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ETSI GANA in 5G Network Slicing PoC by ETSI NTECH AFI WG

5G Network Slices Creation, Autonomic & Cognitive Management & E2E Orchestration; with Closed-Loop (Autonomic) Service Assurance for the IoT (Smart Insurance) Use Case

Presenters: ***Tayeb Ben Meriem; Ranganai Chaparadza; Dominik Spitz; David Khemelevsky***

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The PoC's Demo-2 of a Series of Planned Demos:

C-SON Evolution for 5G, and Hybrid-SON Mappings to the ETSI GANA Model

Federation of GANA Knowledge Planes for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices

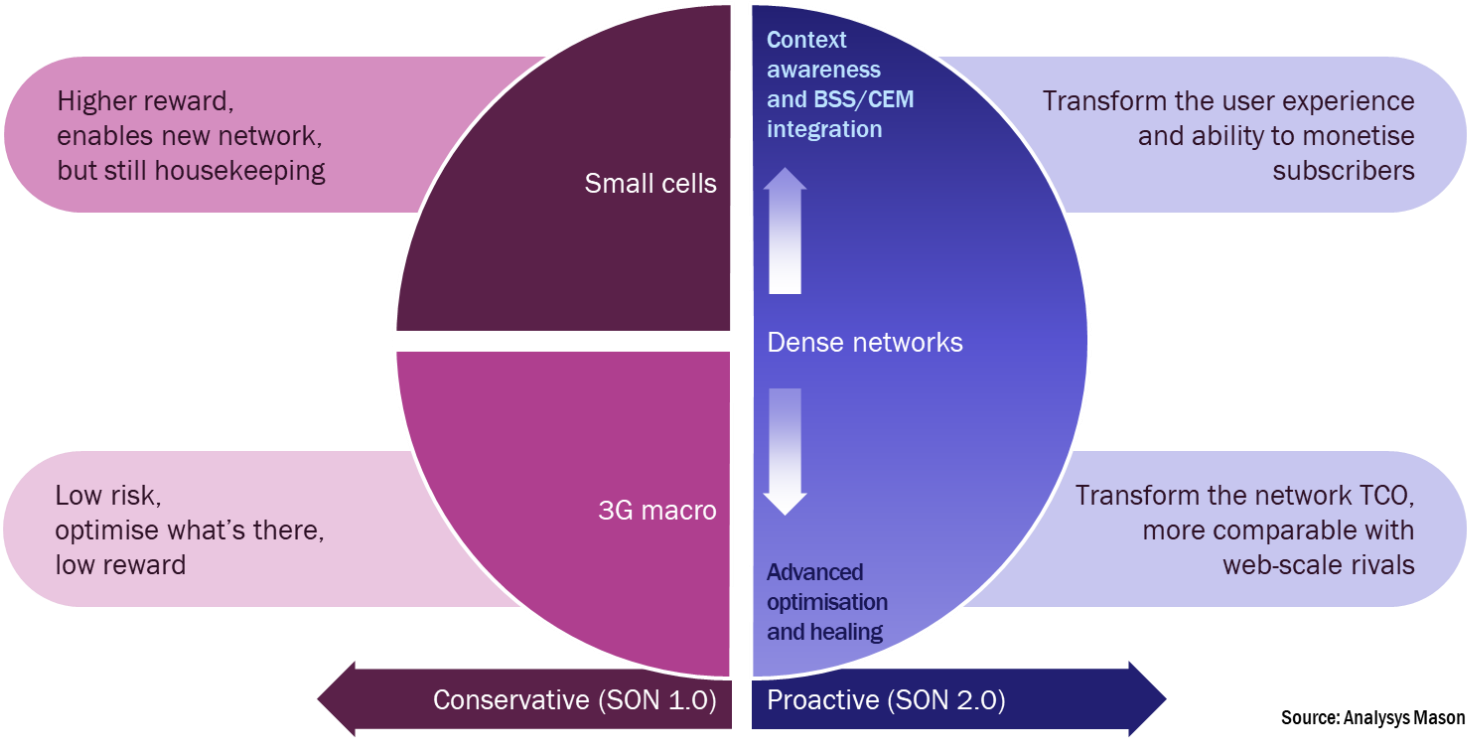
AGENDA Outlook

AGENDA Outlook for Demo-2 of the PoC

- Introduction to the ETSI AFI 5G GANA PoC
- Key Messages & Reflections
- ETSI GANA Model
- Hybrid-SON Mappings to the ETSI GANA Model
- Centralized SON as GANA Knowledge Plane (KP) for RAN – Cellwize Implementation

C-SON Evolution Towards 5G

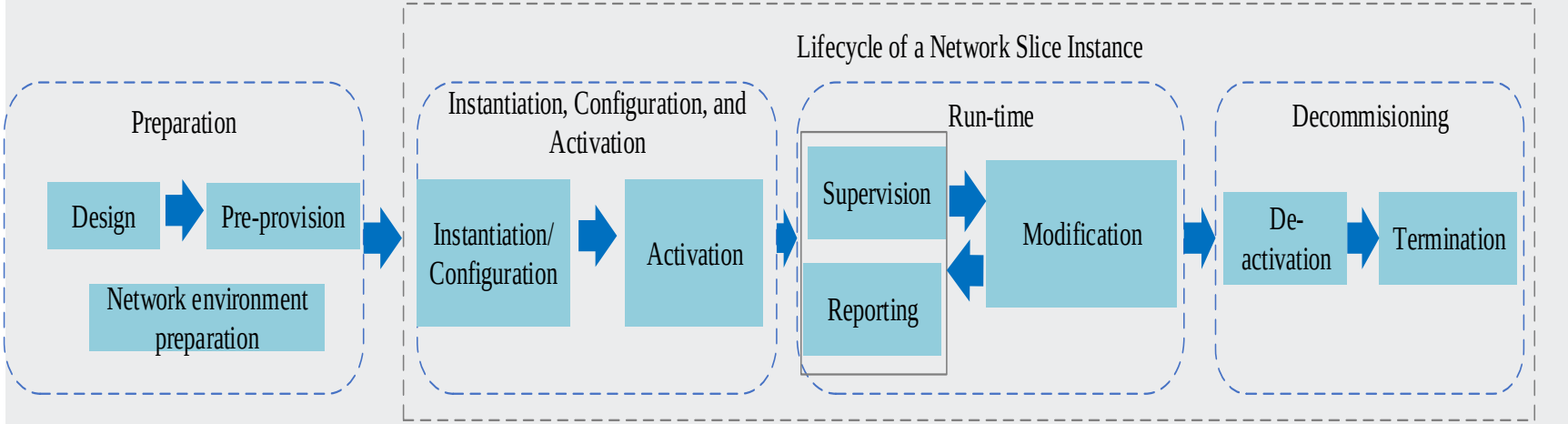
SON Evolution for 5G



Source: Analysys Mason

"…As operators embark on a migration to 4.5G and 5G, several key elements can only be fully achieved with advanced SON solutions. These include densification, co-ordinated use of large numbers of spectrum bands including unlicensed and cloud-RAN (C-RAN)."

Lifecycle of a Network Slice



3GPP Figure: Lifecycle phases of an NSI

- Creation and verification of network slice template
- Preparation of the necessary network environment that is used to support the lifecycle of NSIs
- Any other preparations that are needed in the network

- Configuration of all network slice instance (NSI) shared/dedicated resources
- Channel traffic to the NSI
- Provisioning of databases
- Instantiation, configuration and activation of shared and/or non-shared network functions

- In the run-time phase the NSI is capable of traffic handling to support communication services of certain types
- supervision/reporting (e.g. for KPI monitoring)
- NSI modification e.g. upgrade, reconfiguration, NSI scaling, changes of NSI capacity, changes of NSI topology, association and disassociation of network functions with NSI

- Deactivation (taking the NSI out of active duty)
- reclamation of dedicated resources (e.g. termination or re-use of network functions)
- configuration of shared, dependent resources
- After decommissioning the NSI does not exist anymore.

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Cellwize Service Assurance Coverage Map for 5G

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Mobility Assurance & MRO

Intra-/Inter-Band, Intra-/Inter-Slice, Inter-RAT, Inter-Beam, toWifi mobility service assurance and architecture harmonization: multi-vendor, multi-RAN (cRAN, vRAN, femto, macro, indoor...) .
Adaption of mobility behavior to specific QoS requirements and business objectives (MRO).

Load Balancing & Traffic Steering

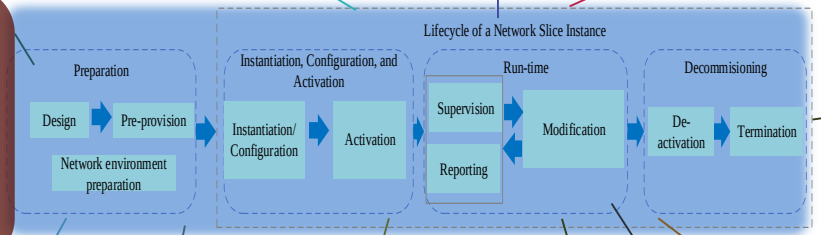
Dynamic and proactive load balancing across physical resources like e.g. site, cell, antenna… and/or logical resources such as new radio (NR), frequency bands, slice, sub-slice, Inter-Slice resource allocation. Policy governed Inter-RAT, to WiFi traffic steering.

Slice Resource Optimization

On demand triggered slice resource allocation and/or Self-Configuration of a new Network Sub-Slice Instance. i.e load balancing, SLA breach, upgrade, resource allocation and related.

Unified NSI Policy

Centralized policy orchestrator with the ability to unify various network and slice configuration policies and rules, such as e.g. business objectives (SLA), governance regulations, external constraints, etc.



Service Retainability Assurance

Monitoring and optimization of service retainability through the orchestration of managed NR resources (logical and physical).

0-Touch NR Rollout

Full autonomous and rapid 0-Touch NR node integration. Demand triggered and scheduled for scalable massive Network rollout.

Dual Connectivity

Simultaneous service connection through multi-RAT connectivity (e.g. New Radio and LTE, -WiFi) orchestration and management.

Self Healing

Automatic fault detection and service recovery, self-repairing of configuration, fault reporting.

Service Coverage Assurance

Coverage and interference target optimization of physical and logical, shared and dedicated resources, such as remote electrical tilt, 3D-beamforming, remote azimuth (SONAR), etc. Shared resources are optimized with individual service prioritization.

Carrier Aggregation

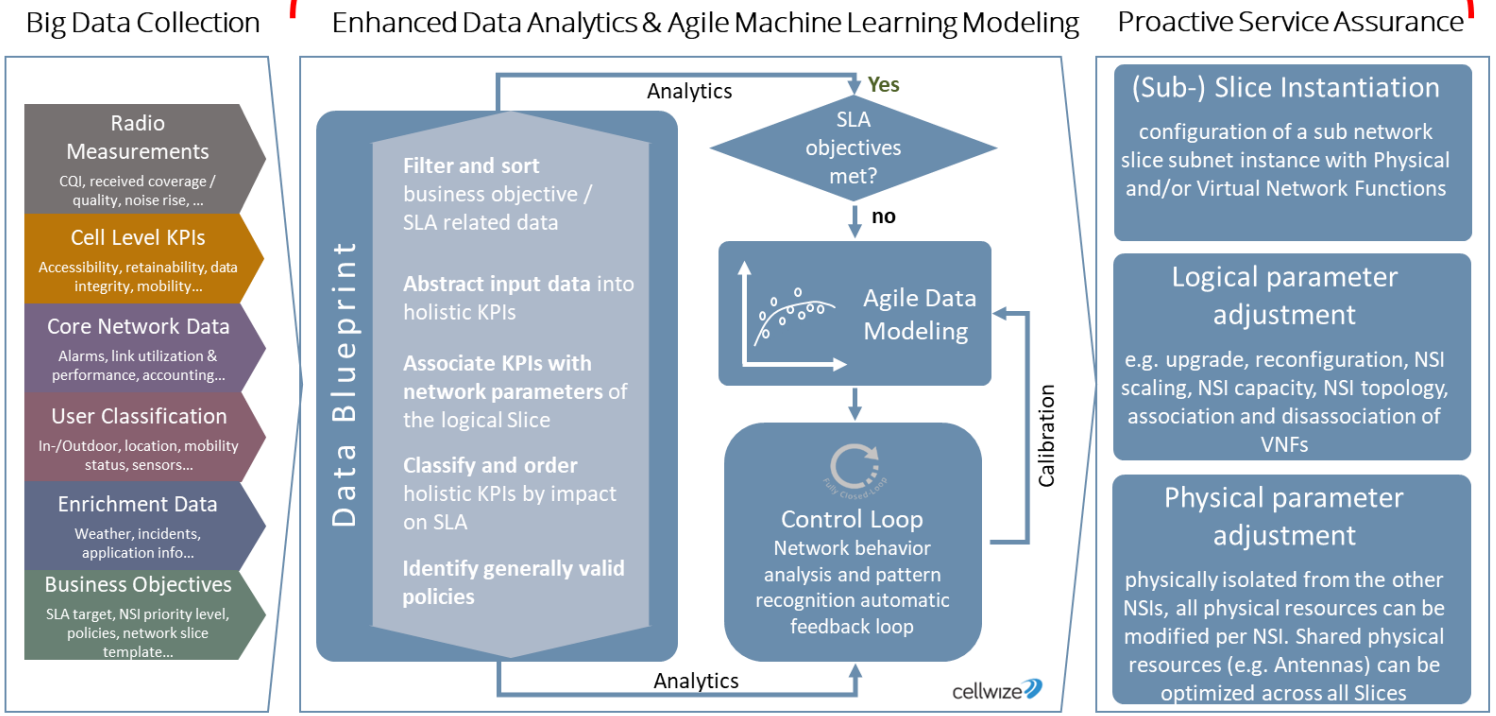
Dynamic on-demand orchestration, management and optimization of Carrier Aggregation.

Massive MIMO Optimization

Coverage and spectral efficiency optimization of Large-Scale Antenna Systems, Very Large MIMO, Hyper MIMO, Full-Dimension MIMO and ARGOS

Cellwize 5G RAN Service Assurance Workflow for C-SON (GANA KP for RAN)

Federated GANA Knowledge Planes (KPs) for RAN, X-Haul and Core Nets)



Remark: There is More on Data Sources for the KPs and KP Interfaces with OSS, EMs/NMs, Orchestrators, SDN, ..

NSI - Network Slice Instance KPI – Key Performance Indicator SLA – Service Level Agreement VNF – Virtual Network Function

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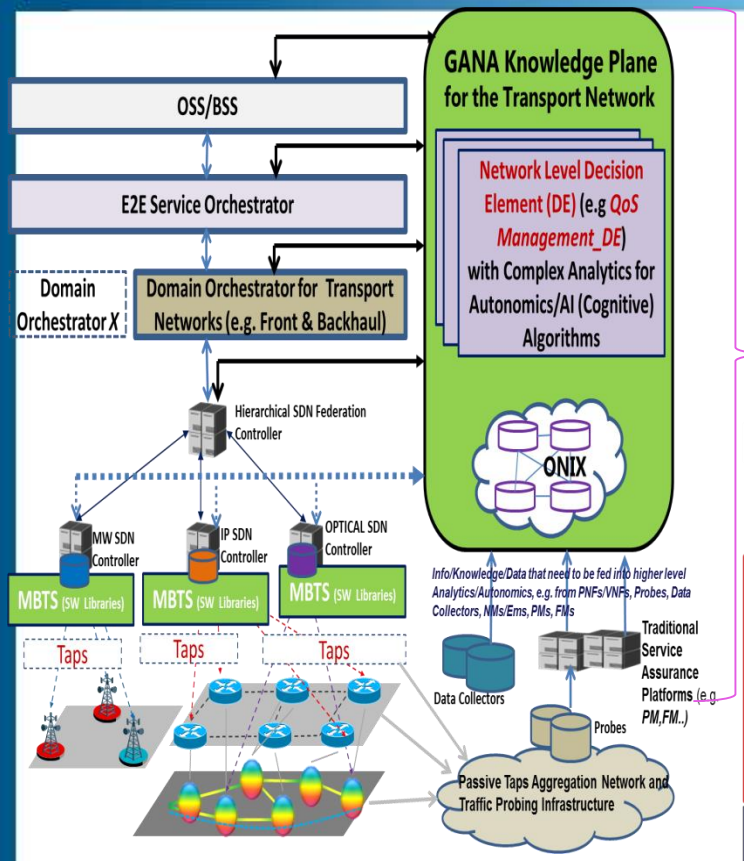
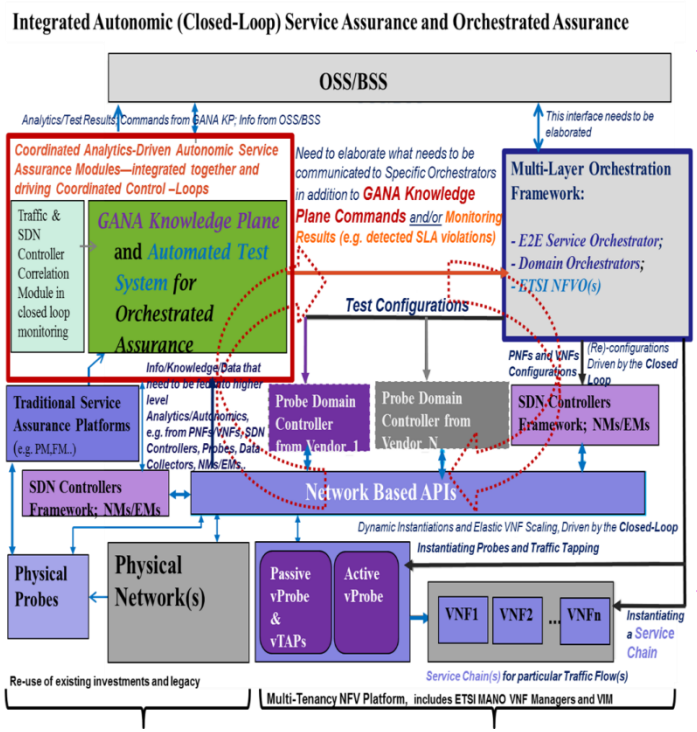
More on Data Sources for the KPs and KP Interfaces with OSS, EMs/NMs, Orchestrators, SDN, ..



More Insights on Data Sources for GANA Knowledge Planes and Interfaces



Big Data Collection

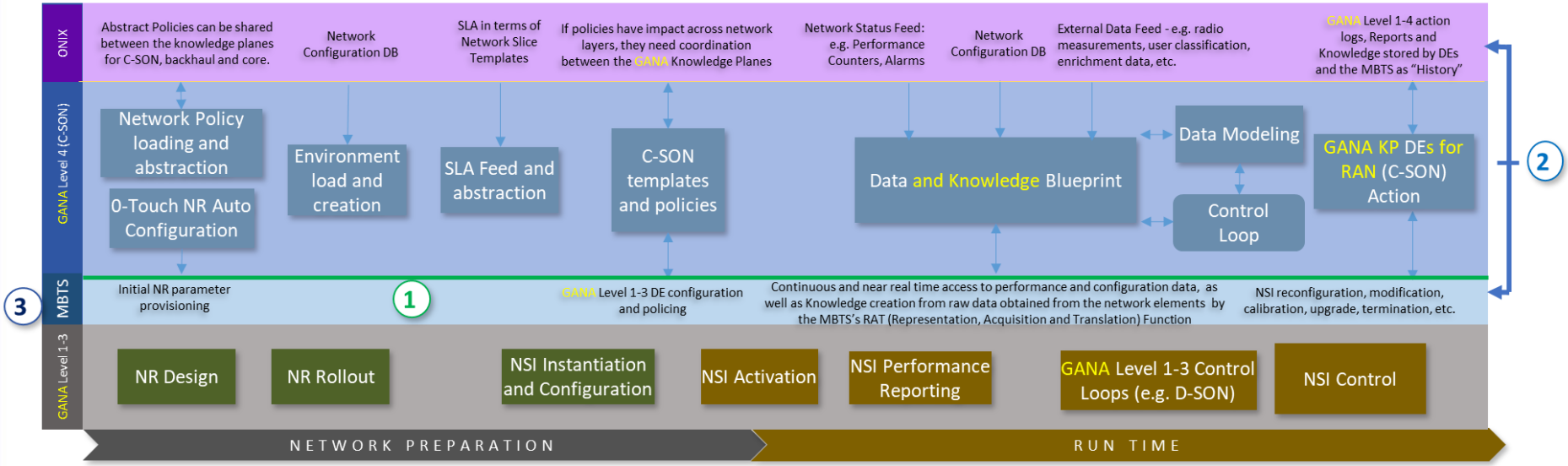
- **Radio Measurements**
  CQI, received coverage / quality, noise rise, ...
- **Cell Level KPIs**
  Accessibility, retainability, data integrity, mobility...
- **Core Network Data**
  Alarms, link utilization & performance, accounting...
- **User Classification**
  In-/Outdoor, location, mobility status, sensors...
- **Enrichment Data**
  Weather, incidents, application info...
- **Business Objectives**
  SLA target, NSI priority level, policies, network slice template...

More Insights on Data Sources for GANA Knowledge Planes and Interfaces

Cellwize Provisioning GW as an Implementation case for the ETSI GANA MBTS (Model-Based Translation Service) Functional Component

5G RAN Service Assurance Blueprint

Cellwize 5G RAN Service Assurance Blueprint



Remarks:

(1) MBTS Interface with DEs must be a strong interface for continuous real time status and configuration knowledge streaming from the MBTS to DEs and immediate implementation of slice modification/upgrade actions issued by DEs towards NEs.

(2) The MBTS provides knowledge from network raw data for ONIX, while streaming it to the DEs in real-time. MBTS may also pull Data/Info of interest from ONIX (e.g. configuration data available through ONIX)

(3) The Cellwize provisioning gateway represents an implementation of the **GANA MBTS** for the RAN that can be opened for other Knowledge Plane service providers

Cellwize Provisioning GW Mapping to GANA MBTS

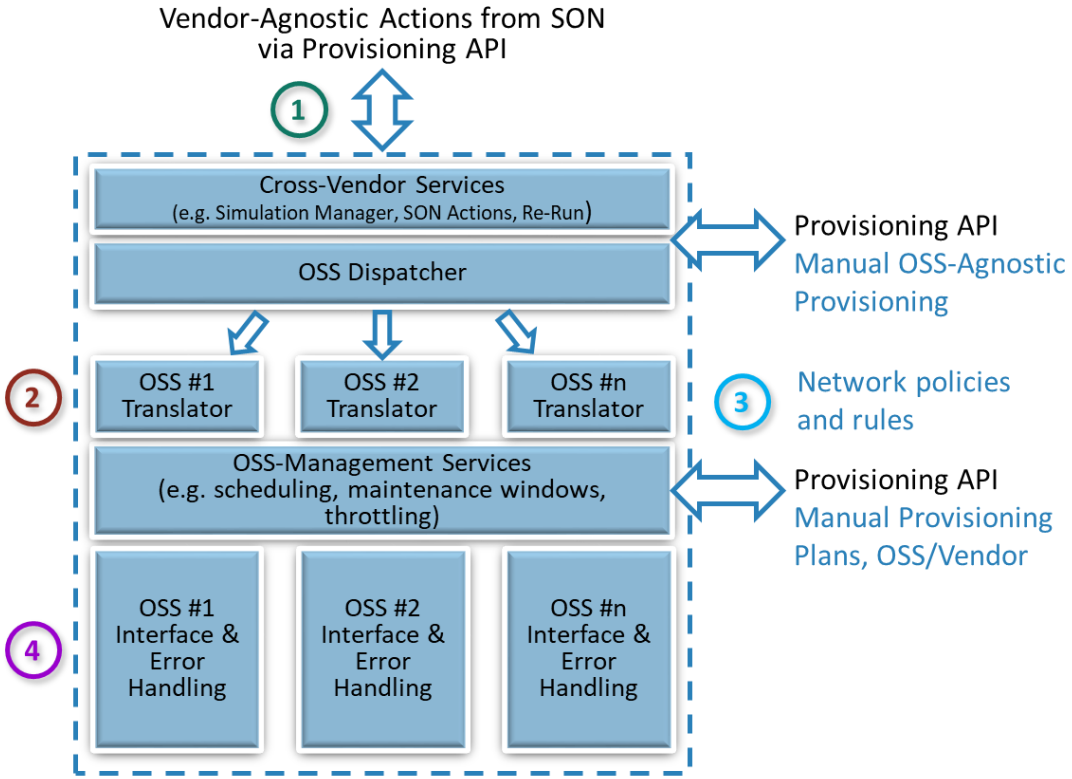
The Cellwize C-SON Provisioning Interface architecture is built to translate vendor agnostic commands to vendor specific language:

(1) C-SON modules (DE's) are **aware about vendor specific peculiarities** but **operate vendor agnostic**.

(2) The C-SON internal, unified language **translates to vendor specific commands inside OSS Translators**.

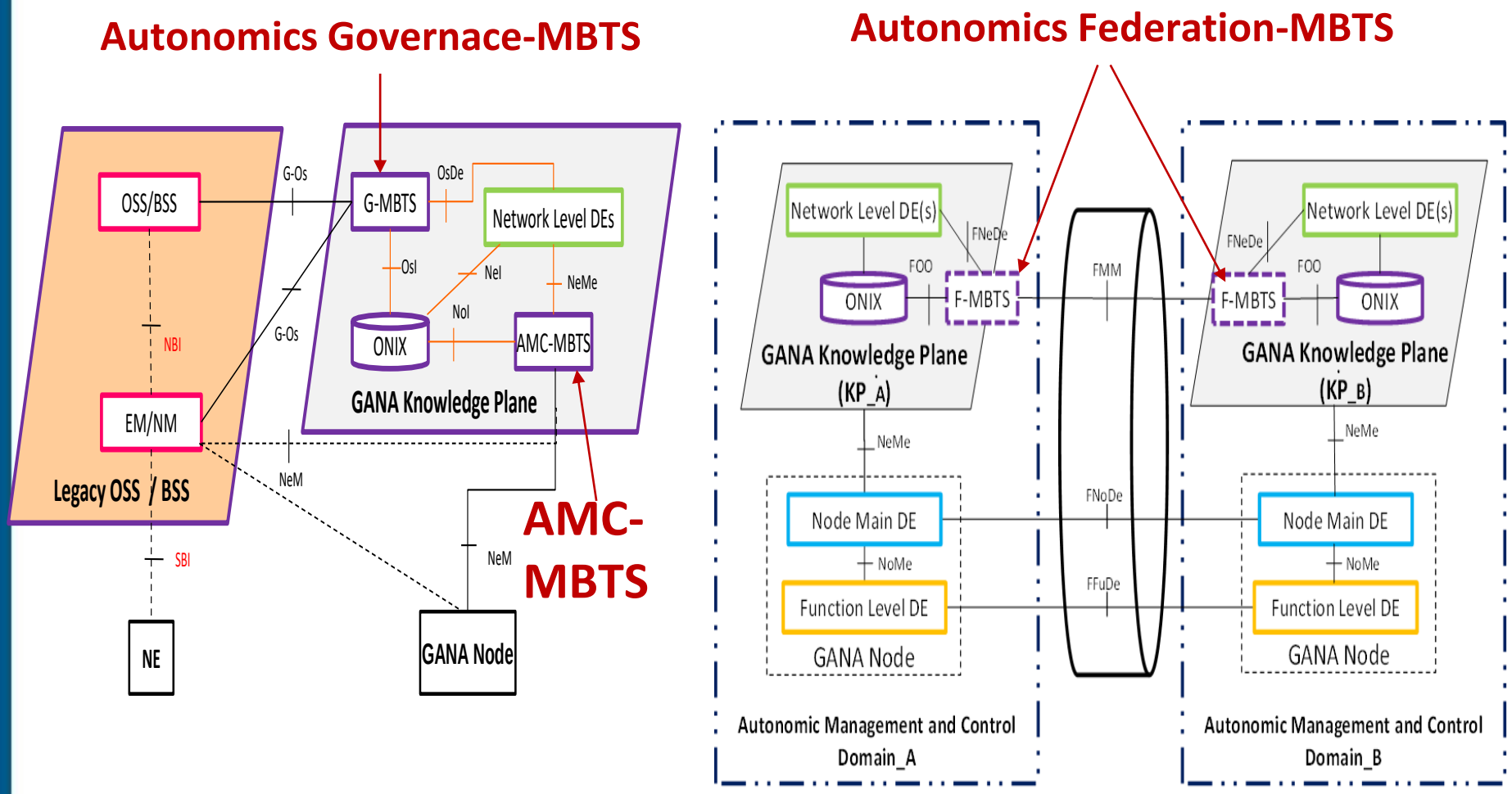
(3) Network **policies and** operator **rules** are **applied through the OSS Translators**

(4) Operational **Network status information is processed into network knowledge** (e.g. KPIs) and used to feedback corrective actions



KPI – Key Performance Indicator OSS – Operating Sub System

The Three Types of MBTS Functions Defined in the GANA Model



Cellwize Provisioning GW Mapping to the GANA MBTS for RAN

The current mapping and required evolution of the Cellwize provisioning gateway towards MBTS for RAN can be summarized as follows:

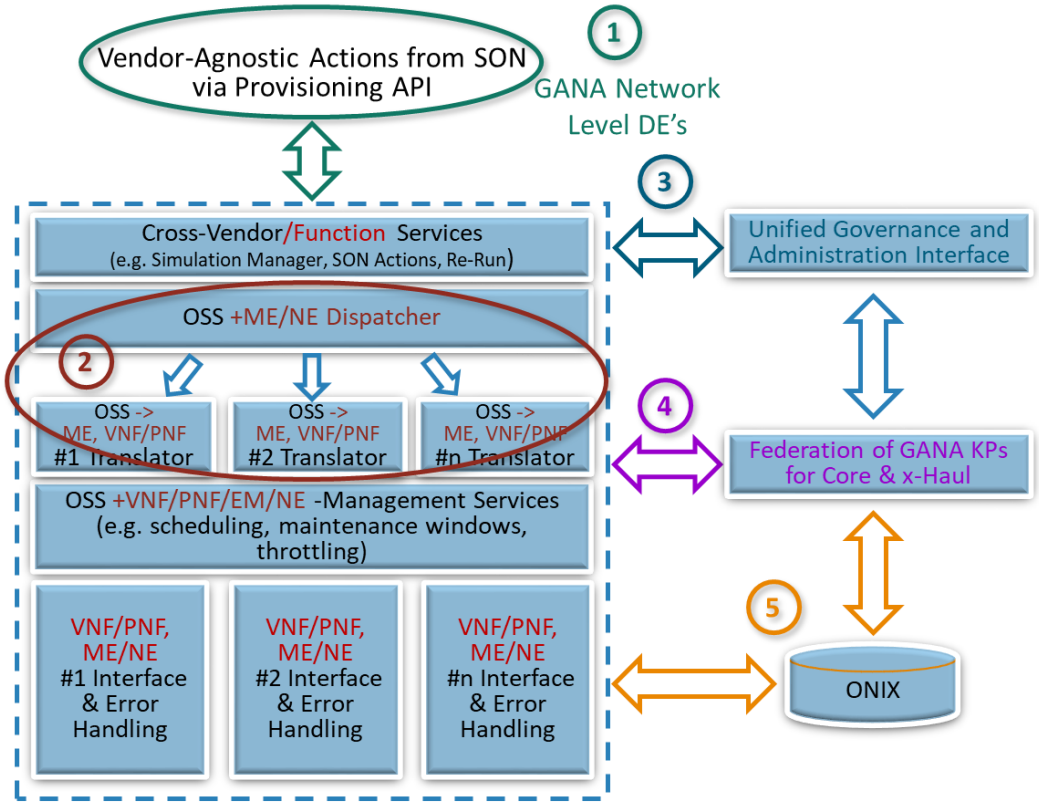
(1) **SON Actions** represent network adjustments that **map to the GANA Decision Element (DE)**

(2) The envisioned 5G architecture requires an evolution of the **OSS dispatcher for MBTS to communicate directly to Managed Entities (ME's), PNFs and VNFs**

(3) The provisioning API may be used as **Governance and Administration interface** for manual parameter enforcement, provisioning, policies and rules

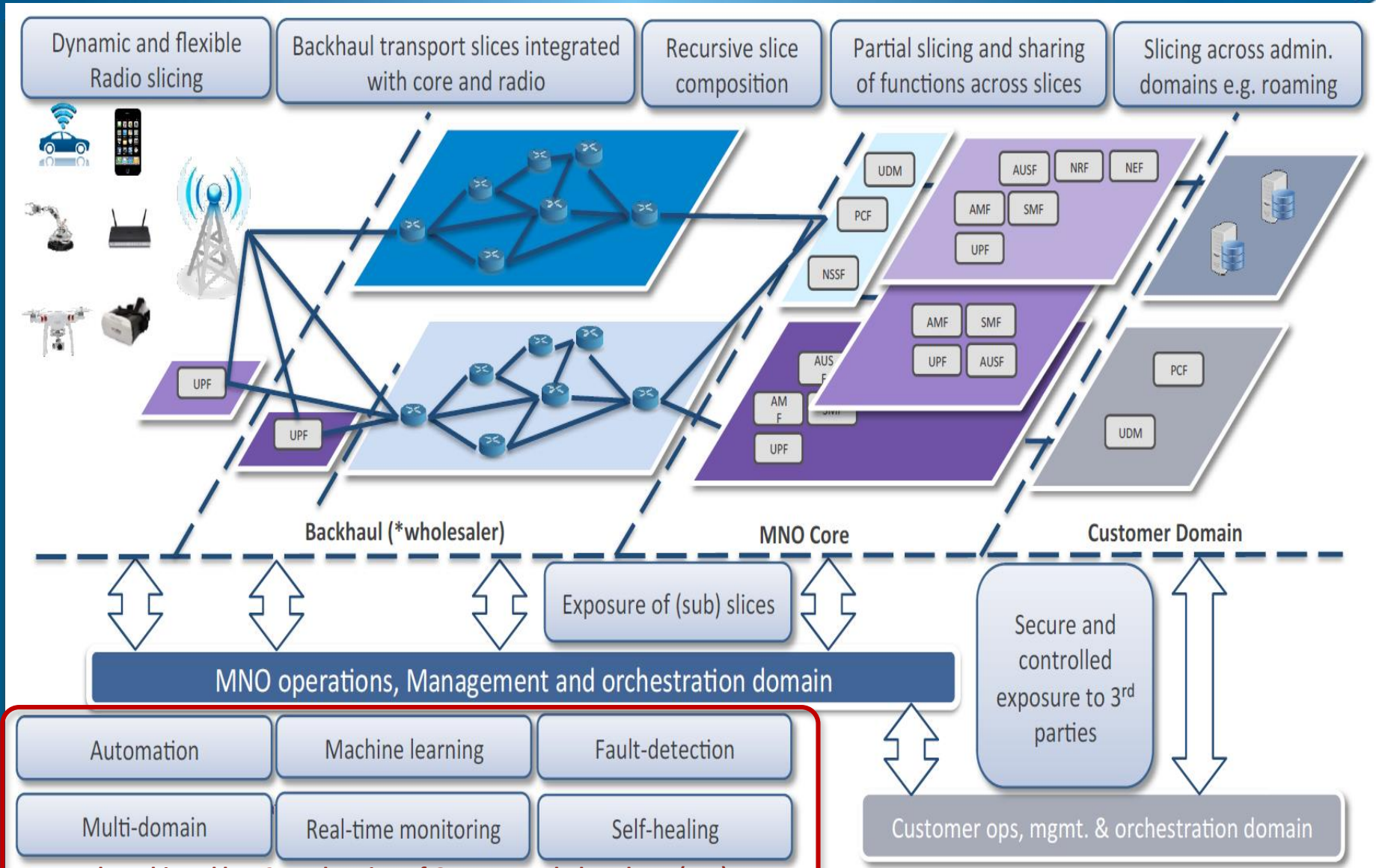
(4) **Inter GANA KP communication and coordination API** is needed for cross KP (RAN, xHaul, Core) MBTS domain function sharing

(5) **Unified KPIs (operational), Policies, Fault Management information and SON (DE) action logs can be provided through ONIX** and in some cases directly through the F-MBTS (e.g. to trigger cross domain control loops)



KP – Knowledge Plane DE – Decision Element ME – Managed Entitiy NE – Network Element VNF – Virtual Network Function PNF – Physical Network Function

5G Network Architecture



To be achieved by E2E Federation of GANA Knowledge Planes(KPs)

Source: British Telecom '5G Network Slicing Opportunities and Challenges ahead'

Case Study

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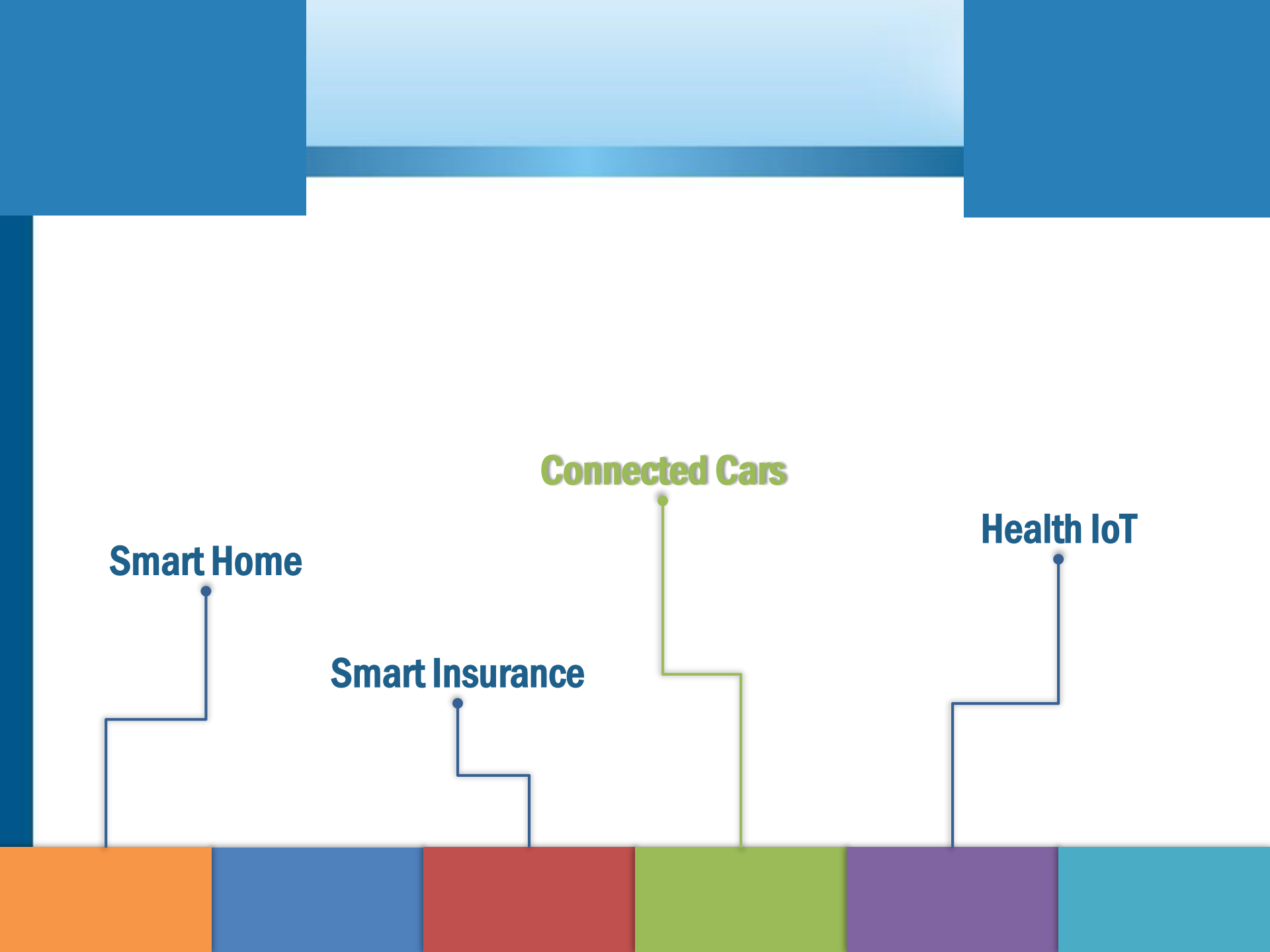
Driving value through SON


Connected Cars
Health IoT
Smart Home
Smart Insurance

cellwize
Driving value through SON

1. Connected Car networks need to assure service availability and high responsiveness to rapidly changing, fast moving mobile traffic

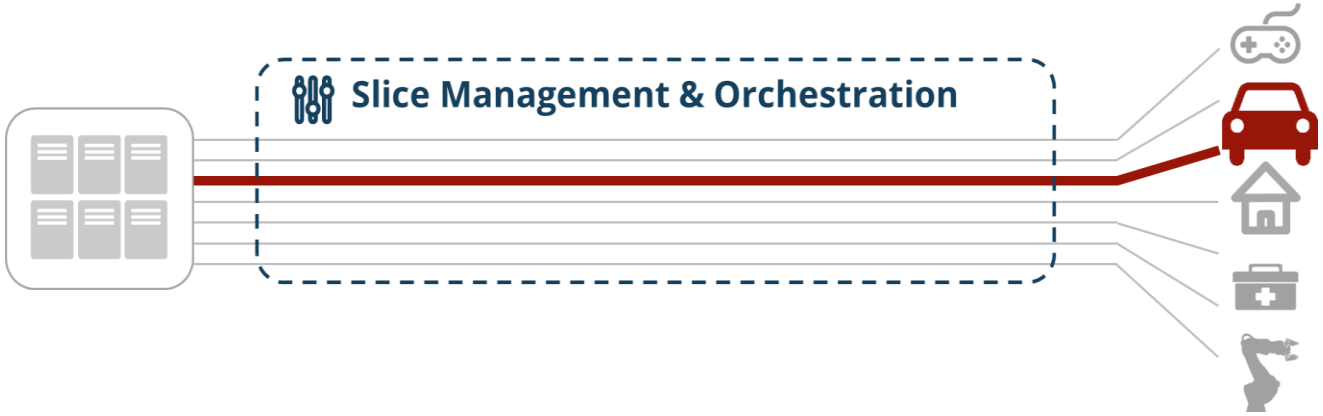
2. Traffic that emerges from a broad variety of QoS requirements with the entire spectrum of 5G Use Cases e.g.
   - onboard Entertainment & Wifi (eMBB)
   - Sensors and Carmakers Network (mMTC)
   - Autonomous Driving and Infotainment Services (uRLLC)

3. Very dynamic adaption to changing traffic density, location and sudden traffic bursts are required to provide capacity in time

4. Connected cars networks require a management and control system that is capable to forecast, identify and handle necessary network adjustments

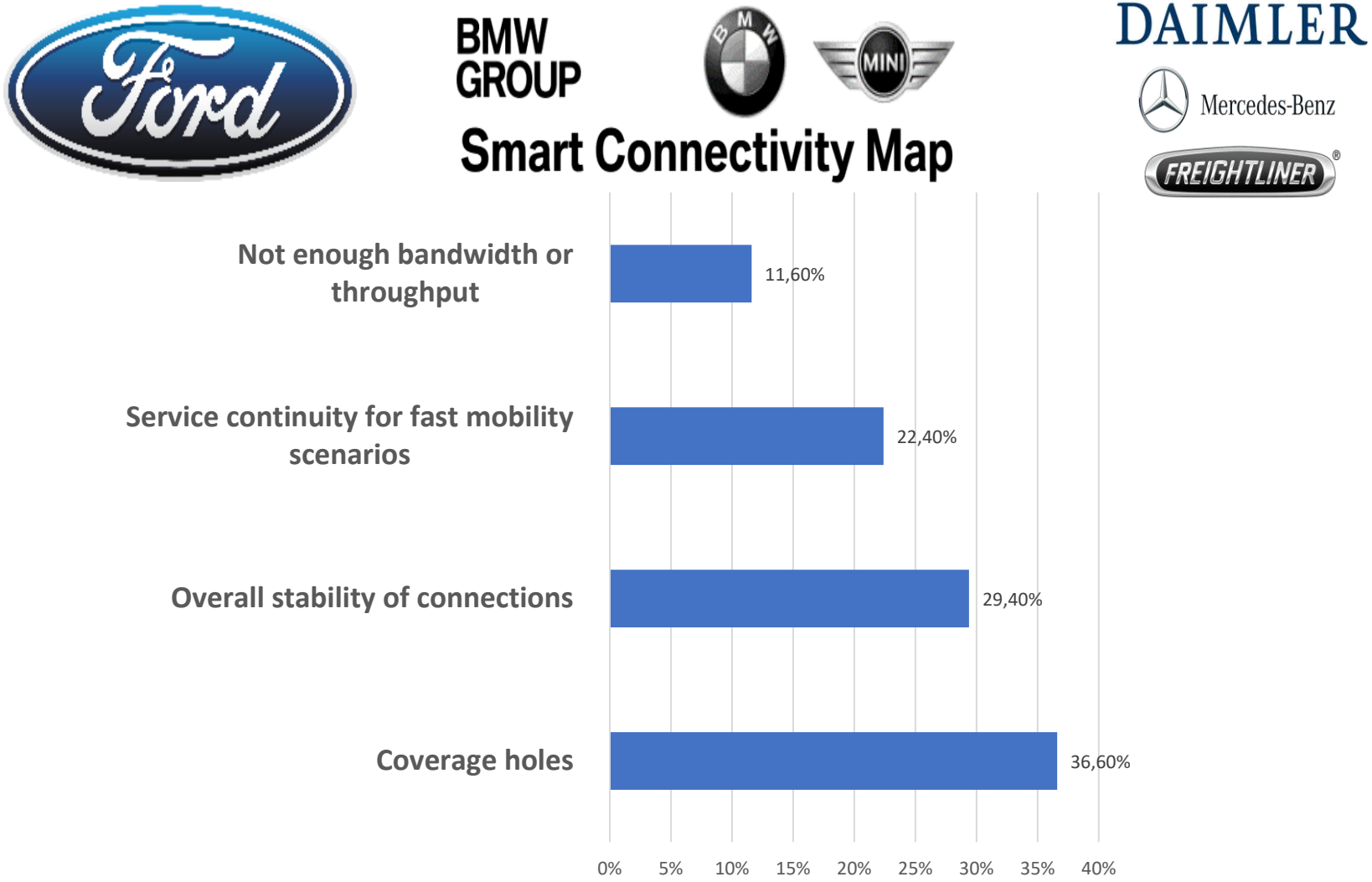
Connected Cars units diversified performance requirements

Assumptions for ETSI 5G-GANA PoC: Conn. Cars use case



1. The 3GPP standardization group defined the following minimum requirements for mobile broadband in vehicles:
   - User Experienced Data Rate – **DL: 50 Mbps UL: 25 Mbps**
   - E2E Latency – **10ms**
   - Mobility – **on demand (up to 500 km/h)**
2. With the emergence of autonomous driving assistance systems, the connected cars vertical can be classified as UrLLC (Ultra-reliable and Low-latency Communications) and thus **prioritized service category**
3. Further it can be concluded that service availability in terms of **coverage is imperative**

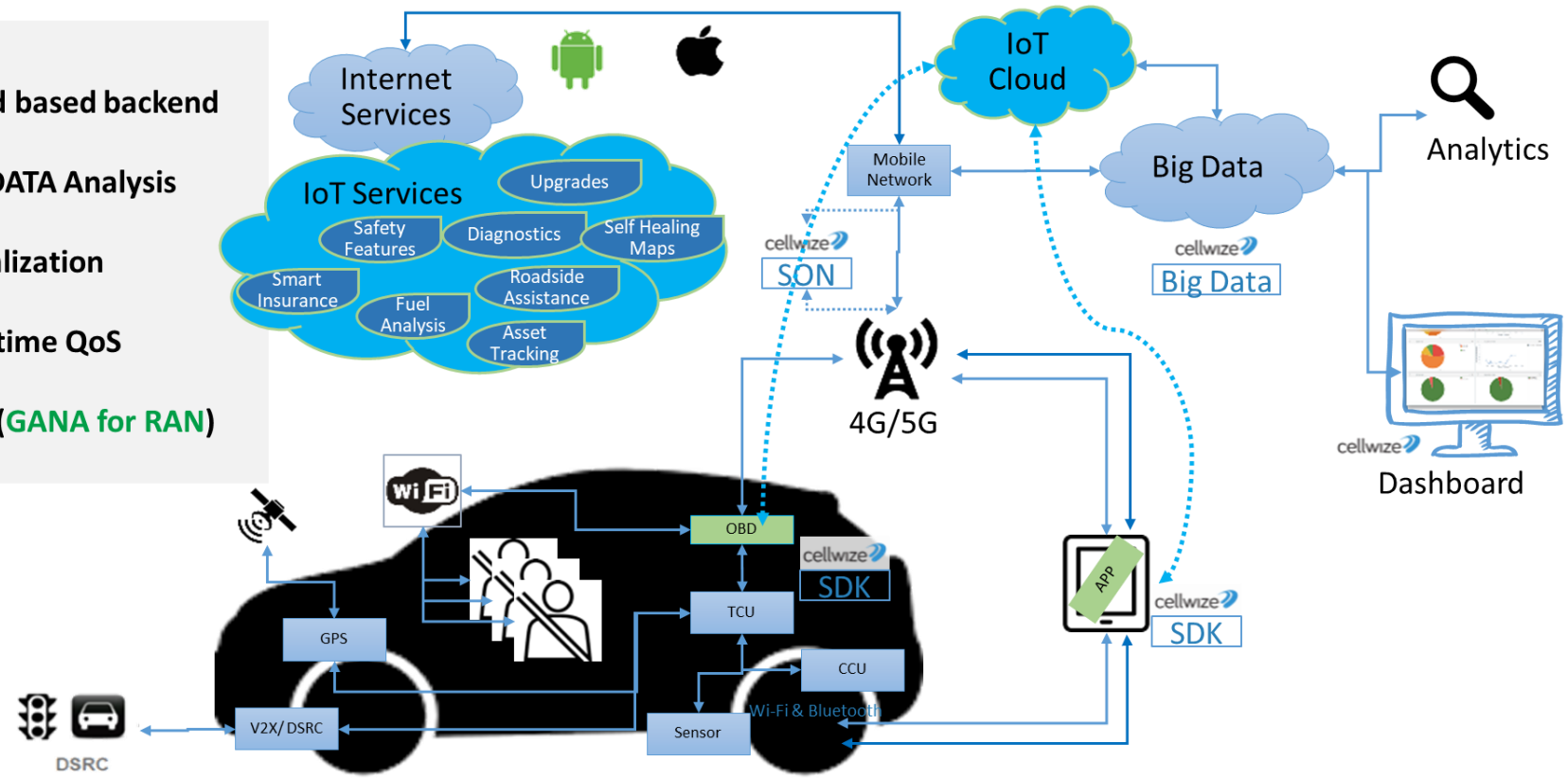
Connected Cars - Connectivity Map



(Source: Connected Cars: From here to autonomy MWC 2017)

Connectivity Eco System for Connected Cars

- **Cloud based backend**
- **BIG DATA Analysis**
- **Visualization**
- **Real time QoS**
- **SON (GANA for RAN)**



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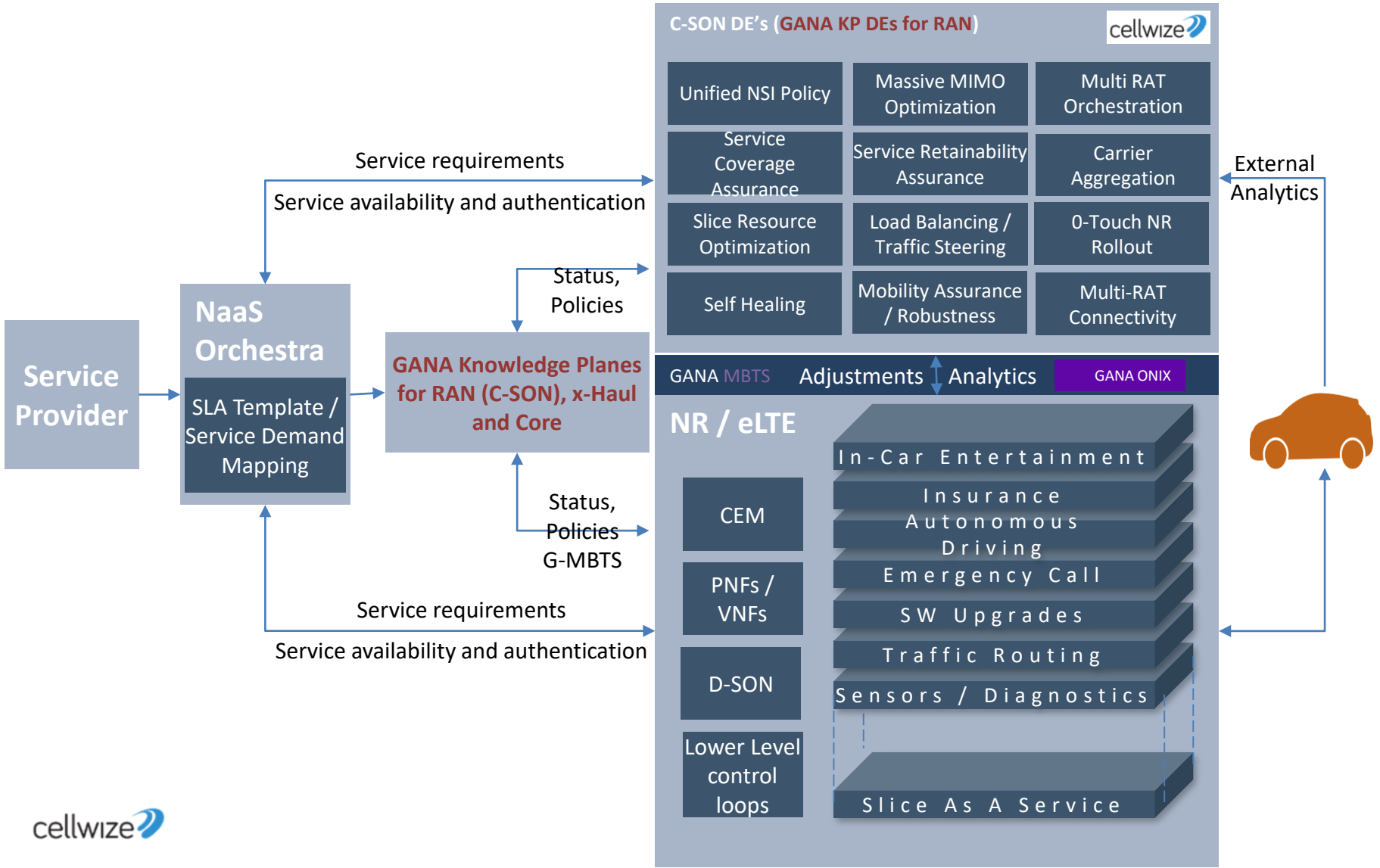
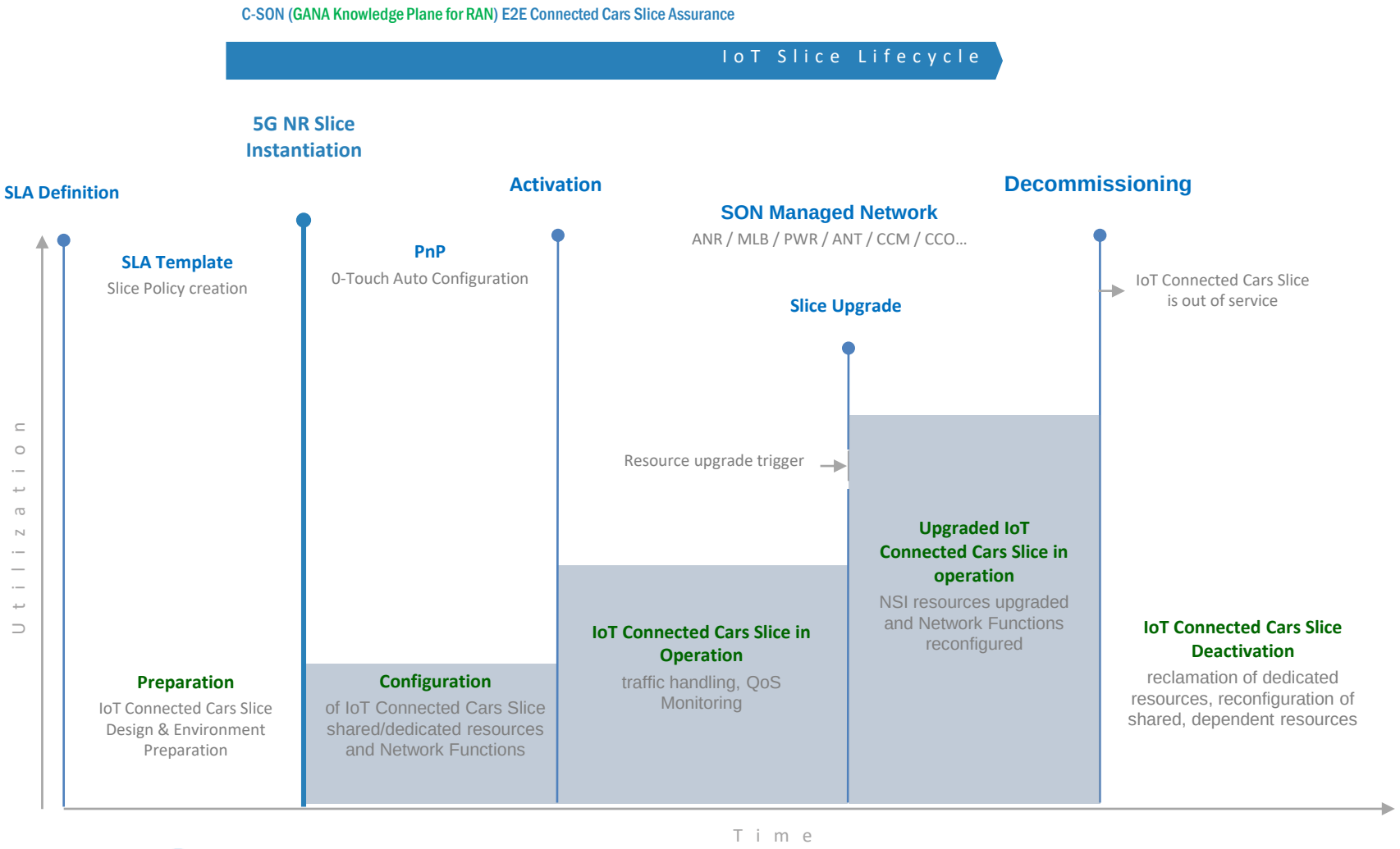
5G C-SON Abstraction Layer



IoT Slice Lifecycle
Connected Cars



Connected Car Service Assurance

Slice Management & Optimization

Network Intelligence

Network Design
& Area Density

Control Mobility
Parameters

Network Guard

In-Car Entertainment
Insurance
Autonomous Driving
Emergency Call
Upgrades
Traffic Routing
Sensors / Diagnostics

Slice As A Service

Connected Cars Slices

The Added Value of Machine Learning | Highway Use Case

Use Case: Highway Reliability and Latency

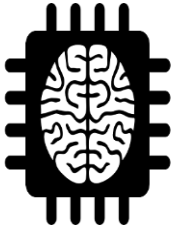
Traditional Approach

Optimization based on Cell KPIs

ANR and MRO are performed at the cell level. The experience of the commuting users is lost in the cell average, due to larger number of stationary users

- **Commuting users are experiencing call drops** and reestablishment in spite of ANR and MRO optimizations
- **Optimization is focused towards the stationary users** who are indeed the larger segment of users however already experiencing very good retainability

SON with ML Capabilities



Optimization based on Machine Learning

Mobility optimization is performed based on learning of the different customer types and experiences, and understanding that the commuting users are getting a bad experience

- ML-based models **learn the different customer groups and experiences**
- **Commuting users are getting a much better experience** while maintaining excellent retainability for the stationary users (or an unnoticeable degradation)
- Optimization is **focused on real customer experience** rather than on improving average cell KPIs
- **No manually managed lists** for configuring individual policies for highway cells

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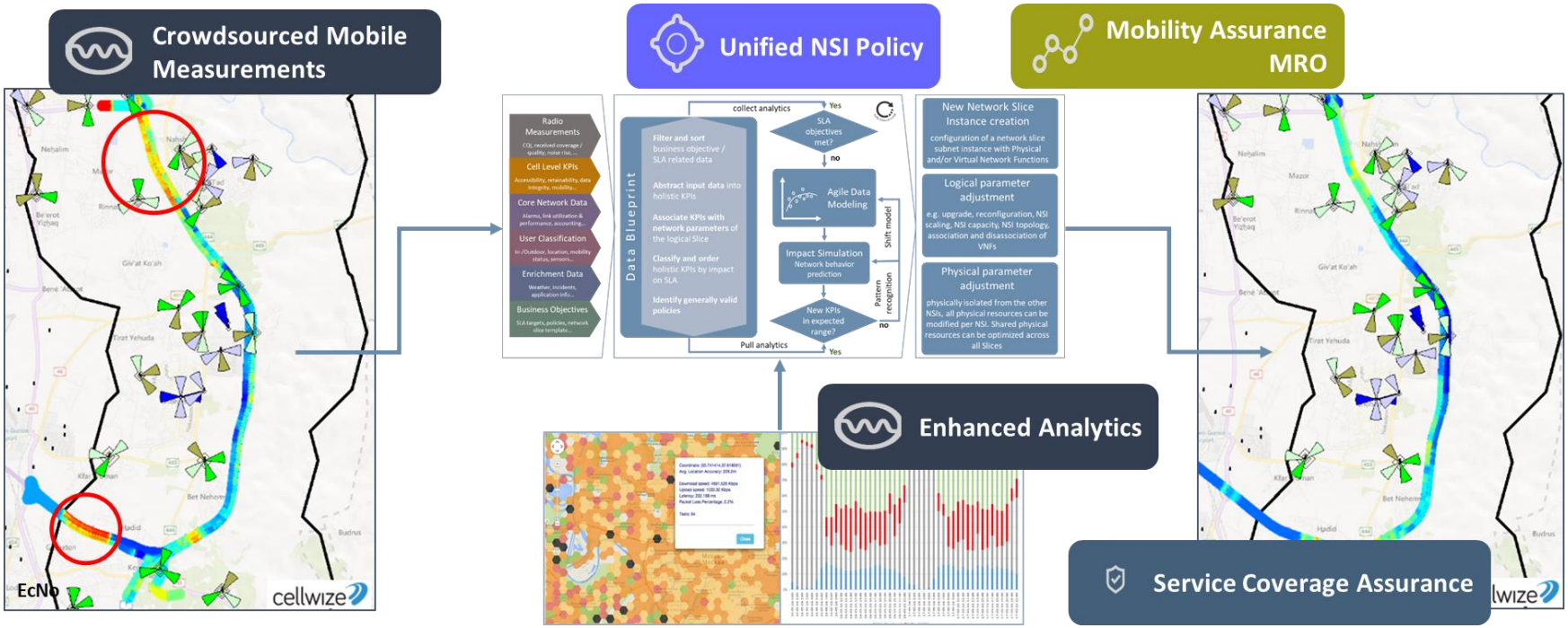
Cellwize Solution for Connected Cars| Highway Use Case



Demanded NSI Service Level performance can be assured through:

- The orchestration of enhanced big data analytics in combination with immediate access to unified policies and real time provisioning of NSI modification actions
- The Federation of GANA Knowledge Planes (KPs) for Radio Access-, X-Haul- and Core Networks, and strong interfaces with OSS, EMs/NMs, Orchestrators, SDN, .. for prompt access to knowledge for the KPs

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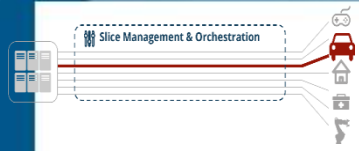
In 2015 Cellwize successfully executed its first connected cars trial



High speed highway user

A

B

E

C

D

Standard Behavior on reference users (Slice)

Cellwize Connected Cars Solution

cellwize

ETSI

Enhanced Analytics

Intelligent, self calibrated analytics model with automatic feedback loop and network behavior analysis. Sourced from big data analytics, network performance statistics, mobile edge collected network measurements and call logs/traces.

Unified Network Slice Instance Policy

Centralized policy orchestrator with the ability to unify various network and slice configuration policies and rules, such as connected cars SLA, governance regulations, external constraints, etc.

Service Coverage Assurance

Coverage target optimization of physical and logical, shared and dedicated resources, such as remote electrical tilt, beam tracking and mobility, remote azimuth (SONAR), etc.
Shared resources are optimized with best effort considering individual service prioritization.

Mobility Assurance

Intra-/Inter-Band, Intra-/Inter-Slice, Inter-RAT, to Wifi mobility service assurance and architecture harmonization: multi-vendor, multi-RAN (cRAN, vRAN, femto, macro, indoor...)

Key Takeaways

Key Takeaways

- **Cellwize C-SON and its framework for policy control of D-SON implements the GANA Knowledge Plane for the RAN**
- **Cellwize provides an implementation of the GANA Knowledge Plane for the Backhaul to some degree**
- The Cellwize C-SON Implementation Opens a Door and **Opportunity Towards a Specification/Standardization of an MBTS for RAN (an MBTS that also covers 5G)**
- **The GANA model empowers Autonomic (Closed-Loops) Service Assurance for 5G Network Slices**
- This ETSI 5G PoC is clarifying the Required Carriers'(Operators') ***Framework for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices***

  → E2E Autonomic Slice Assurance shall be achievable through the Federation of GANA Knowledge Planes for RAN (C-SON), Front-/Backhaul and 3GPP Core Network, Complemented by lower level autonomics, for Multi-domain state correlation and programming by the GANA KPs (RAN, DC, MEC, Backhaul, Core Network)

Key Takeaways

- There is a need for Integration/Convergence of Autonomic Service Assurance with Orchestrated Assurance in the Carrier/Operator's Environment
- Further Study on how to evolve ONAP Components to address GANA Requirements should now be triggered and contributions to ONAP and other Open Source Projects like TIP and BBF CloudCO and Open BroadBand should now be launched
- We are calling upon the IPv6 Community to Showcase in this PoC and Discuss more on IPv6 Features that play a role in Autonomic Management and Service Assurance in 5G, and IPv6 expectations in 5G Traffic Flows and QoS Tuning
- Hybrid-SON Model (Combining C-SON and D-SON) is an illustration of GANA for the RAN

Implementation of Action Point suggested by Participants at the Demo-2, regarding Need for Interaction/Liaison between ETSI NTECH AFI WG and ONAP

One of the Comments Received during the Demo-2 Presentation was on the "***Need for Interaction/Liaison between ETSI NTECH AFI WG and ONAP***" in order to encourage the launch of an activity on "*ONAP for GANA requirements (i.e. GANA components that can be implemented using ONAP components)* "

Implementation of the Action Point: ETSI NTECH AFI WG is preparing a Liaison Statement (LS) to ONAP, with the aim to send the LS to ONAP within March 2018.

Consortium and Contact Details for Demo-2

Contact Details of PoC Leader (contact to join the consortium)

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- Orange
- Verizon
- NTT
- Altran
- Asocs Networks
- Cellwize
- Huawei
- Incelligent
- QualyCloud
- IPv6 Forum

Thank you!

At Every Moment of Truth