



5G Slicing and Management in the TM Forum

TM Forum ZOOM Project Team
April 26, 2018

- **Learning from related Catalyst (Proof of Concept) Projects since 2016**
 - With SP deployment scenarios to inform the APIs and modelling development (see [supporting slides](#))
- **Intent Based Management**
 - Intent against OLA/SLA targets for each tenant instance is required for managing the volume and velocity of 5G services & resources
- **Closed Control Loop (CCL)**
 - Intent based management needs to support by layered orchestration and closed control loops (which does not imply multiple orchestrator implementations)
- **Hybrid Infrastructure Management**
 - PNF and VNF operations use platform based approach with CCL and policy mgmt.

5G Essentials: Separation of Concerns

- **Horizontal Management Operations:**

Intent based management and cloud native implementation (IaaS PaaS and SaaS) moves operations towards horizontal management of

- Service, Resource, Infrastructure /VIM Functions - linked by intent based abstraction using exposed service APIs and agreed SLAs for individual tenants.
- 5G Domains – Access/ Backhaul/ Core network 5G ‘Sub Slices’ all modelled using intent based management to support multiple and changing 5G business models i.e. no static relationships between domains but defined exposed services
- Intent-based approach allows for easier migration among generations of radio technologies and also support non-radio transport, i.e., the technology-specifics are not embedded in the exposed Service API .

- **For agility, change management and model driven approaches:**

Platforms like ONAP should explicitly separate / decouple individual actors’ needs:

- The Service View exposed at NBI ExtAPI (Service User actor)
- The virtualization and onboarding of Software Assets including NFV (Operational Management actors e.g. SDC)
- Management of policies including Security (Enterprise management actors e.g. SDC)
- Example anti patterns:
Exposing deployment flavors in the NBI ExtAPI Service views – couples implementation to the exposed Service definition making onward change management challenging

- **Open APIs need to support change by rendering payload dynamically from catalog /repository**

- 5G slicing needs flexibility to support new features without re-coding API
- Early APIs statically bind Payload /DM to API implementation requiring re-coding rather than configuration to accommodate change

- **TOSCA metadata needs to support full commercial and operational onboarding** (e.g., testing, metrics, licensing) , **not solely instantiation of Software Images** i.e. multiple actors in a lifecycle from supplier to deployed images.

- Affects structure and actor usage of ONAP TOSCA templates

5G Essentials: Slicing Model Considerations

- **Expose technology neutral connectivity models for e2e Service (CFS) and exposed Resource Services (RFS)**
 - Decouple exposed service from internal technical implementation (vendor and technology specific aspects)
 - Achieved by use of Connectivity Model using exposed (simple) service topology, flows and features
 - Allows hybrid 5G legacy for 5G slicing capabilities (decouples connectivity models from technology evolution)
 - TM Forum solution defined in TR 255 Connectivity Model (requirement and use case) covering:
 - Features constraints and topology models linked to GB 922 Logical Resource Models (Eases integration with Information framework based OSS /BSS e.g. SDC)
 - The connectivity model is also supported in an intent-based API.
 - Mapping /integration with detailed resource models and topology e.g. 5G (managed independently by Operational Management e.g. SDC recipes and templates)
- **End point modelling for aggregation and concatenation of subnetworks using different internal technologies (multi-SDO discussion)**

TM Forum Key Assets and Relevance to ONAP (1 of 2)

TM Forum Work Activities	Relevance to ONAP
Requirements/ Use Cases	
<u>IG1152 Dynamic Network Slices Management and Business Models R17.0.1</u>	<ul style="list-style-type: none"> • Network slice consists of multiple domains (i.e. Access/Backhaul/Core) • Network slice provided by multiple service providers through APIs • Definitions of actors for 5G e2e management • SDO alignment achieved with Use Case w/ NGMN E2e Arch. , Virtualization w/ ETSI-NFV, 3GPP 23.799
<u>TR229 ZOOM/NFV User Stories Suite R17.0.0</u> Part A section 4	<ul style="list-style-type: none"> • Defines actor for Slice Orchestration Policy and Governance • Network Slicing User Stories: Slice Orchestration in Multi-Service Provider with a single Slice Partner; Multi-Service Provider in B2B2C Model; Federated Orchestration
Catalyst	
<u>5G Intelligent Service Planning and Optimization</u>	<ul style="list-style-type: none"> • Specifically looked at opportunities for integration with VES, DCAE, to achieve E2E Service Assurance
5G Intelligent Service Operations (WIP)	<ul style="list-style-type: none"> • Using ONAP Policy Manager to control Service Orchestration run time behavior
Blade Runner (WIP)	<ul style="list-style-type: none"> • 5G enabled AR scenario • Service Assurance/SLA flow through ONAP modules: SDC, SO, SDNC, AAI, External API and VID • TOSCA template for service assurance across CFS and RFS layers

TM Forum Key Assets and Relevance to ONAP (2 of 2)

TM Forum Work Activities	Relevance to ONAP
<p>Intent Based Management</p> <ul style="list-style-type: none">• IG1128 Dynamic Control Architecture for Managing a Virtualized Eco-System R16.0.1• IG1139 Business Rationale and Technical Overview for Orchestration and Autonomic Control Loops R16.0.1• TR262 Management Platform Blueprint and Application to Hybrid Infrastructure R17.5.1• IG1161 Overview: Agile Intent-based Resource Management in Hybrid Environments R17.5.1	<ul style="list-style-type: none">• ONAP 5G architecture, SO, Closed control loop, Separation of management concerns amongst different actors
<p>Modeling</p> <ul style="list-style-type: none">• TR255 Connectivity Patterns for Virtualization Management R17.5.1• GB922 Logical and Compound Resource Computing and Software R17.5.1 supports digital services, multi-tenancy offerings and virtualization/cloudification by the introduction of the Resource Function concept.• TR275 Core Networking Resources Business Entities R17.5.1 Proposal on federation of parts of the TM Forum Information Framework R17.5 and ONF CIM v1.3 Describes federation between the two models and specific interconnections. This allows Information framework to incorporate transport network models .	<ul style="list-style-type: none">• SDC, Intent based Modelling of run time configurable and programmable network slicing.• Provides connectivity model with features to abstract /hide internal network detail needs for intent based management..

Next Steps

- Identify key areas where ONAP can leverage 5G modeling and API experiences from the TM Forum
 - Coordinate deeper dive discussions

- Identify & prioritize concrete joint Casablanca deliverables
 - May require multi-SDO coordination

Supporting Materials

IG1152 Dynamic Network Slices Management and Business Models

- ❑ This TM Forum 5G slice approach is **Business Scenario and User Story/Use Case-driven** with the objective to derive **Top 13 slice requirements** to pave the way for identifying and demonstrating the value creation for the players interacting in the 5G ecosystem
- ❑ Targeting relevant technical drivers and overcoming main challenges are key **to drive the standardization phases and Products & Solutions maturity** and sustainability
- ❑ **Operational 5G System** (or Network Slice Platform) as a playground is major piece to be built by the Catalyst partners to assess identified Technical and Business scenarios
- ❑ **The Catalyst cover a small scope and small size** then grows as 5G standard matures
- ❑ 3GPP Architecture options considered: **Standalone (SA) and Non-Standalone (NSA)**
- ❑ Business scenarios are limited to only two use cases with extreme requirements (**eMBB and URLCC**). **The 5G Catalysts cover (URLCC, eMBB, m IoT, V2X)**
- ❑ Network Slices for those 2 selected use cases could be supported under 2 Deployment Scenarios
 - ❑ **A single Slice Provider model** where E2E Network Slice spans the Slice Provider's 3 domains (Access, Backhaul, Core Network) under non-roaming model
 - ❑ **Multi-Slice Provider model** where E2E Network Slice spans Multi-Slice Provider according to governance, agreement and commercial arrangement among those partners (Roaming model could be an example)

Public Document

IG1152 Dynamic Network Slices Management and Business Models R17.0.1

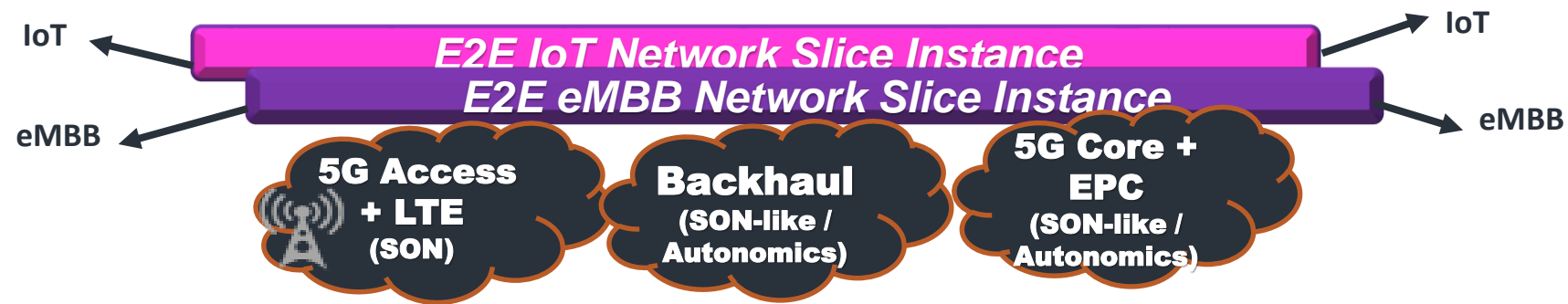
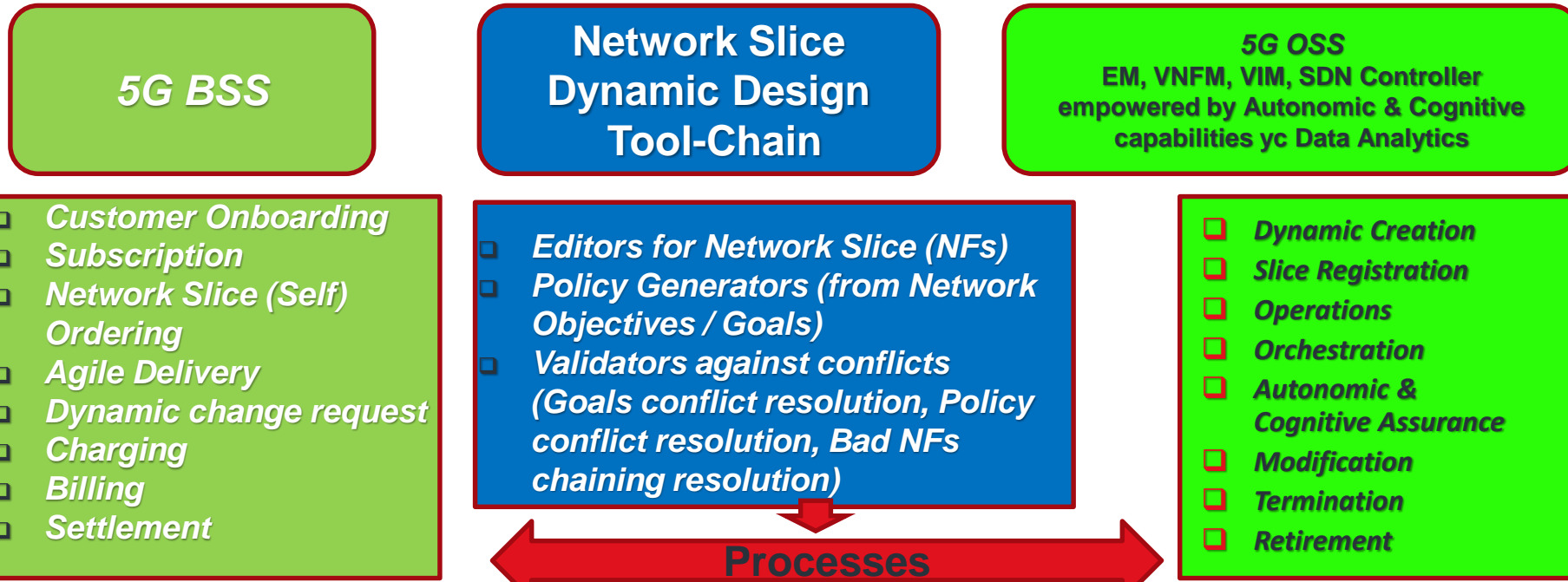
Key Contributors



E2E Network Life Cycle Management: Architecture and Processes (Holistic view: Customer & SP)

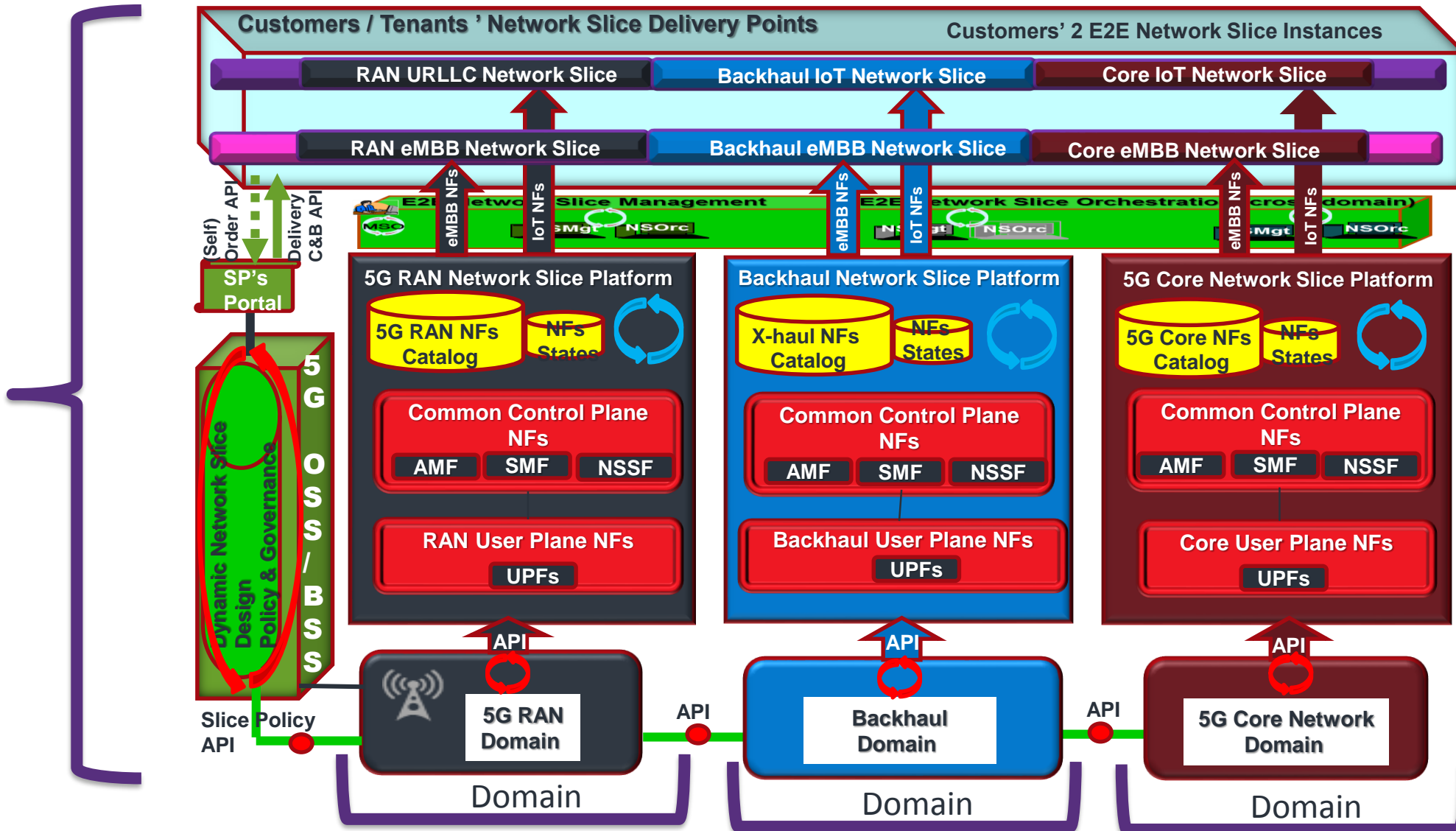
Customer's perspective

Slice Provider's perspective



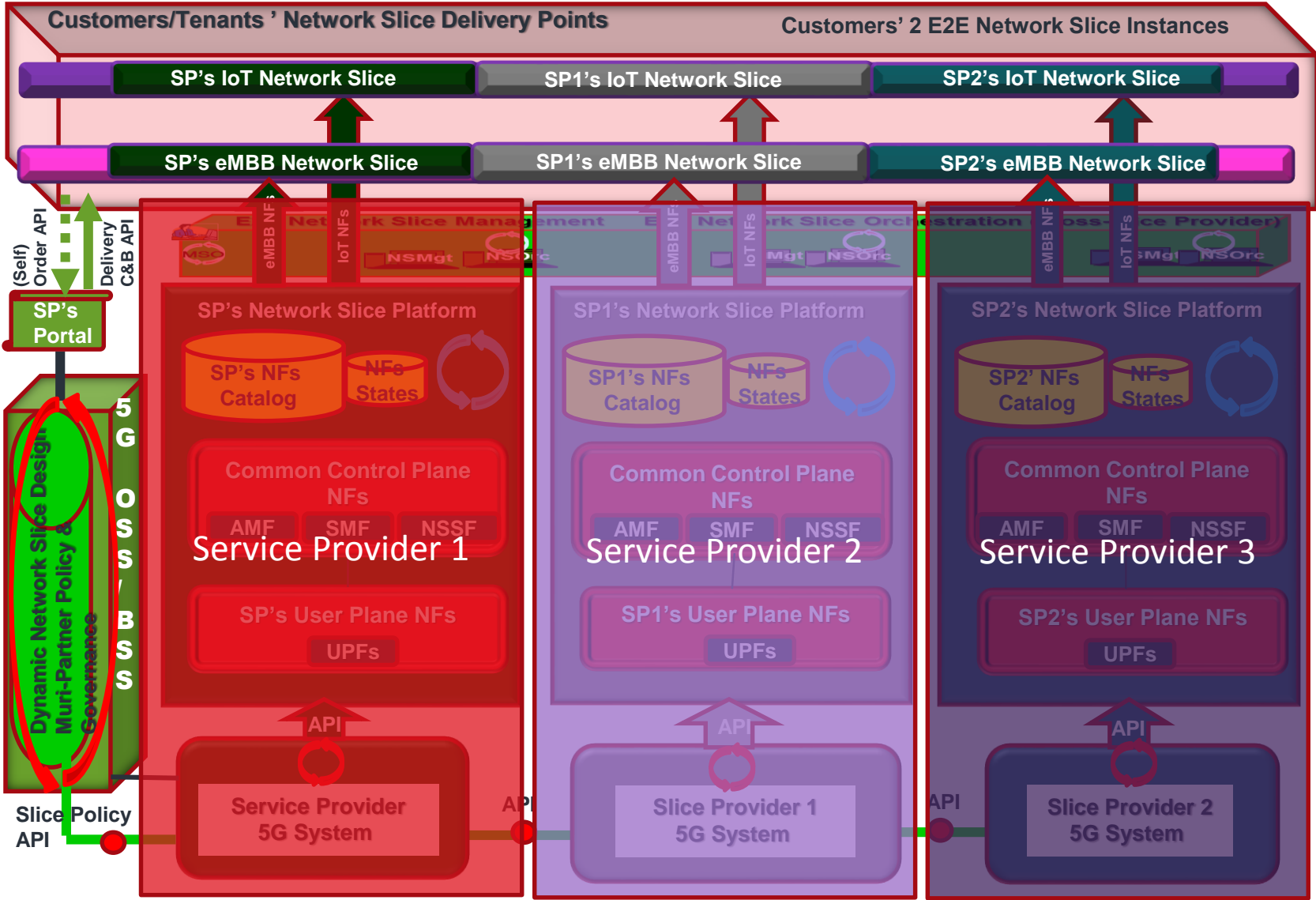
Network Slice Deployment Scenario 1: in Single Slice Provider (Multi-Domain model)

Single Provider



Network Slice Deployment Scenario: 2: in Multi-Slice Provider model

Multi - Provider



Network Slice structure options: Network Functions composing a Network Slice instance

- Network Slice is designed as composition of NFs at CP and UP according to 3GPP SA2 TR 23.79
 - Control Plane NFs
 - User Plane NFs
- Each of those Resources Capabilities (RFs) are stored in a catalog. We are using TM Forum terminology with those resource capabilities (RF: Resource Function)

Catalyst:

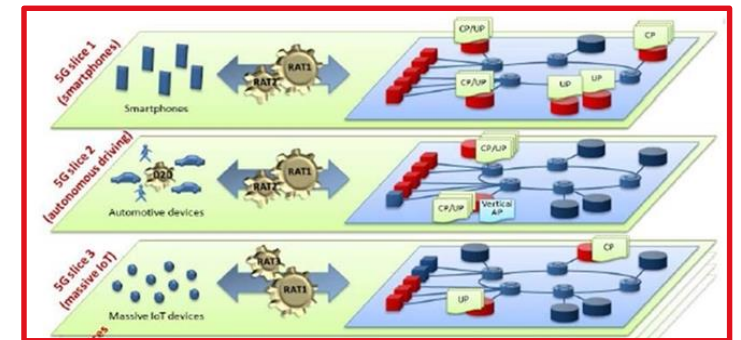
5G Service Operations – Real Time Service Assurance

■ 5G Service Management and Orchestration

- Many POCs and research on 5G radio aspects but very little on operations and management.
- No clear agreement on what needs to be managed or how the management should be organised
- Expectation of radical change in how 5G operations is organised and the OSS IT systems to support them
- Impact of 5G on service orchestration for slices not fully explored
- Create, manage and automate end-to-end service-specific network slices that cross legacy, SDN, mobile and fixed networks
- SDN/NFV operations platforms need enhancement to deliver new services
- Full automation from fulfilment to assurance processes to support billions of IoT connections

■ New 5G services

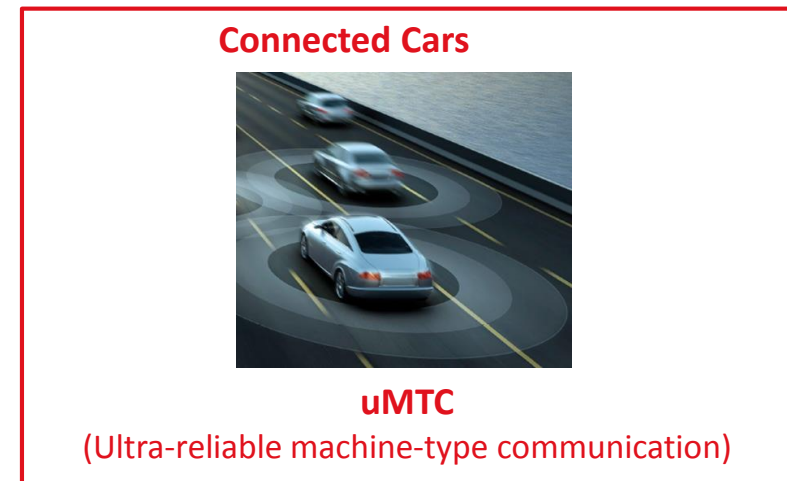
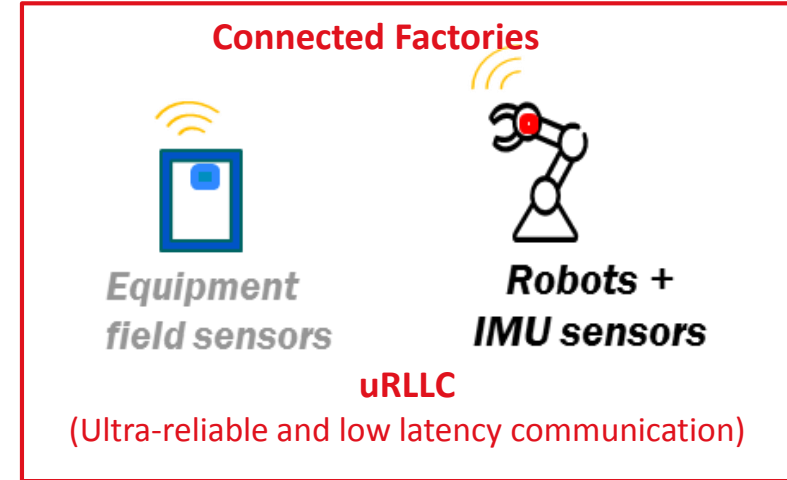
- Assigning specific network characteristics for each type of service across the network.
- Defining services with specific attributes such as latency, bandwidth etc by creation of network slices
- Assuring and guaranteeing service performance and SLAs per network slice

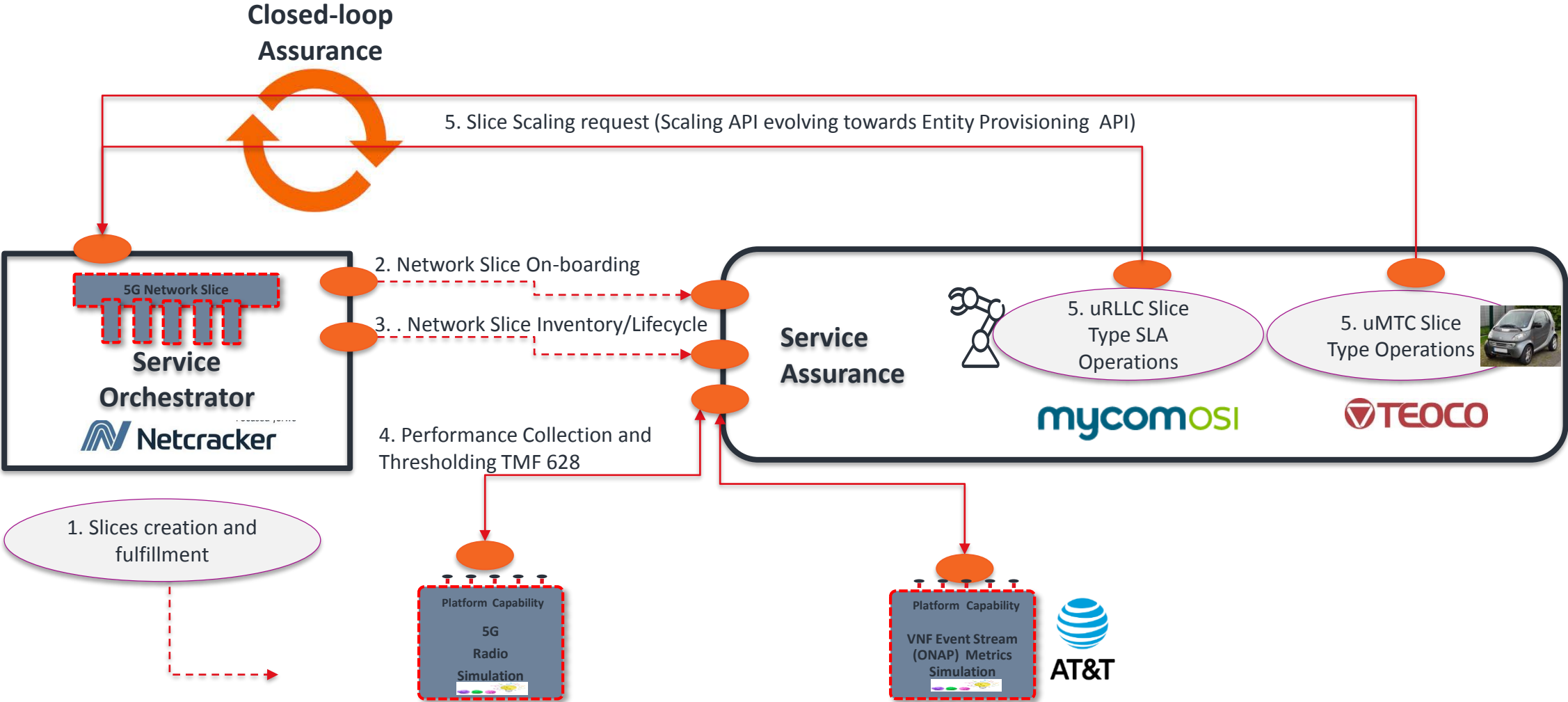


■ 5G Network Slicing

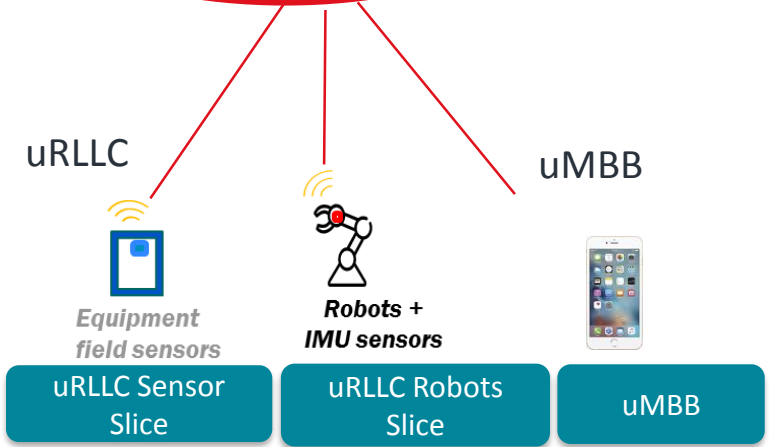
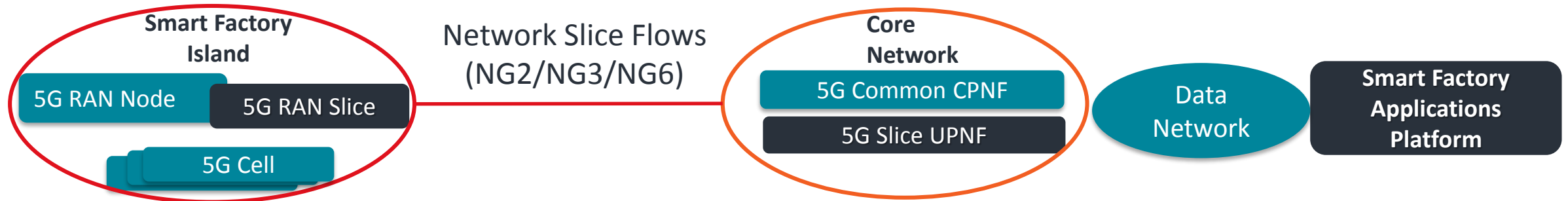
- Currently on a service class basis with services mapped into 3-4 network slices manually
- 5G based IoT services (with different attributes) need to be treated individually for better network utilization
- Tens of thousands of slices require the entire process to be automated

- Focus on two 5G based IoT use cases with the goal of:
 - Composing repeatable services for industry verticals in hours
 - Zero friction integration into OSS /BSS Operations Center of the Future
 - Dynamically and autonomously fulfilling and assuring numerous concurrent slice instances (in parallel) with total isolation and security to meet carrier-grade standards.
- Explore the impact of 5G networks and network slicing on operations in creating and automating many parallel end-to-end network slices that cross multiple network types to:
 - Explore technology readiness and close potential gaps in 5G operations
 - Enable CSP to automate the creation and modification of specific network slices for new IoT services with specific SLAs and characteristics
 - Leverage open source to address the needs of IoT and to accelerate innovation





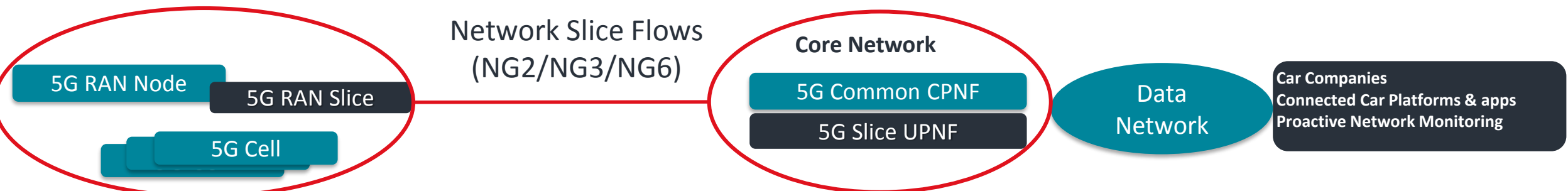
Connected Factory – uRLLC slice operations



	uRLLC-Slice-Sensors	uRLLC-Slice-RobotCams	uMBB-Slice
Latency	<10ms	SLA <10ms	SLA <50ms
DataRate-uplink per Device	200 Kbps CBR per Device	50 Mbps CBR per Device	5 Mbps VBR
DataRate-downlink per Device	100 Kbps CBR per Device	200 Kbps CBR per Device	5 Mbps VBR per Device
Reliability	< 0.3%	< 0.3%	< 1%

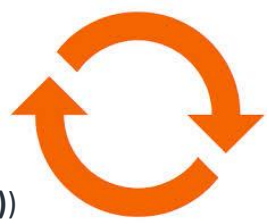


Connected Car- uMTC slice operations



	uMTC for V2x communications	mBB-Slice
Latency (ms)	SLA < 10ms	SLA < 50ms
Availability (%)	SLA > 99%	> 95%
Reliability (%)	SLA > 99.99%	> 98%
Slice Utilization (%)	< 75%	< 85%
User Experienced Data Rate (UL/DL) (Mbps)	DL > 5 UL > 1	DL > 30 UL > 5

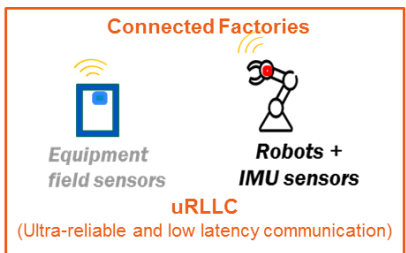
Dynamic Scaling
(vnfcScalingMetric,
Slice allocated bandwidth (MHz))



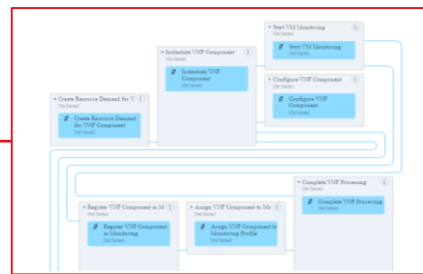
Proactive Alarming, Correlation
Closed Loop Automation

- Devised an efficient system to **operationalize 5G slices** using:
 - Closed loop assurance
 - Policy-based automation
 - Domain/service Orchestration
- Tested the system for **dynamic and autonomous Fulfillment and Assurance** for concurrent 5G Slices
- Gained clarity on **QoS requirements for 5G** service categories: uRLLC and uMTC
- Established the **role of APIs** in the 5G ecosystem: how to leverage open source to address the needs of IoT
- Demonstrated how 5G ecosystem integration can be carried out through **TM Forum concepts and API operations** in:
 - TM 628 Performance Management API,
 - TR 255 Entity Provisioning API, (aka Resources Function Configuration and Activation API)
 - Service Assurance using intent based SLA/OLA approach
- Validated the **ZOOM TR 262** Hybrid Infrastructure Platform principles and requirements

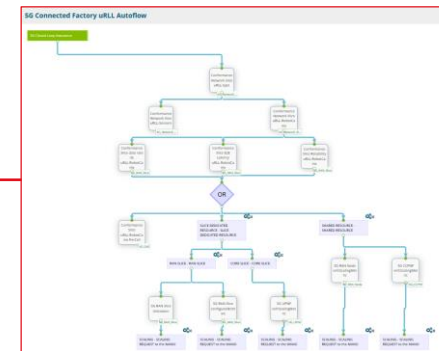
5G Connected Factory uRLLC Use Case



Resource (re)allocation

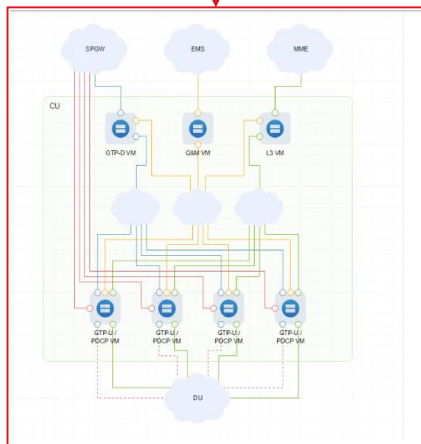


Scaling request

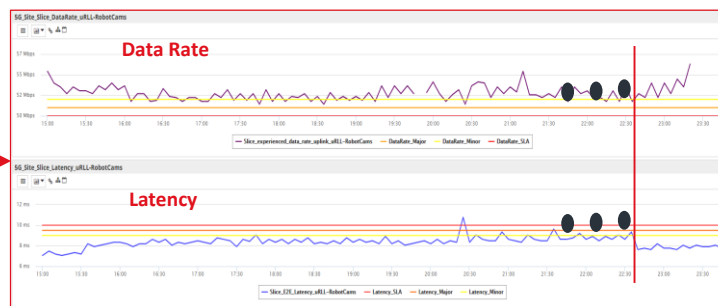


uRLLC slice type Assurance Policy-based automation (Demand and Congestion)

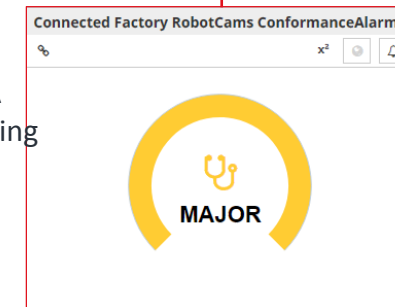
uRLLC slice-type on-boarding / instantiation



uRLLC slice type Assurance On-boarding

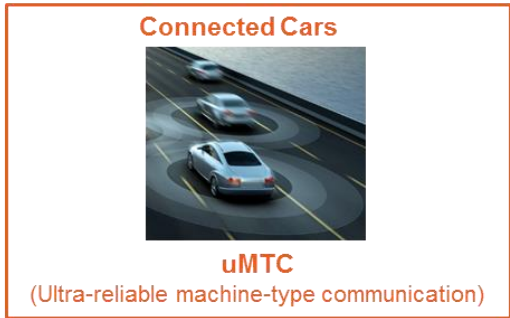


uRLLC Slice type SLA Conformance Alarming



uRLLC slice type Assurance SLA proactive monitoring

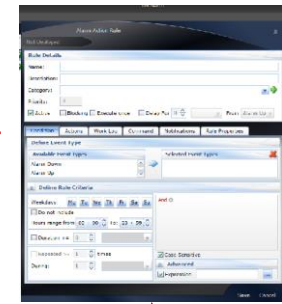
5G Connected Cars uMTC Use Case



uMTC slice type
Orchestration
tasks

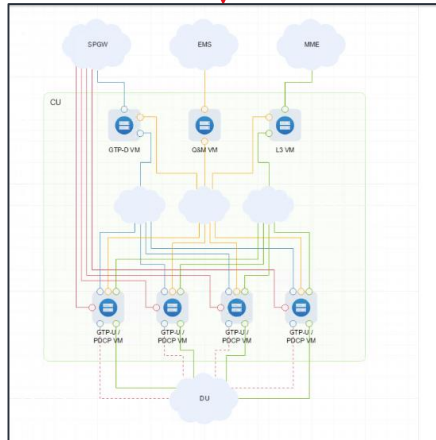


Scaling request



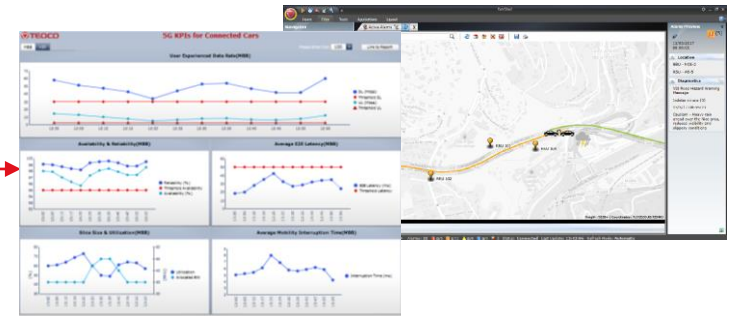
Rule-based Automated
activation of scale-out
and scale-in commands
per monitored slice(s)

uMTC slice type On-
boarding /
Instantiation

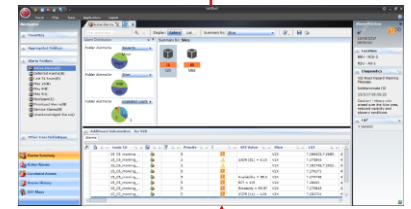


Application of smart
thresholds and
correlation to
proactively monitor SLA
conformance

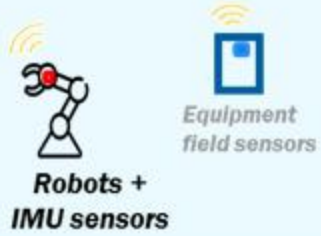
uMTC slice type Assurance
On-boarding



uMTC (V2X)
Integrated monitoring of contextual
car data



Consumer Scenario



SmartDevices - uRLL



Vehicle monitoring and Assistance - MMTC



Operations Scenario

uRLL Ops



mycomOSI



Resource Utilisation Ops



Netcracker

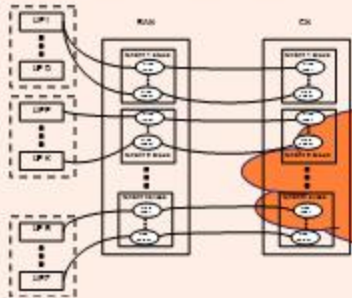


MMTC Ops



TEOCO

Network Scenario



RAN

Core Network

Data Network

Closed Control Loop



Closed Control Loop



Closed Control Loop

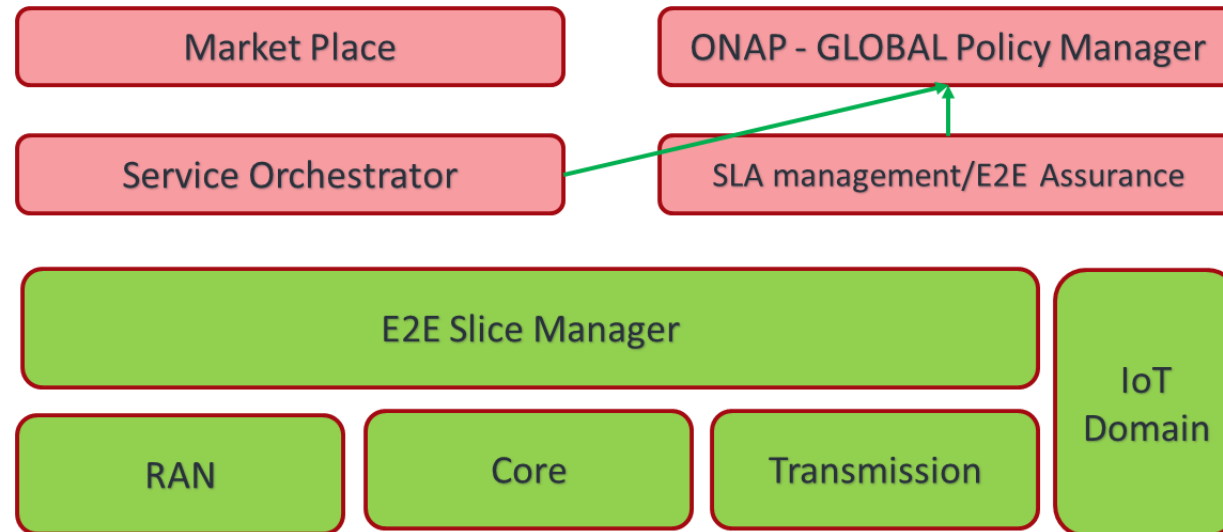
Applications



5G Intelligent Service Operations Catalyst – ONAP Policies

- The 5G Intelligent Service Operations is demonstrating the usage of ONAP Policy management integrated with external OSS/BSS systems as part of an operational closed-loop use case.

- Business-Service Orchestration policies
- Service-slice policies
- Centralized and distributed policy management



Key Contributors

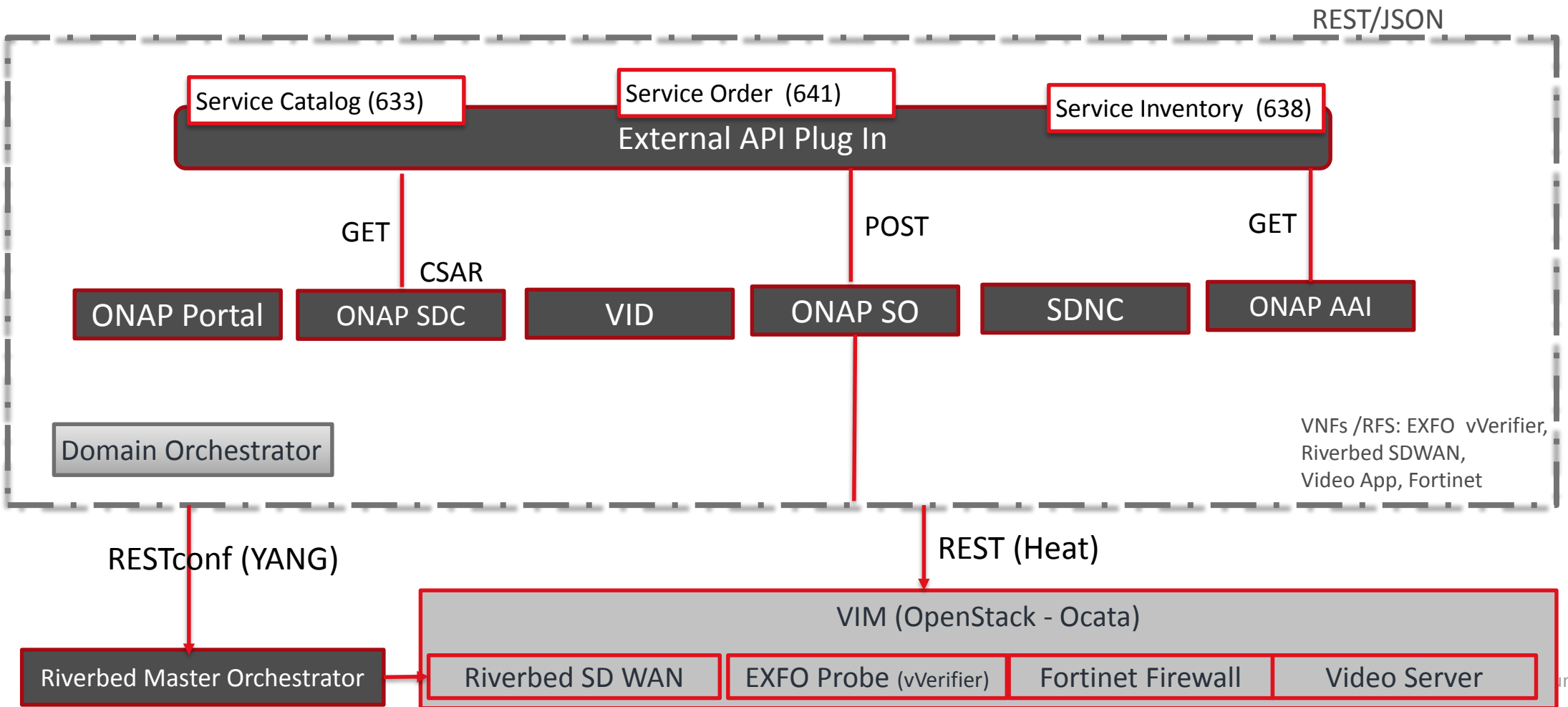


ONAP Solution for Blade Runner Catalyst

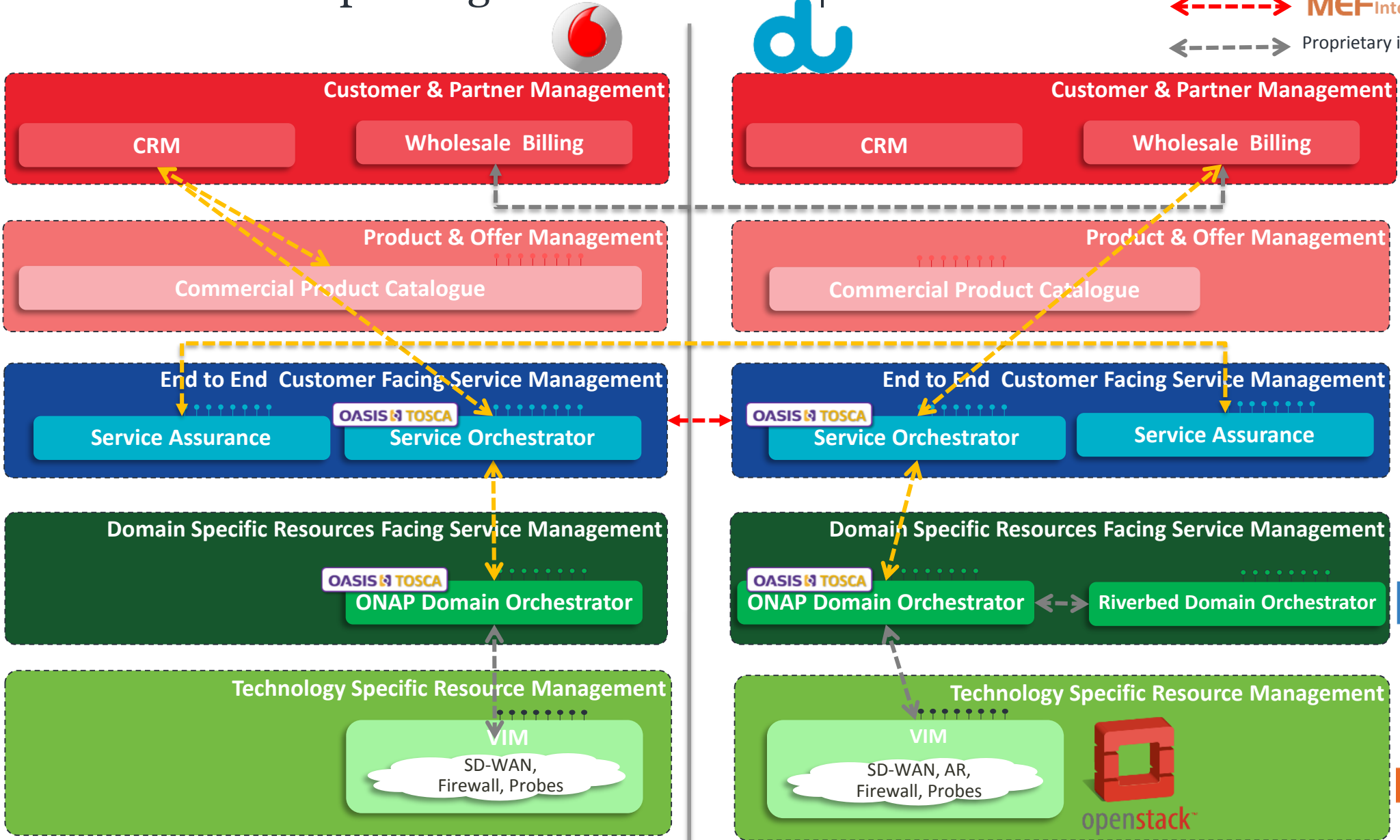
Blade Runner Catalyst – ONAP Solution Overview

- Onboarding VNFs on ONAP
- Instantiating VNFs on Openstack Via ONAP
- Scale out Network Service

RIFT.io Service Designer / Orchestrator/Inventory CFS: Internet Reference to RFS



Blade Runner: Open Digital Architecture | Partners View



Blade Runner: Systems Integration on a page

