



5G end-to-end experimentation by verticals in EU projects

Online workshop 9 June 2020

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

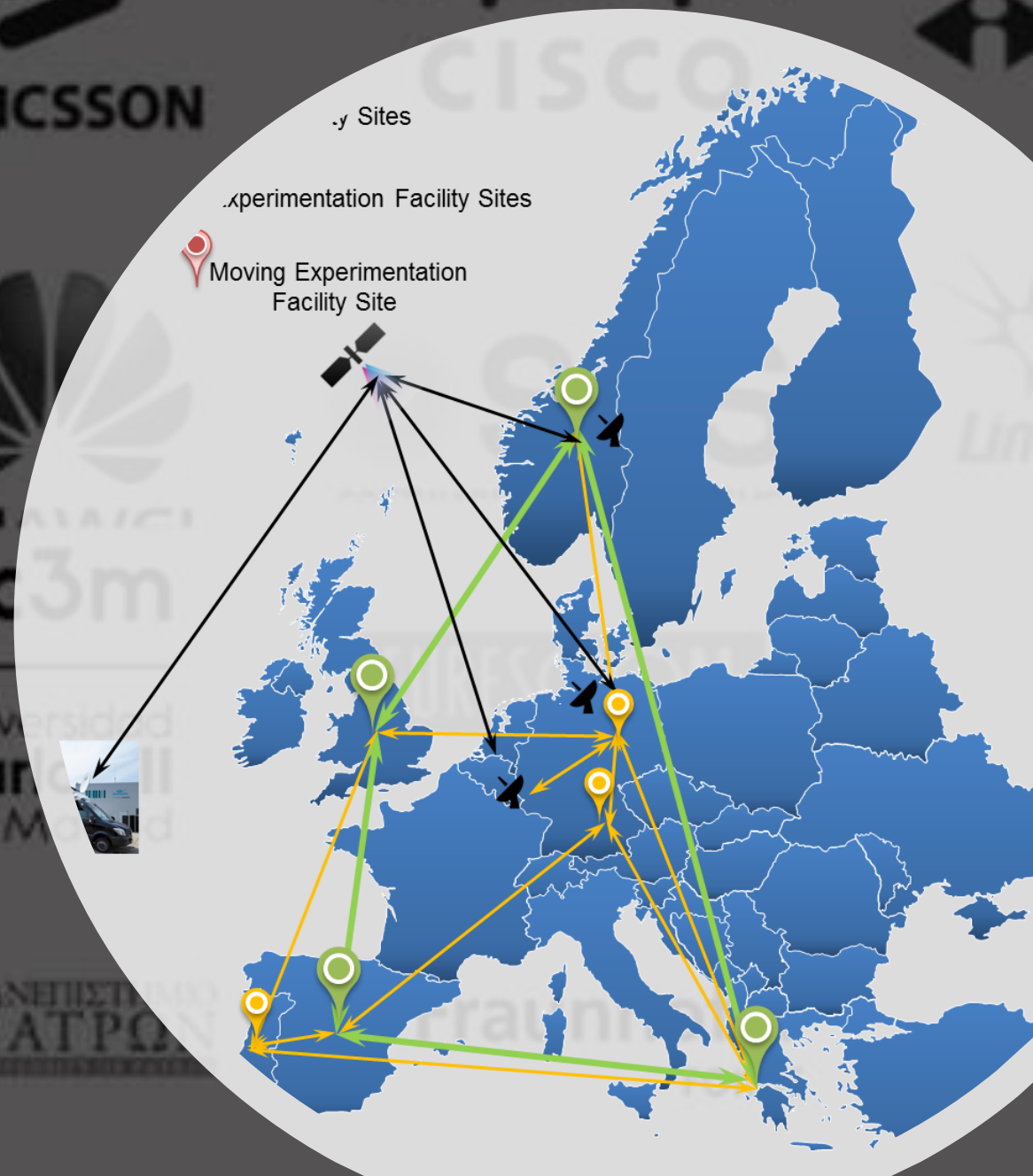
Christos Tranoris

University of Patras, Greece

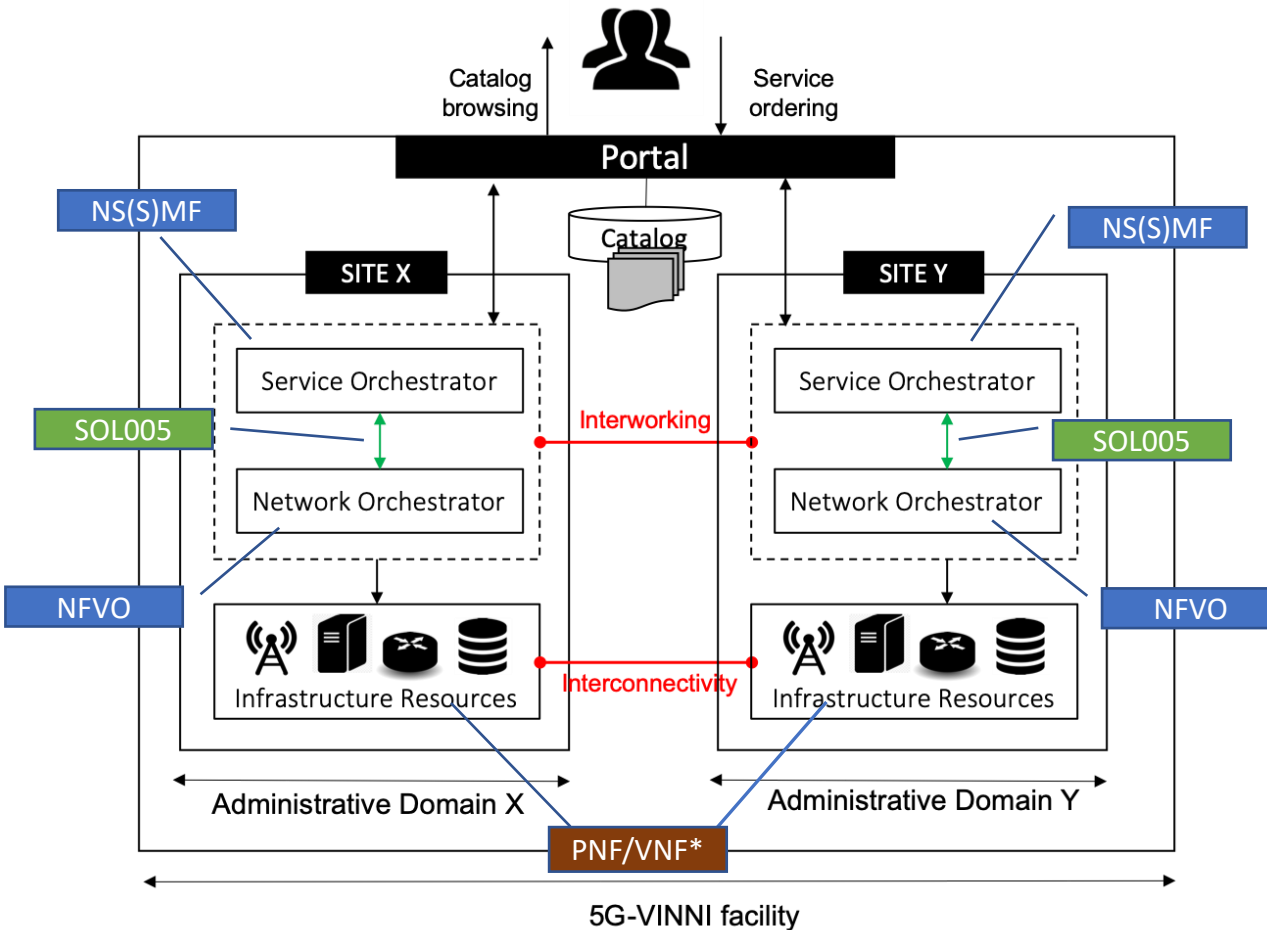
5G-VINNI (5G Verticals INNnovation Infrastructure)

- 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.



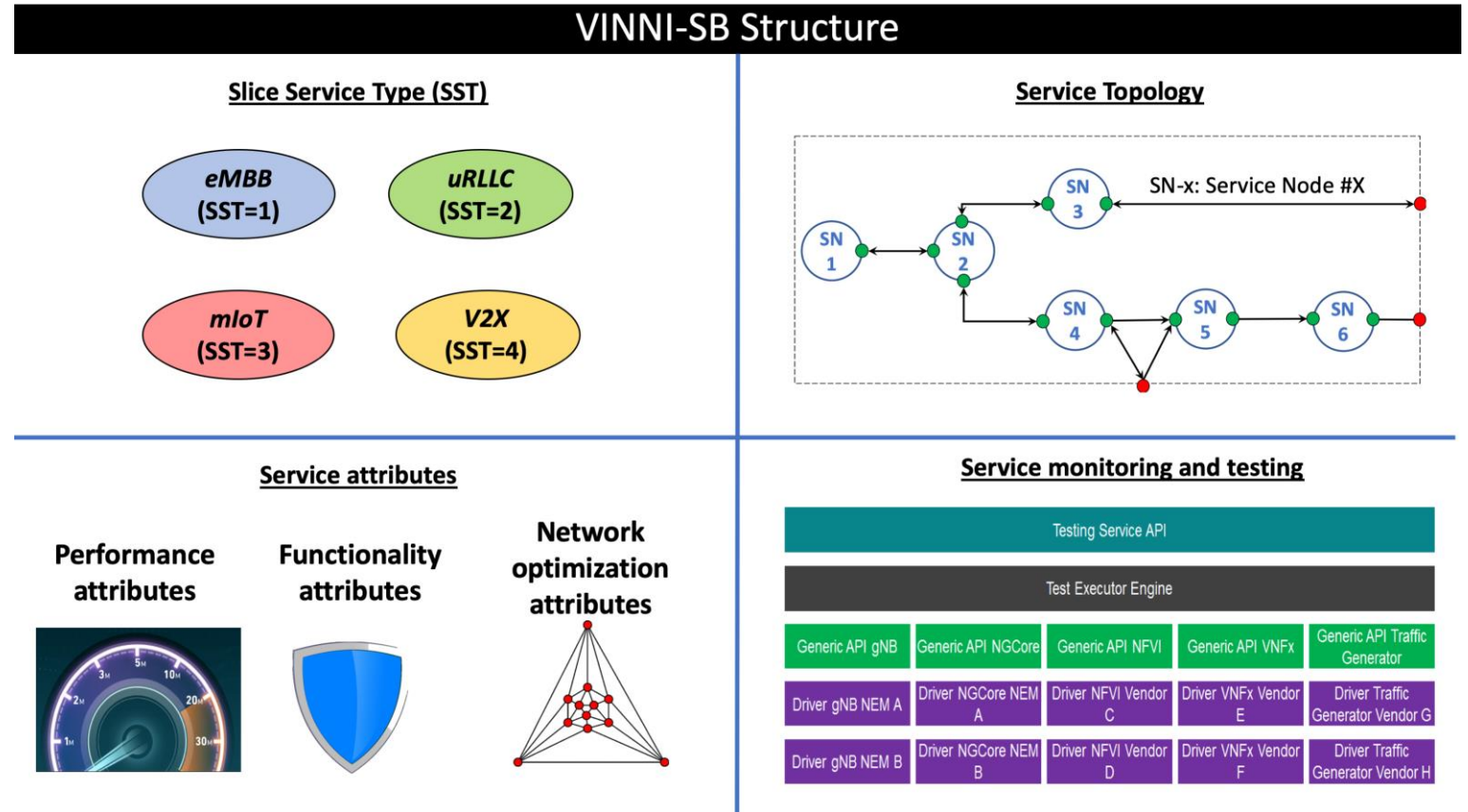
This project has received funding from the EU's Horizon 2020 research and innovation programme under grant agreement No 815279.

(*) 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**

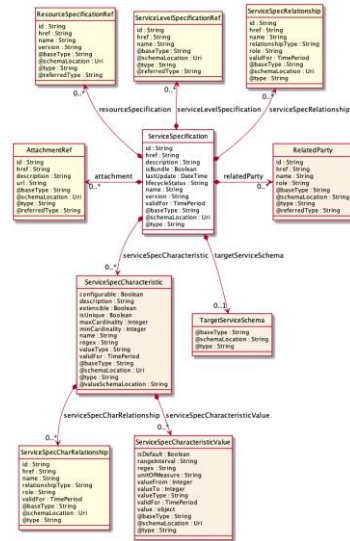


This project has received funding from the EU's Horizon 2020 research and innovation programme under grant agreement No 815279.



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



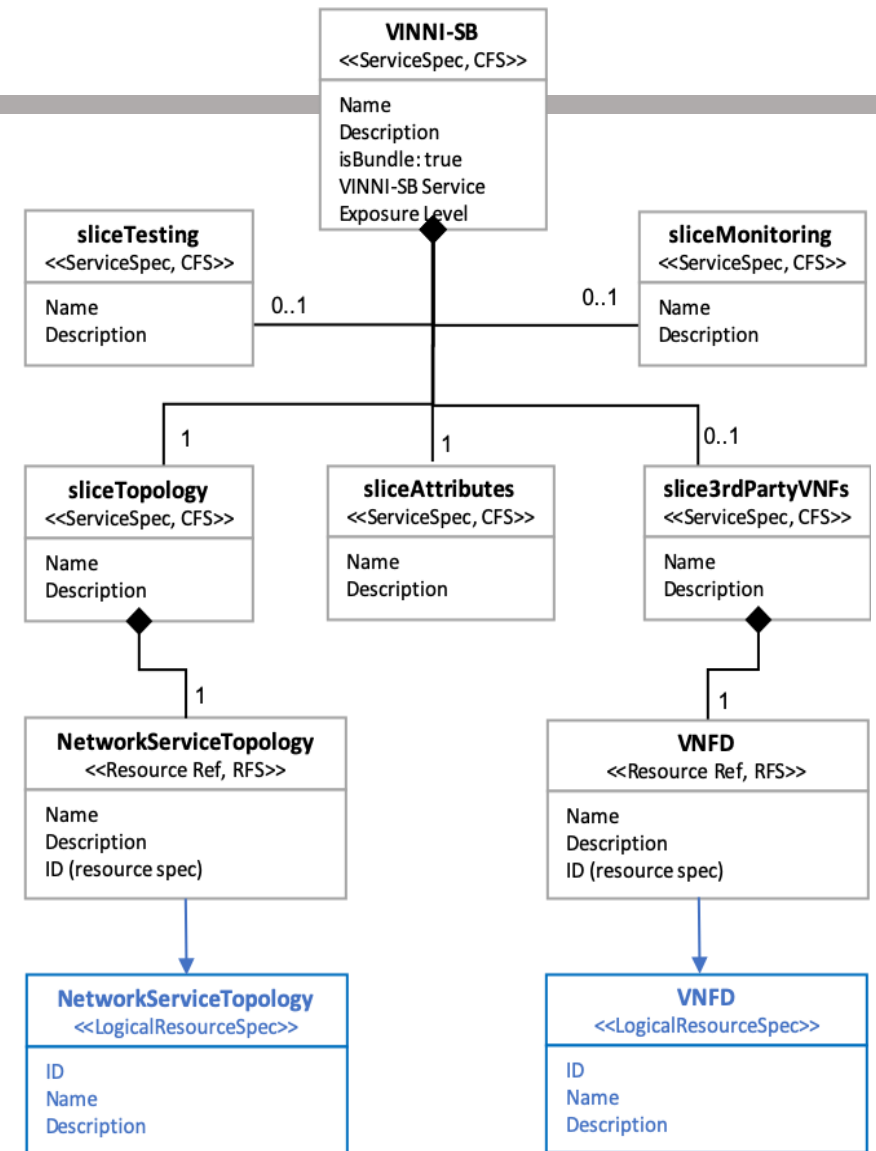
```

{
  "name": "GST External",
  "description": "GST external example",
  "version": "0.4.0",
  "isBundle": false,
  "attachment": [
  ],
  "relatedParty": [
  ],
  "resourceSpecification": [
  ],
  "serviceLevelSpecification": [
  ],
  "serviceSpecCharacteristic": [
    {
      "name": "Area of Service",
      "configurable": false,
      "description": "This attribute specifies the area where the terminals can access a particular network slice. Therefore, the attri",
      "extensible": null,
      "isUnique": true,
      "maxCardinality": 1,
      "minCardinality": 0,
      "regex": null,
      "valueType": "SET",
      "serviceSpecCharRelationship": [
      ],
      "serviceSpecCharacteristicValue": [
      ]
    },
    {
      "name": "Area of Service: Region specification",
      "configurable": false,
      "description": "For every single country listed in the area of service attribute it needs to be indicated if the service will be",
      "extensible": null,
      "isUnique": true,
      "maxCardinality": 1,
      "minCardinality": 0,
      "regex": null,
      "valueType": "SET",
      "serviceSpecCharRelationship": [
      ],
      "serviceSpecCharacteristicValue": [
      ]
    }
  ],
  "serviceSpecCharRelationship": [
    {
      "name": "Character Attribute", "role": "tag", "relationshipType": "tag" },
    {
      "name": "Functional", "role": "tag", "relationshipType": "tag" },
    {
      "name": "KPI", "role": "tag", "relationshipType": "tag" }
  ],
  "serviceSpecCharacteristicValue": [
    {
      "isDefault": true,
      "rangeInterval": null,
      "regex": null,
      "unitOfMeasure": "N/A",
      "valueFrom": null,
    }
  ]
}

```

Model of VINNI-SB

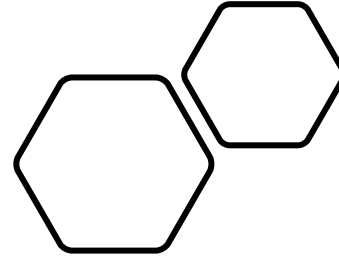
- Definition of a common information model for the entire 5G-VINNI facility:
 - **Site-agnostic design of network slices.**
 - Ensures **reproducibility** and facilitates **cross-site slice deployments.**
- Model following TM Forum's information Framework (SID)



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



Onboarding a Vertical for 5G experimentation

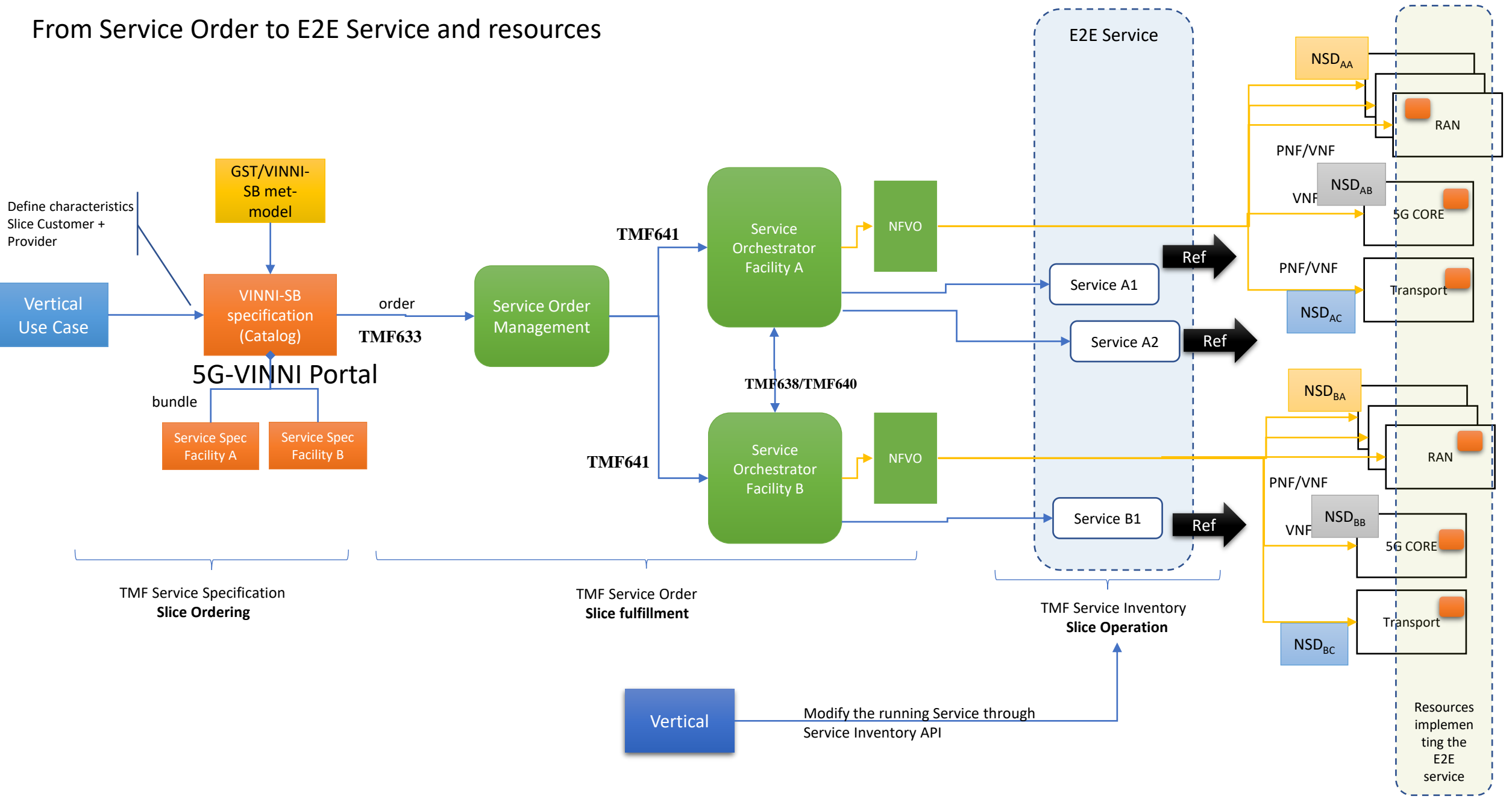


Onboarding a vertical in a 5G experimentation infrastructure involves various **iterative and parallel steps**. **Different stakeholders** (customer, facility provider) must co-design and co-develop different parts for a successful operation and KPI testing on top of a 5G facility.

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.

From Service Order to E2E Service and resources



Supporting the onboarding-process

Welcome to 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. Check <http://openslice.io> for further documentation

Service Catalog

Resource Catalog

SO

NFVO

Deploy Services by using Standard Open APIs!

Design Catalogs and Services specifications and manage Service orders!

Service portal

Deploy VNFs and NSDs to target NFV Orchestrator !

Onboard, manage and share VNFs and Network Services over the target infrastructure

NFV Portal



Service Catalog Explorer

Example Facility Services

evBB

Generic Services

External

Welcome to Openslice demo!

Browse available services and sign in to order

Service Specifications of External category

Filter services...

5G-ACIA-Local Control-to-control

Version: 0.4.0

Generic Services External

5G-ACIA-Local Control-to-control - GST external example Loc...

Preview

Last updated at May 7, 2020, 2:58:03 PM

5G-ACIA-Mobile Robots (Indoor)

Version: 0.4.0

Generic Services External

5G-ACIA-Mobile Robots - GST external example Mobile robots ...

Preview

Last updated at Jan 20, 2020, 5:55:48 PM

enhanced Mobile Broadband with IMS support

Version: 0.4.0

Generic Services External

minimum set of attributes needed NEST for enhanced Mobil...

Preview

Last updated at May 22, 2020, 2:29:33 PM

ExampleDemo

Version: 0.1.0

Generic Services External

VINNI-SB template

Preview

Last updated at Jan 15, 2020, 11:32:17 AM

URArmy

Version: 0.1.0

Generic Services External

VINNI-SB template example

Preview

Last updated at Jan 16, 2020, 7:00:09 PM

Services



openslice

<http://openslice.io>

NSDs

VNFs

All

Networking

None

Service

Welcome to Patras5G!

Browse available NSDs and sign in as an NSD creator to deploy your NSDs!

hackfest_epa-ns

by admin

Version: 1.0

Networking

hackfest_epa-ns

View details

patras5g_multivdu_nsd_example

by admin

Version: 1.0

Networking

VALID Patras (5G)

patras5g_multivdu_nsd_example

View details

NFV artifacts

Service Catalog/Service Specification Design

openslice

Services Marketplace

Manage Services

Service Catalog Explorer

Example Facility Services

eMBB

Generic Services

External

Service Specification Characteristics

Functional




























KPI

Character Attribute

Scalability Attribute

Performance

Create New Characteristic

	Value Type	Default Values	Configurable	Actions
Region specification	SET	5 (Local Indoor) N/A	false	  
Delay tolerance	SET	0 (Full Country) N/A	false	  
Deterministic communication: Availability	BINARY	0 (Not supported)	false	  
Deterministic communication: Periodicity	ARRAY	0 (1-10) ms	false	  
Downlink throughput per UE: Guaranteed downlink throughput	INTEGER	500 Mbps	false	  
Downlink throughput per UE: Maximum downlink throughput	INTEGER		false	  
Downlink throughput per network slice: Guaranteed downlink throughput	FLOAT	5 Gbps	false	  
Downlink throughput per network slice: Maximum downlink throughput	INTEGER		false	  
Group communication support	ENUM	0 (not available)	false	  

Service Specification Designer

Main Service Specification properties

Service Specification Relationships

Resource Specification Relationships

Service Specification Characteristics

Who we are

Connect with us

openslice is a project funded by the European Union under the Horizon Europe research and innovation programme

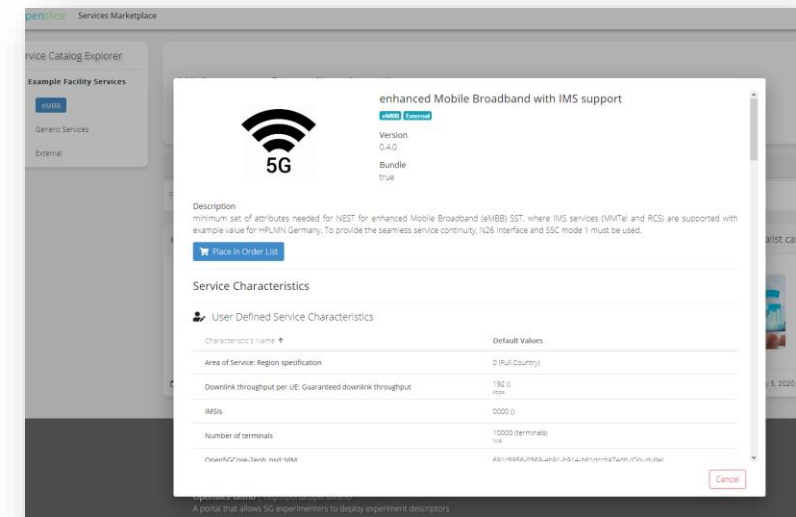
openslice is a project funded by the European Union under the Horizon Europe research and innovation programme

openslice is a project funded by the European Union under the Horizon Europe research and innovation programme

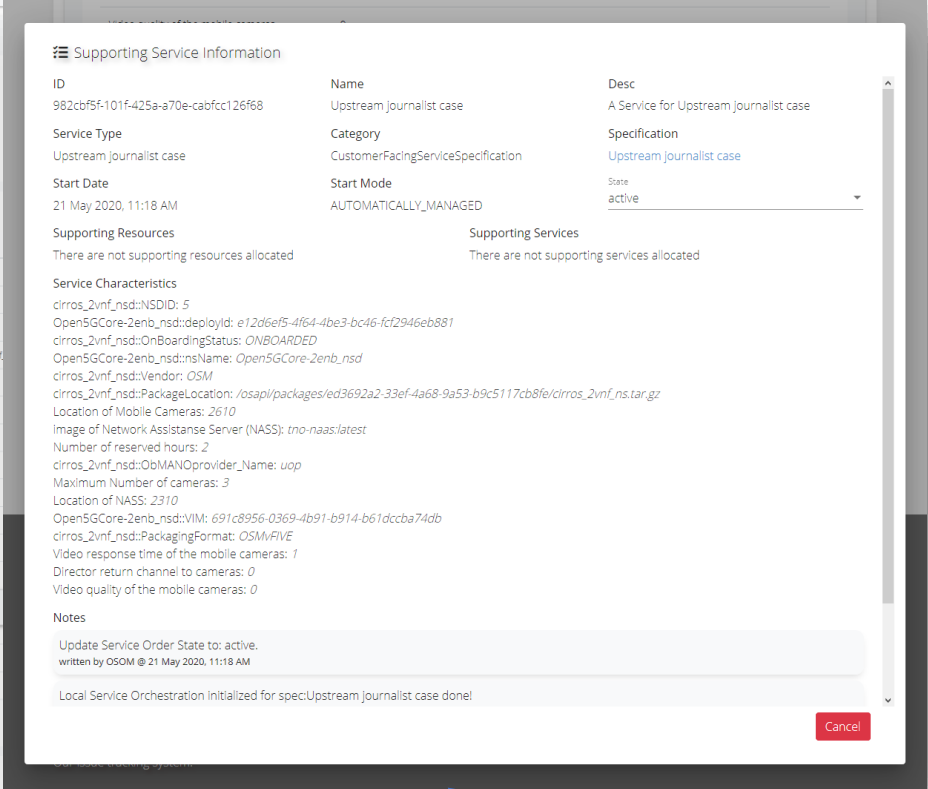
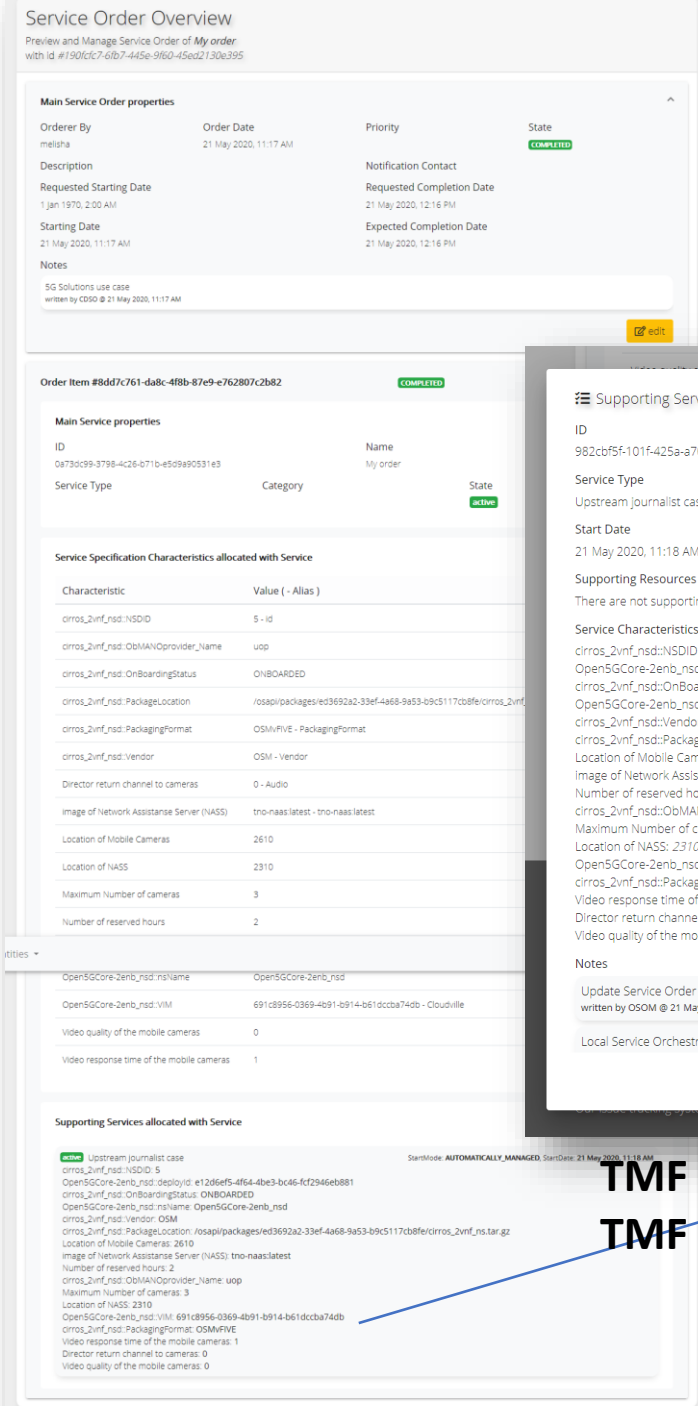
openslice is a project funded by the European Union under the Horizon Europe research and innovation programme

TMF633 - Service Catalog Management
TMF634 - Resource Catalog Management (no UI currently)

Service Order and SOM



TMF 641 - Service Ordering Management



TMF 638 - Service Inventory Management
TMF 640 - Service Activation and Configuration

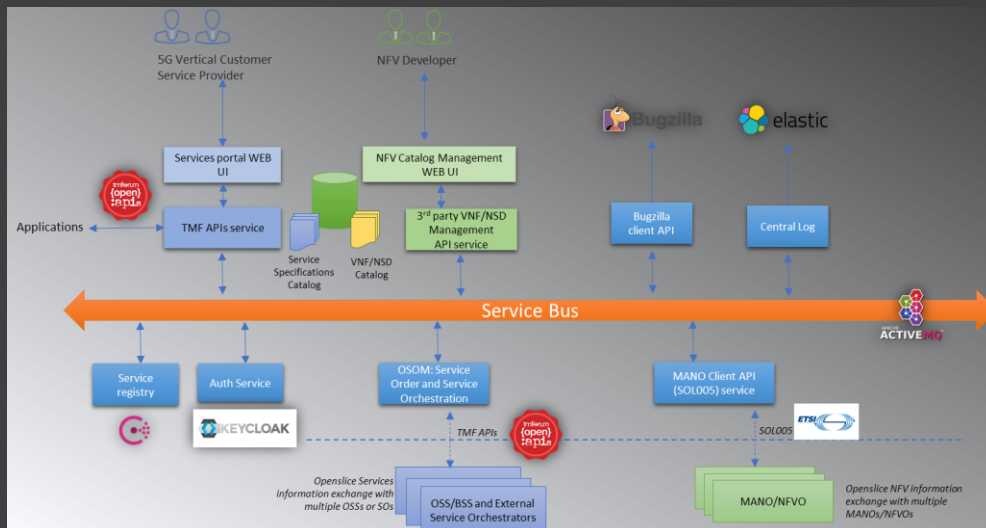
Openslice Open API access

- Supported TMF OpenAPIs for programmatic access by Vertical Application
- 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>

Service Catalog Management

TMF API Reference: TMF633 - Service Catalog Management ### Release : 18.5 - December 2018 Service Catalog API is one of Catalog Management API Family. Service Catalog API goal is to provide a catalog of services. ### Resource - serviceCatalog ### Operations Service Catalog API performs the following operations on the resource : - Retrieve an entity or a collection of entities depending on filter criteria - Partial update of an entity (including updating rules) - Create an entity (including default values and creation rules) - Delete an entity (for administration purposes) - Manage notification of events

export-job-api-controller-633	the exportjob API	>
hub-api-controller	the hub API	>
import-job-api-controller	the importjob API	>
listener-api-controller	the listener API	>
service-candidate-api-controller	the serviceCandidate API	>
service-catalog-api-controller	the serviceCatalog API	>
service-category-api-controller	the serviceCategory API	>
service-specification-api-controller	the serviceSpecification API	>
exportjob		>
events subscription		>
exportjob		>
notification listeners (client side)		>
serviceCatalog	list or find ServiceCatalog objects	>

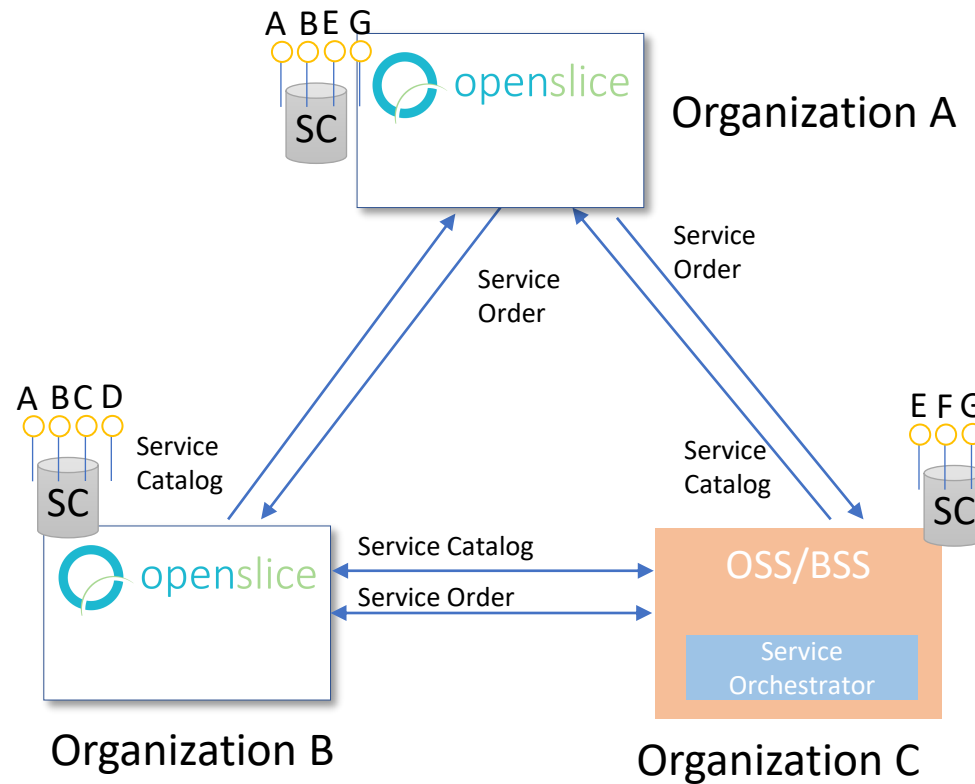


TMF API Reference: TMF 641 - Service Ordering Management ## Release : 18.5 - Dec 2018 The Service Order API is a standardized mechanism for managing Service Order, a type of order which can be used to place an order between a customer and a service provider or between a service provider and a partner and vice versa. ## Service Order resource A service order will describe a list of service order items. A service order item references an action on an existing or future service. By service we designed Customer Facing Service (CFS) as well as Resource Facing Service (RFS). From a component perspective, a service order should be available - from a Service Orchestration Component (and it could mix CFS and RFS) - from an Infrastructure Control & Management component (and it would have only RFS) ## Service Order API performs the following operations on service order : - Retrieval of a service order or a collection of service orders depending on filter criteria - Partial update of a service order (including updating rules) - Creation of a service order (including default values and creation rules) - Deletion of service order (for administration purposes) - Notification of events on Service order Copyright © TM Forum 2018. All Rights Reserved

hub-api-controller	the hub API	>
listener-api-controller	the listener API	>
service-order-api-controller	the serviceOrder API	>
events subscription		>
notification listeners (client side)		>
serviceOrder		>
GET	/serviceOrder/log/v4/serviceOrder - list or find ServiceOrder objects	>
POST	/serviceOrder/log/v4/serviceOrder - Create a ServiceOrder	>
GET	/serviceOrder/log/v4/serviceOrder/{id} - Retrieve a ServiceOrder by ID	>
DELETE	/serviceOrder/log/v4/serviceOrder/{id} - Delete a ServiceOrder	>
PATCH	/serviceOrder/log/v4/serviceOrder/{id} - Update partially a ServiceOrder	>

Multidomain scenarios and federation

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



Service Specification Designer

Edit Design of *URArmy* Service Specification (*CustomerFacingServiceSpecification*)

Last updated at 1/16/20, 7:00 PM

Main Service Specification properties

Name	URArmy	Version	0.1.0	<input checked="" type="checkbox"/> Bundle
Description	VINNI-SB template example			
Lifecycle Status	In Study			
Valid From	16/01/2020, 17:39	Valid Until	16/01/2040, 17:39	

☒ Submit

Service Specification Relationships

Apply Filter to related Service Specifications...

☒ Assign

- URArmy-VINNI-SB Service Monitoring
- cirros_2vmf_ns
- URArmy-VINNI-SB Service Exposure Level 2
- URArmy-VINNI-SB Service Testing
- URArmy-VINNI-SB Service Requirements
- URArmy-VINNI-SB Service Exposure Level 1
- URArmy-Service Topology

Resource Specification Relationships

There are no resource specification relationships assigned

Service Specification Characteristics

Apply Filter...

Create New Characteristic

All Performance Functionality Network Optimisation Exposure Level

Name	Value Type	Default Values	Configurable	Actions
5G-VINNI Service Type	SET	1 (4-100)	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Exposure Level 1:Exposure Level	SET	1 (Level 1)	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Exposure Level 2:Exposure Level	SET	2 (Level 2)	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Monitoring:On-demand monitoring support	BINARY	1 (Yes)	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:5G Quality of Service (QoS) DL Packet loss rate	FLOAT	1%	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:5G Quality of Service (QoS) DL Packet size	INTEGER	8 Bytes	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:5G Quality of Service (QoS) E2E latency	INTEGER	10 ms	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:5G Quality of Service (QoS) Jitter	INTEGER	10 ms	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:5G Quality of Service (QoS) One-way latency	INTEGER	10 ms	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:5G Quality of Service (QoS) UL Packet loss rate	FLOAT	1%	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:5G Quality of Service (QoS) UL Packet size	INTEGER	8 Bytes	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
URArmy-VINNI-SB Service Requirements:Access technology	ENUM	1 (NR)	false	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>



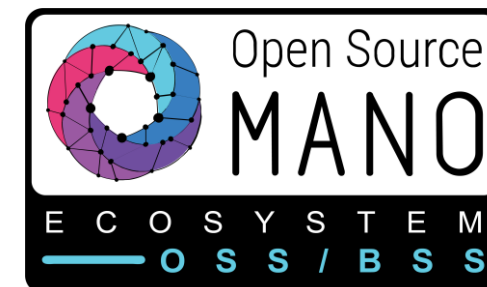
Openslice is a prototype open source, operations support system. It supports VNF/NSD onboarding to OpenSourceMANO (OSM) and NSD deployment management. It also supports TMFORUM OpenAPIs regarding Service Catalog Management, Ordering, Resource, etc.

Microservices based architecture

<http://openslice.io>

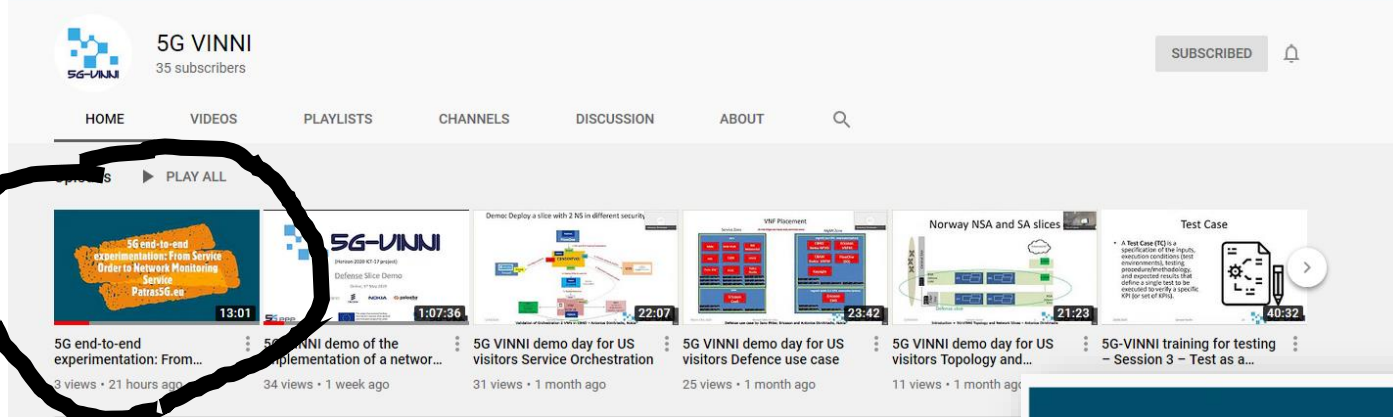
Demo

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





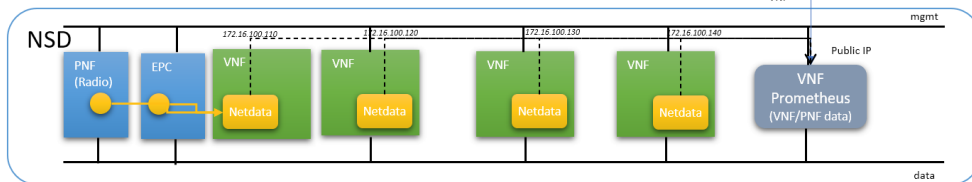
Use case examples
Test case training sessions



Monitoring Example with 5G NR - NSA

Access VNF mgmt or
data plane via
netdata/NSD
prometheus of each
VNF

5G Vertical Customer
Service Provider



<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)



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





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

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.