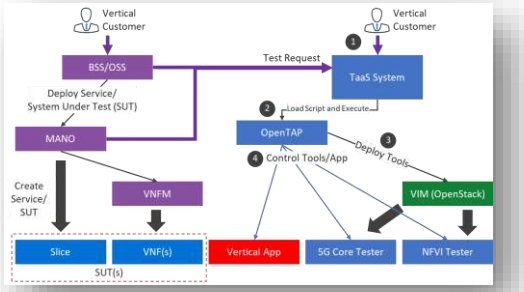
E2E Service Order Fulfilled

Understand:
- Network requirements
- Measurement points
- What can (must) be automated
- What can be parameterized
Prepare onboarding Plan

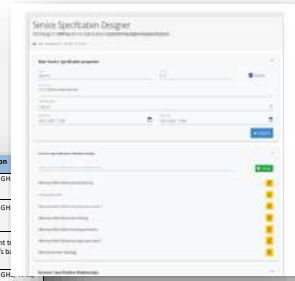


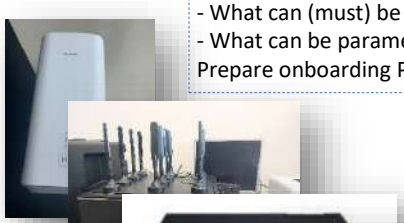
Test deployment/ activation of SB

Test case design
Test scripts for TaaS



-This cycle might be repeated multiple times
- Service and NFV orchestration is key part to repeatability of NF deployments/testing

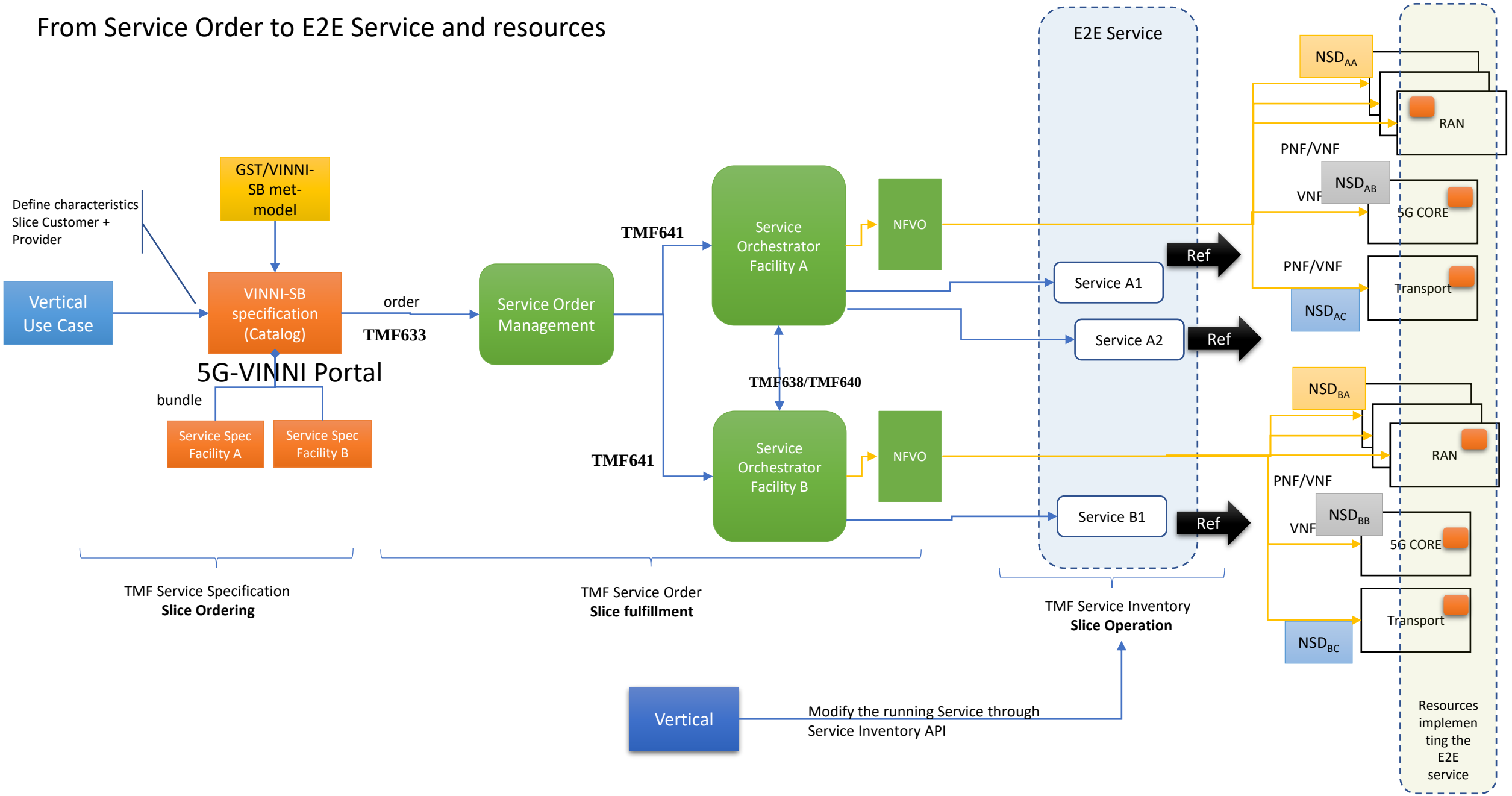




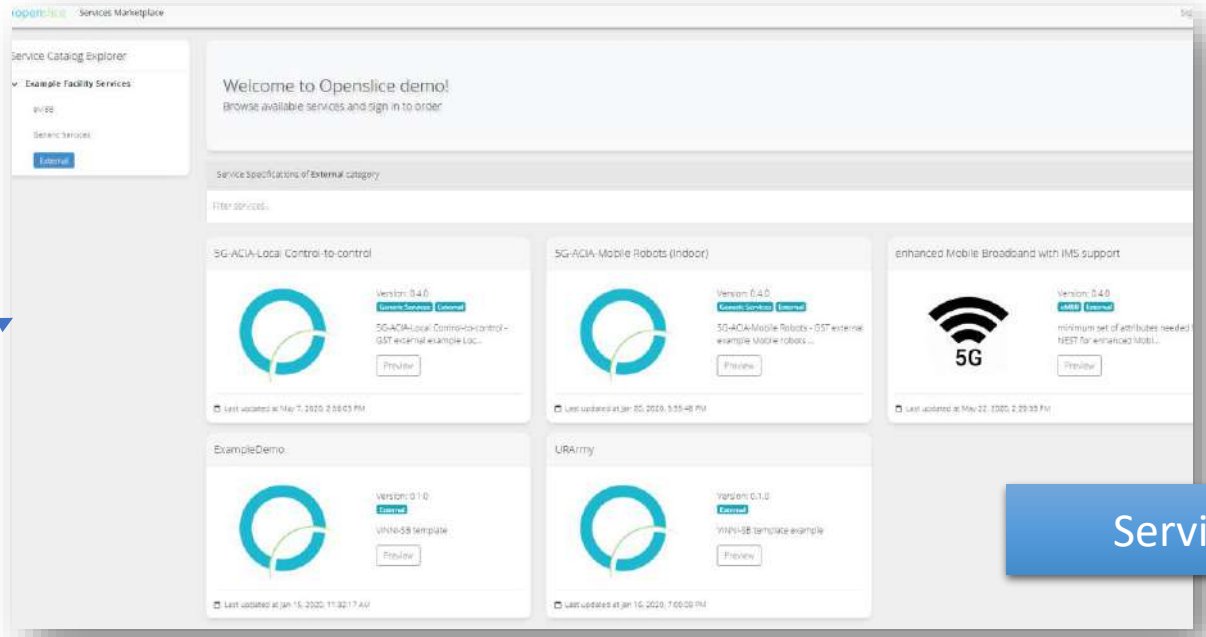
Category	KPIs	Achieved Values	Description
E2E Network Performance	UL Maximum Throughput (Mbit/s)	104.27 Mbit/s	mmWave, 27.3-27.5 GH stream
	DL Maximum Throughput (Mbit/s)	883.69 Mbit/s	mmWave, 27.3-27.5 GH 40 streams.
	UL Latency (ms)	13.77 ms	3.6GHz, low foot-print t profile with 100Kbit/s b
	DL Latency (ms)	9.15 ms	
	UL Jitter (ms)	1.01 ms	mmWave, 27.3-27.5 GH low foot-print traffic profile with
	DL Jitter (ms)	0 ms	100Kbit/s bandwidth.
	UL Frame Loss (%)	0.01%	3.6GHz, low foot-print traffic
	DL Frame Loss (%)	0%	profile with 100Kbit/s bandwidth.
NFVI Network Performance	Maximum Throughput (0 Frame Loss)	4.573 Gbit/s	two compute nodes, DPDK was configured in the test environment.
	Latency between VMs	0.067 ms	
NFVI Compute Resource Performance	CPU Benchmarking Score	3,510	Yardstick CPU/Memory/Storage tests.
	Memory Read Latency	7.97 ns	
	Memory r/w Bandwidth	25.641 GB/s	
	Storage r/w IOPS	5.65 k / 4.21 k	
	Storage r/w Latency	188 / 621 ms	
	Storage r/w Bandwidth	1,018 / 425 MB/s	

Optional

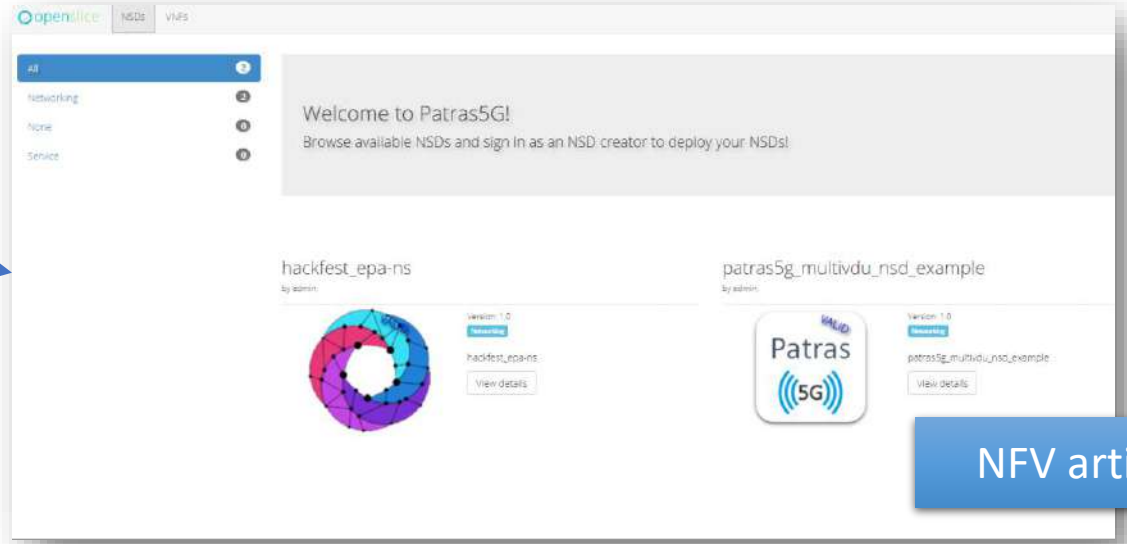
From Service Order to E2E Service and resources



Supporting the onboarding-process



Services

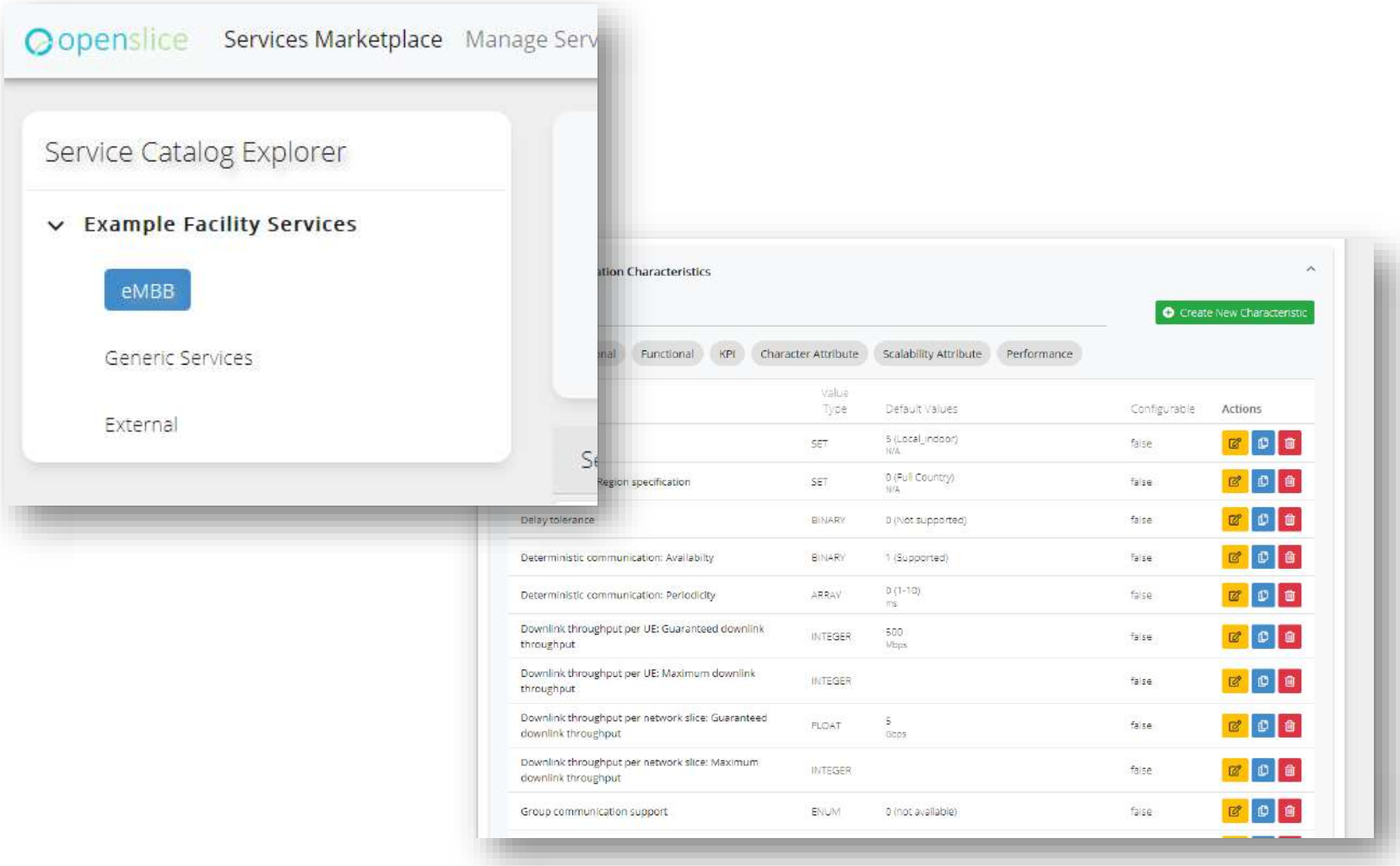


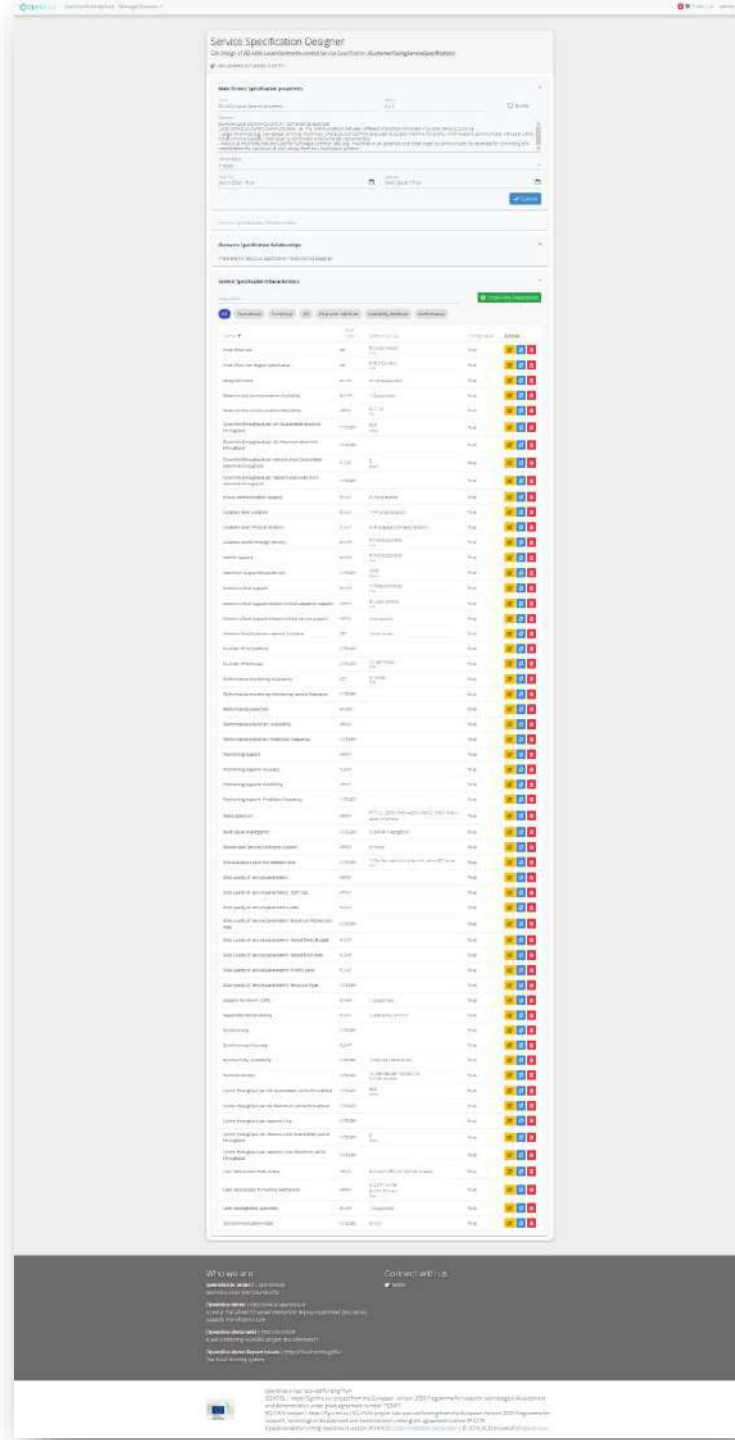
NFV artifacts

openslice

http://openslice.io

Service Catalog/Service Specification Design

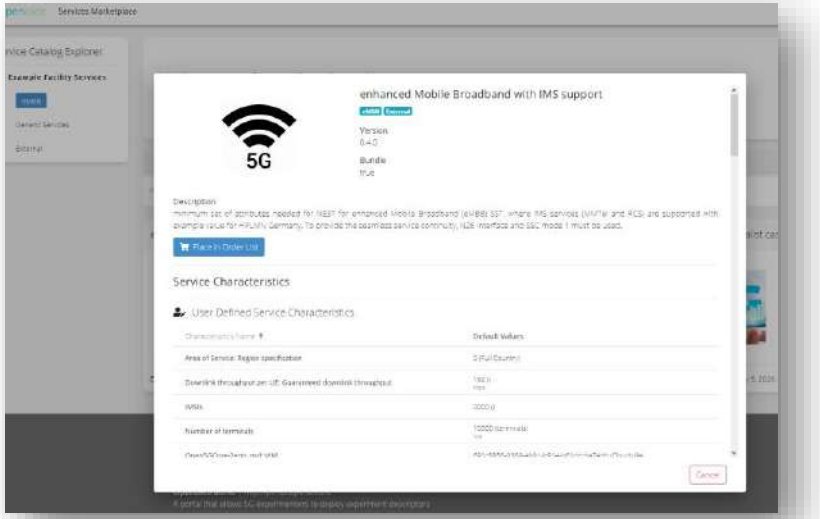


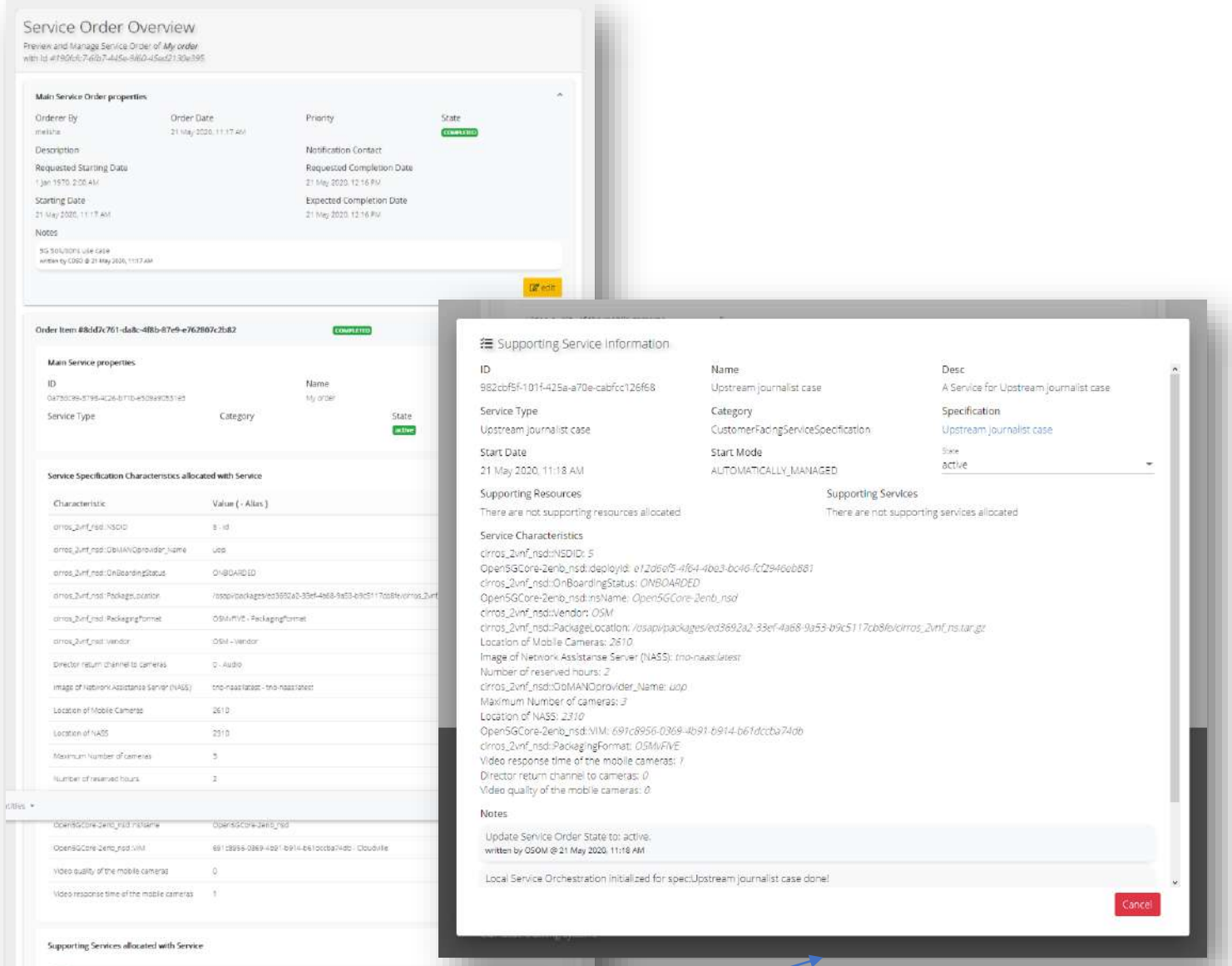


TMF633 - Service Catalog Management

TMF634 - Resource Catalog Management (no UI currently)

Service Order and SOM





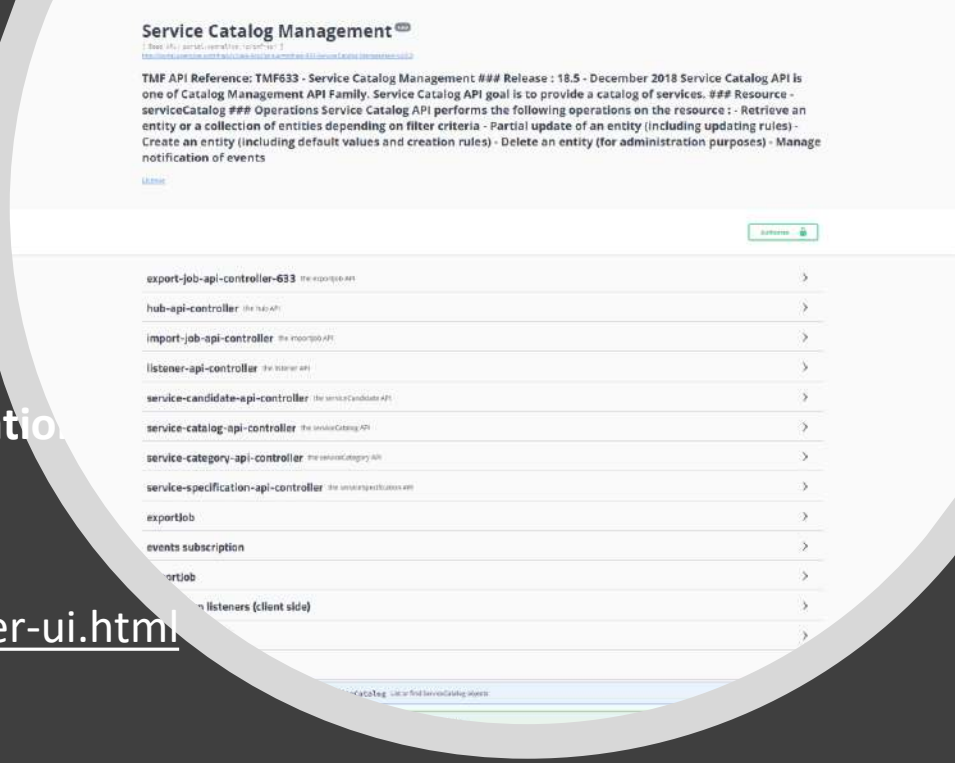
TMF 638 - Service Inventory Management

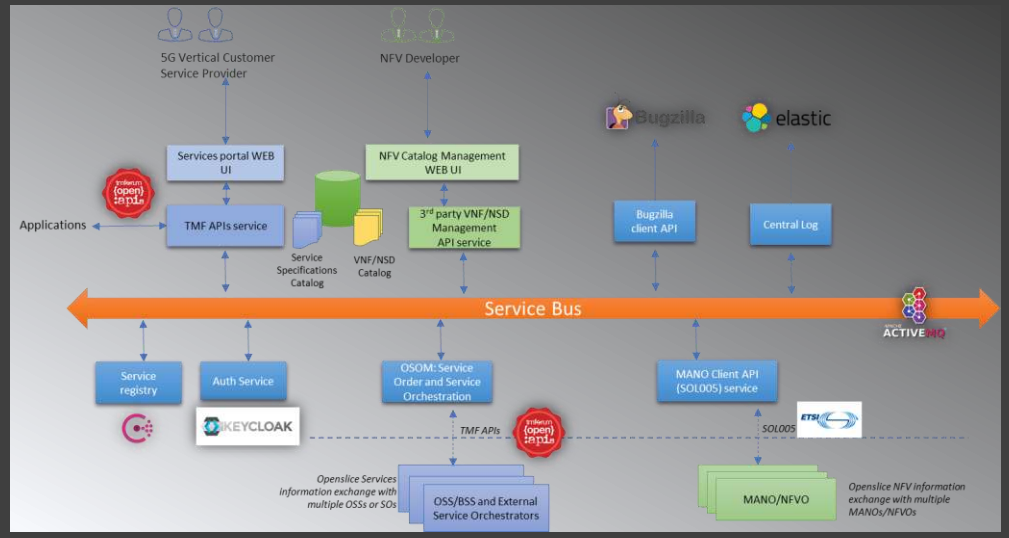
TMF 640 - Service Activation and Configuration

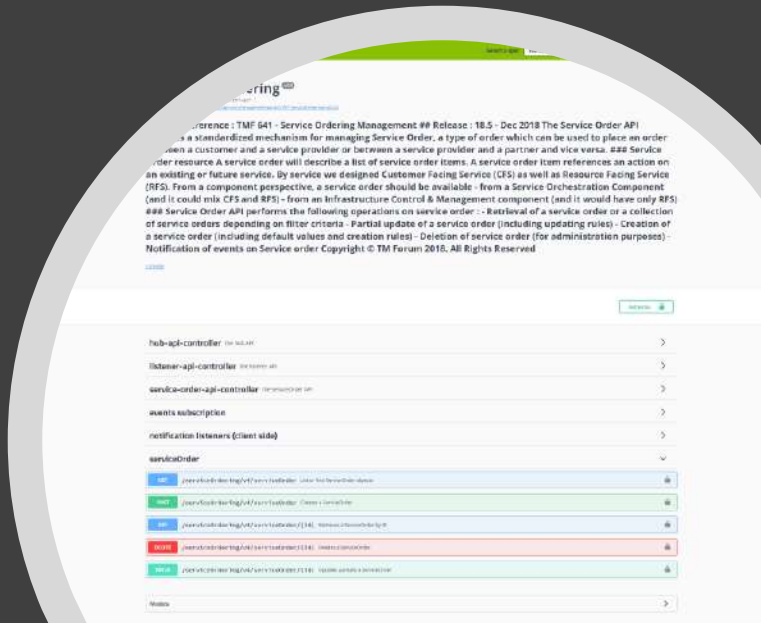
TMF 641 - Service Ordering Management

Openslice Open API access

- **Supported TMF OpenAPIs for programmatic access by Vertical Applicatio**
- For a quick access check our swagger links:
- TMF APIs: http://portal.openslice.io/tmf-api/swagger-ui.html
- API for VNF/NSD management: http://portal.openslice.io/osapi/swagger-ui.html

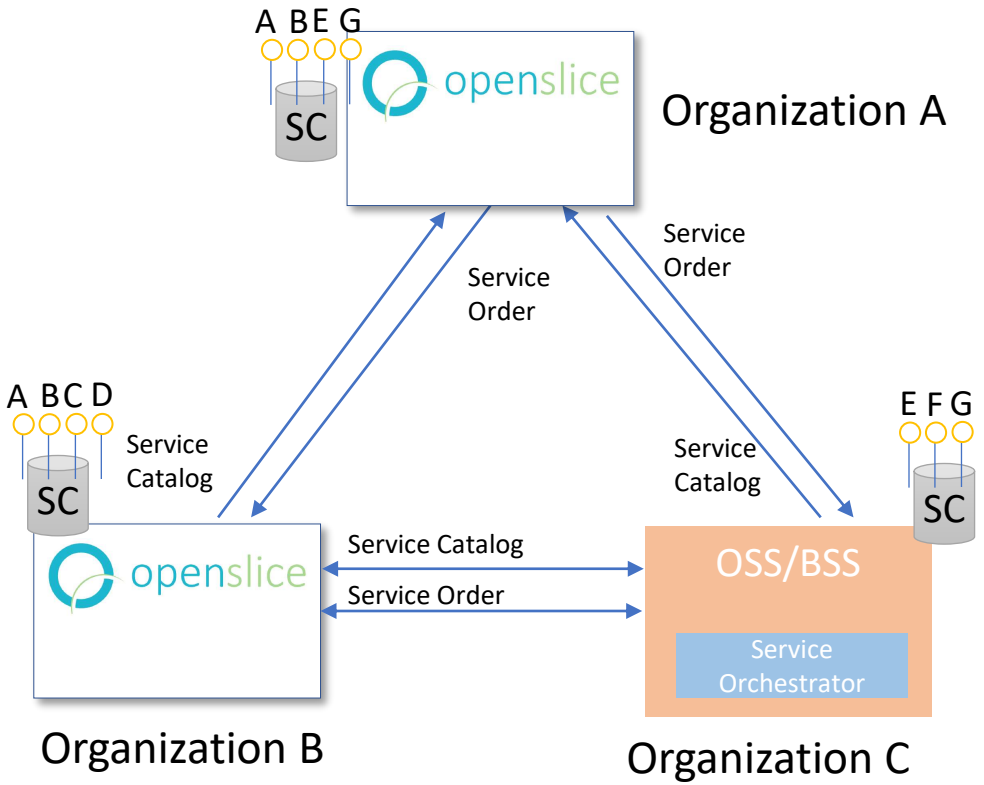




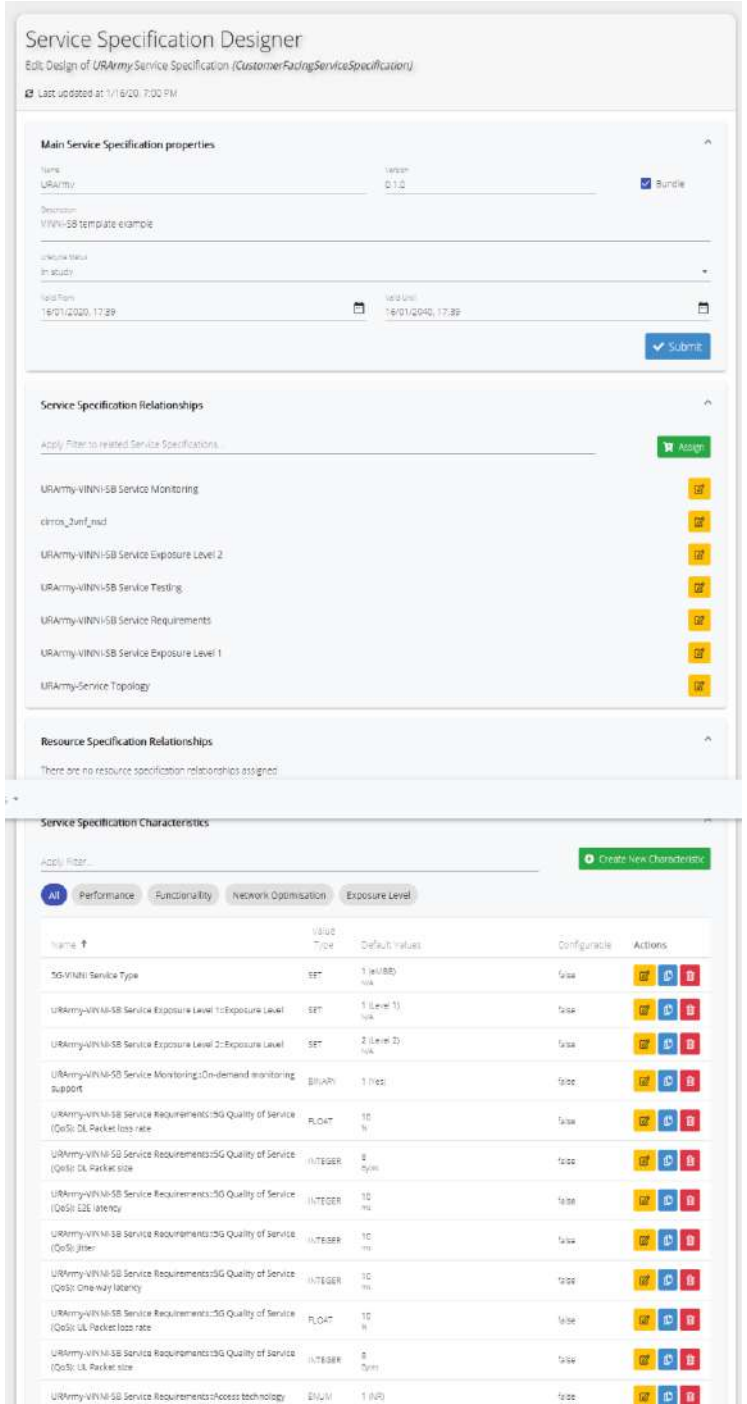


Multidomain scenarios and federation

Openslice can be used to exchange service specifications/catalogs and make service orders between Organizations



TMF632 – Party Management



openslice

Openslice is a prototype open source, operations support system. It supports VNF/NSD onboarding to OpenSourceMANO (OSM) and NSD deployment management. It also supports TMFORUM OpenAPIs regarding Service Catalog Management, Ordering, Resource, etc.

Microservices based architecture

http://openslice.io

Demo

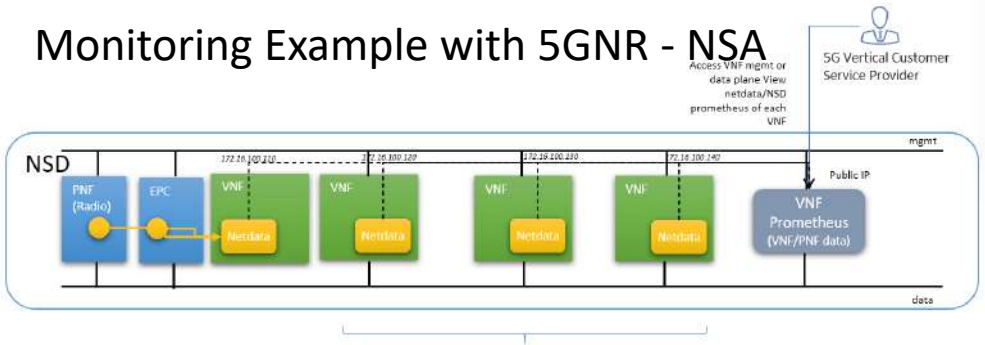
- Openslice demo: http://portal.openslice.io/
- Openslice Service Catalogs and ordering: http://portal.openslice.io/services/

Open Source MANO
ECOSYSTEM
OSS / BSS

5G-VINNI channel
https://www.youtube.com/channel/UCJvEIH7_8ocLyVOmwLDldwA

Use case examples
Test case training sessions

Monitoring Example with 5GNR - NSA



https://www.youtube.com/watch?v=X662lml0p8w

Challenges

- Understand the facility and offered services
  - Training sessions
- Automation of Services
  - NFV artifacts/ Service Templates
  - Orchestration
- Interconnection with APIs and Services (Commercial/Open source)
  - Standards
- Integration with new locations (NPNs)
- Definition of Service Parameters and KPIs
- 5G SA available in next months (orchestrated/shared slice support)
- Verticals expectations vs 5G System maturity (RAN, Core, UEs)
  - Orchestration and multiple slices (research)
  - Only eMBB is available (URLLC or mMTC in future)

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Thank you!

Dr. Christos Tranoris is a Senior Researcher at the Electrical and Computer Engineering department of University of Patras, Greece. He currently participates in several Horizon 2020 European projects related to 5G.