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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

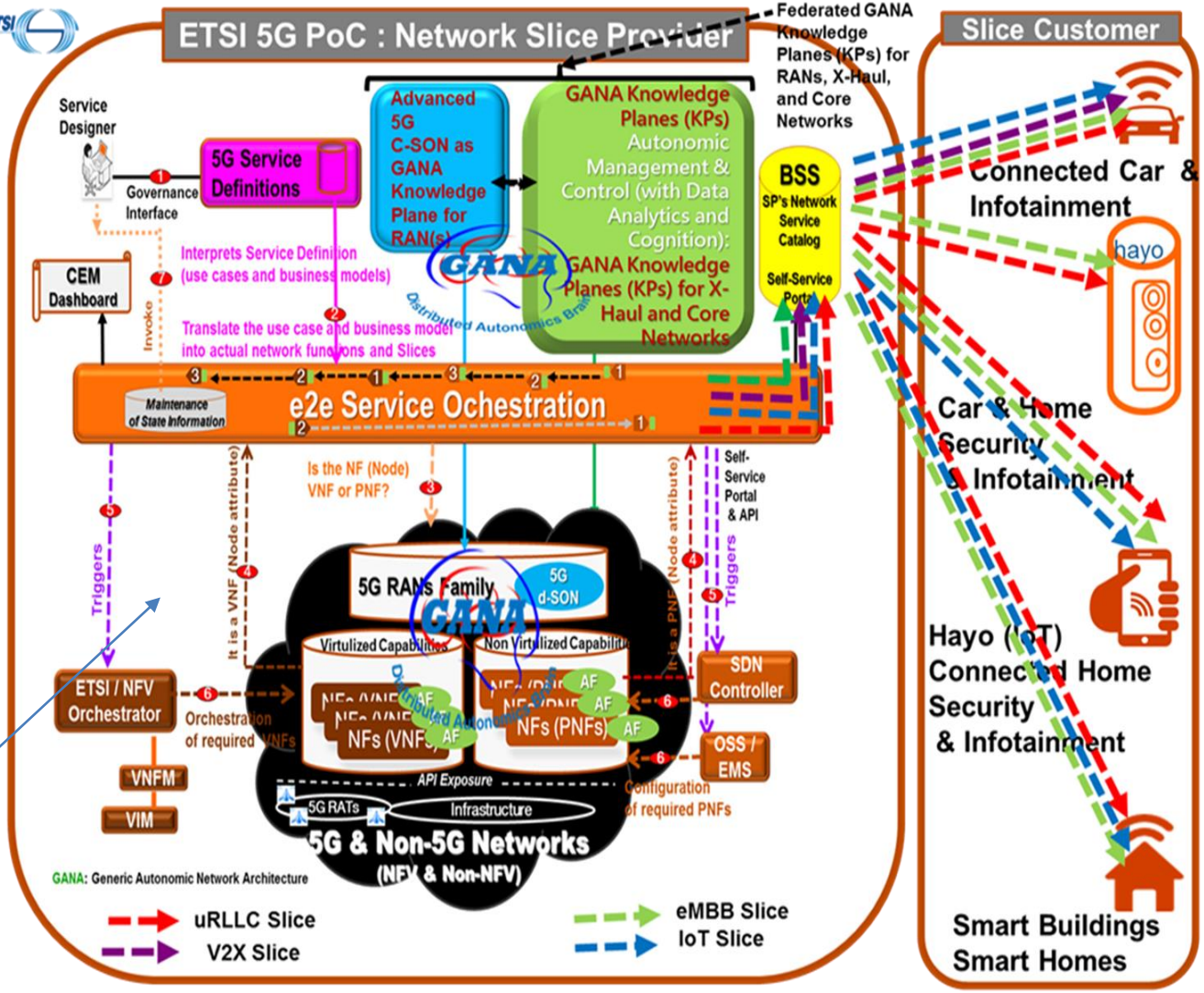
- Introduction to the ETSI AFI 5G GANA PoC
- Key Messages & Reflections
- ETSI GANA Model
- Hybrid-SON Mappings to the ETSI GANA Model
- Centralized SON as GANA Knowledge Plane (KP) for RAN – Cellwize Implementation

Introduction to the ETSI NTECH AFI WG 5G GANA PoC and Consortium (Open to Join)

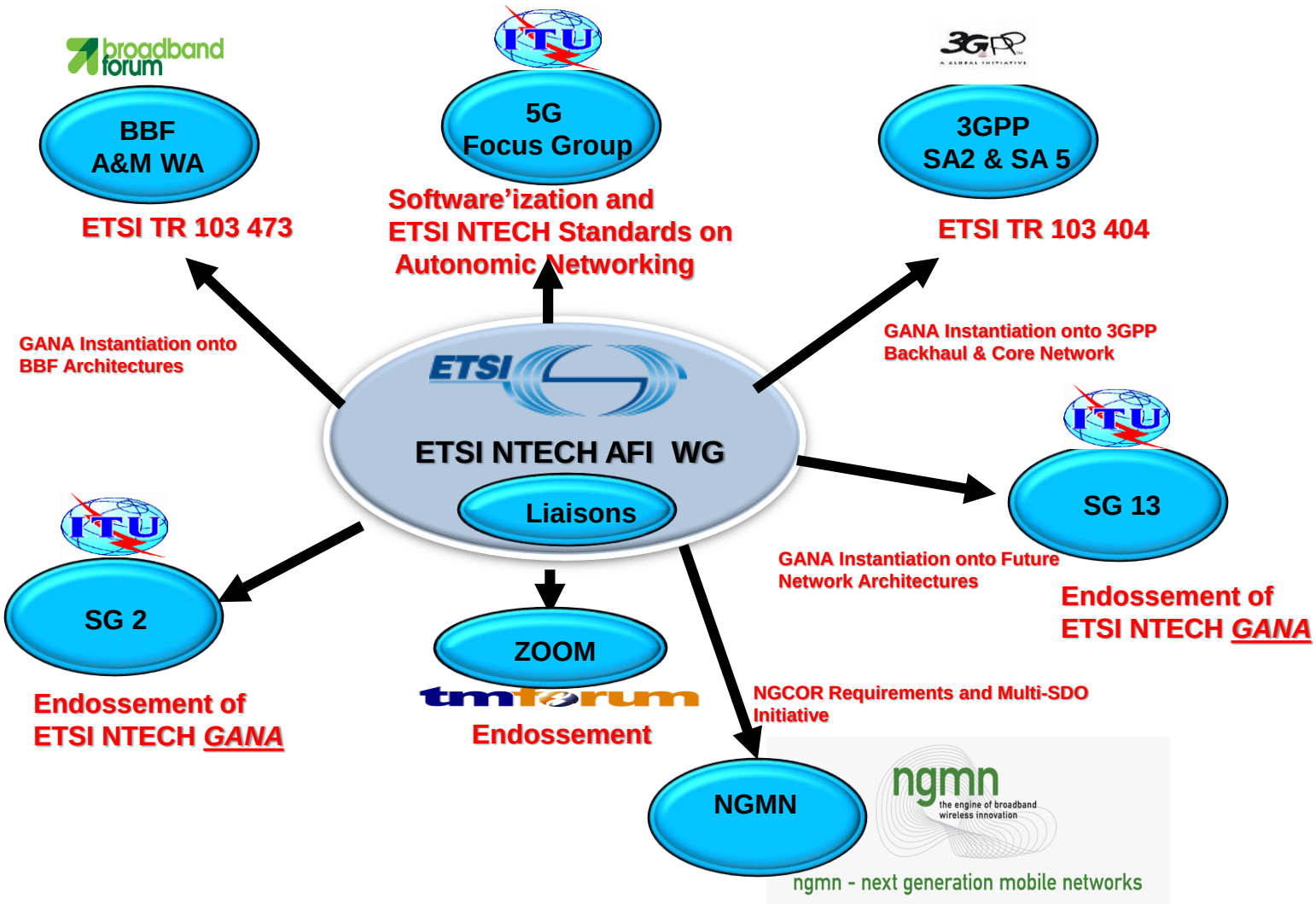
- Orange
- Verizon
- NTT
- Altran
- Asocs Networks
- Cellwize
- Huawei
- Incelligent
- QualyCloud
- IPv6 Forum

Remark on this ETSI PoC Consortium: This PoC Consortium is not "closed-consortium", and welcomes new members in the course of the PoC duration, which goes beyond 2018. This **Demo-2** is the ***second Demo of a series of Planned Demos on various aspects*** of the overall ETSI 5G Network Slicing PoC, and so more Demos are expected in the duration of the PoC over 2018/2019.

Note: The processes indicated will be further reviewed and elaborated in the course of the PoC



About ETSI NTECH AFI WG on Autonomic Management & Control (AMC) of Networks and Services



Key Messages & Reflections

Key Messages and Reflections

- **Hybrid-SON Model (Combining C-SON and D-SON) is an illustration of GANA for the RAN**
- **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 **GANA model empowers Autonomic (Closed-Loops) Service Assurance** for 5G Network Slices
- E2E Autonomic Slice Assurance shall be achievable through the ***Federation of GANA Knowledge Planes (KPs) for RAN (C-SON), Front-/Backhaul and 3GPP Core Network***, and ***Complemented by lower level autonomics,*** for Holistic for Multi-domain state correlation and programming by the GANA KPs (RAN, DC, MEC, Backhaul, Core Network)

  → The Service Provider's ***Framework for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices***

Key Messages and Reflections

- There is a need for ***Integration/Convergence of Autonomic Service Assurance with Orchestrated Assurance is Inevitable!***
- **What to consider from IPv6 Perspectives in 5G?:**
  - **IPv6 is expected to play a big role in 5G (e.g. in mMTC 5G slices)**
  - **There are IPv6 features that are expected to bring value to Service Assurance for 5G Slicing**:

    → e.g. ***the use of Extension Headers in grooming telemetry information*** required for driving adaptive (autonomic) service assurance of slice specific traffic flows
  - **Remark:** 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

Clarification Aspects on Processes involving Autonomic Management & Control (AMC) of Slices and Assurance

1. **Information and Resources Auto-Discovery and Auto-Configuration : Process (0)**

   - Auto-Discovery and Auto-Configuration (Self-Configuration, Self-Commissioning) of Network Elements (NEs) may not necessarily be triggered by a Network Slice creation request
   - This process could involve initial configurations that prepare resources to then be able to provide Slices upon Slice creation request

2. **Resources Instantiation and Provisioning/Configuration as a result of Network Slice creation demand and adaptation demands : Process (1)**

   - Process (1) happens after Process (0) during the Lifecycle of the Network as a whole

Process Clarification Aspects for E2E Autonomic Service Assurance of Network Slices we seek to address in this PoC are:

- What GANA Components of Autonomic Service Assurance participate in process 0?
- What GANA Components of Autonomic Service Assurance participate in process 1?
- Access to Slice Data by Autonomic Service Assurance GANA components
- Slice monitoring, KPIs and knowledge generation, access and representation of various Knowledge to GANA Knowledge Planes

ETSI GANA Model

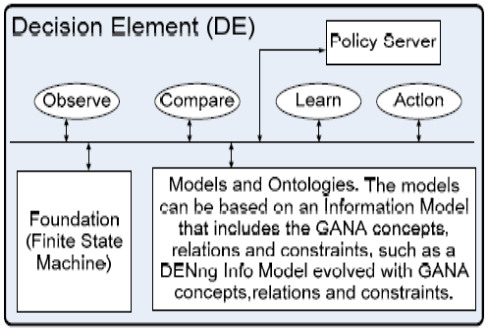
ETSI GANA Reference Model and Value of Modularization of logically centralized Control Software (GANA Knowledge Plane)

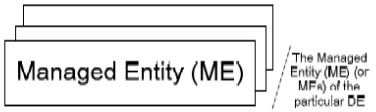
- *Decision Elements (DEs)* = ***Centralized and Distributed Control Software Logics (DEs) that operate in different time-scales but interworking harmoniously in realizing autonomic behaviors (self-configuration, self-optimization, …self-* of Managed Entities)***
- ***DE algorithms imply DE vendor differentiation.***
- ***DEs MAY be "loaded or replaced" ➔ notion of "Software-Driven or Software-Empowered Networks" i.e. the broader picture than Software-Defined Networks***

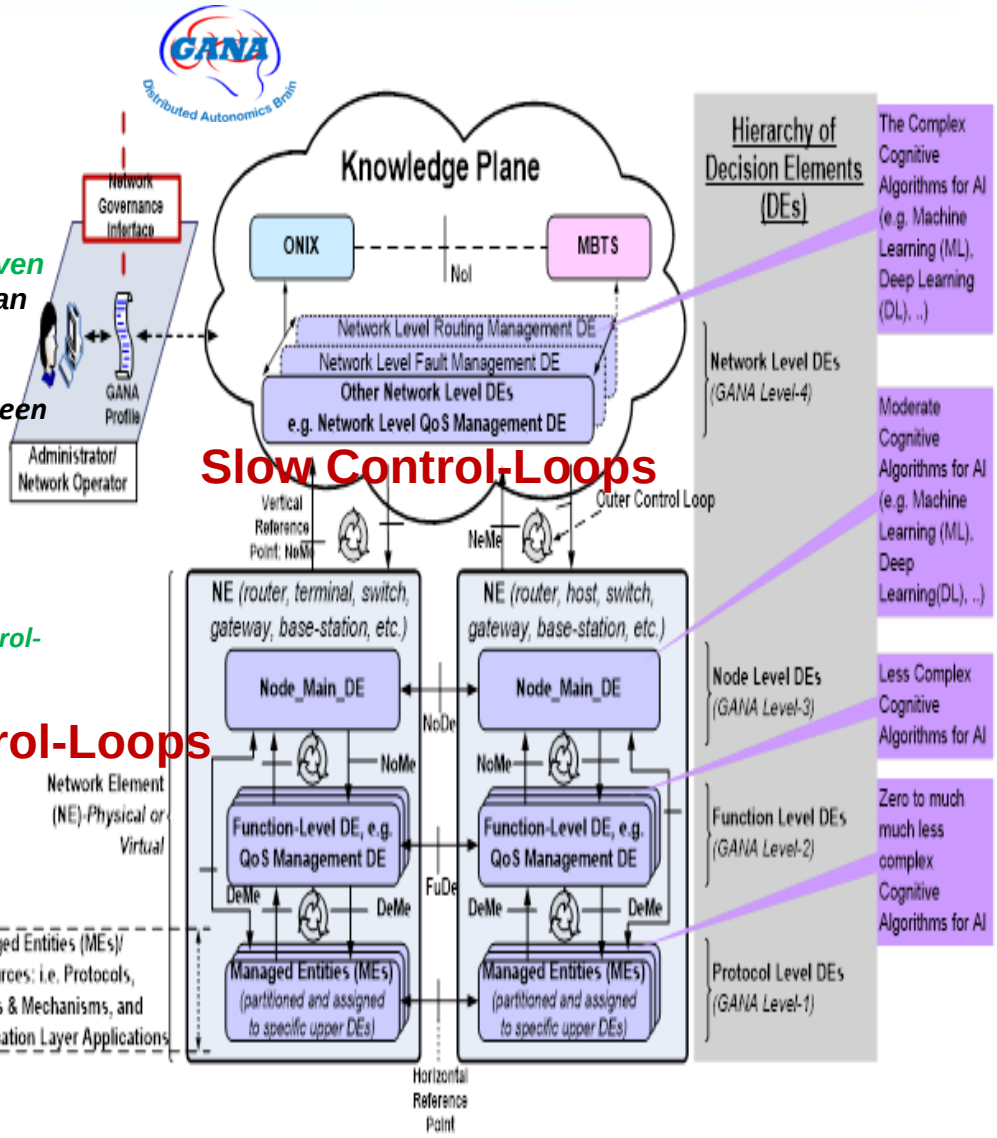
MBTS: Model-Based-Translation Service (mediation service between Knowledge Plane and NEs)

ONIX :Overlay Network for Information eXchange (publish/subscribe services for Info.) ➔ Real-Time Inventory

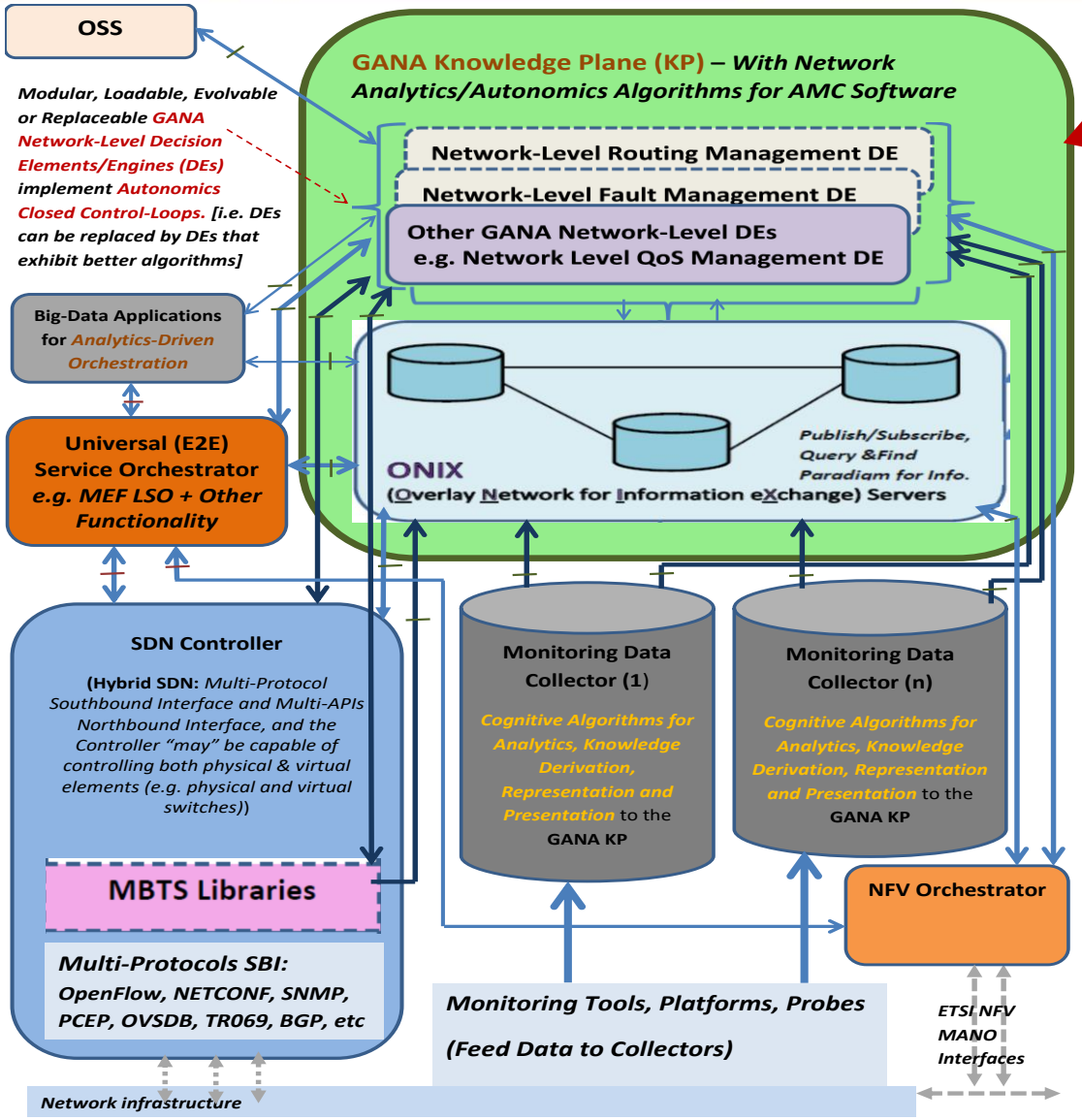
- ***Principles prescribed by IBM MAPE-K, OODA, FOCALE, and other Control-Loop models, can be applied to designing DE internal logic***







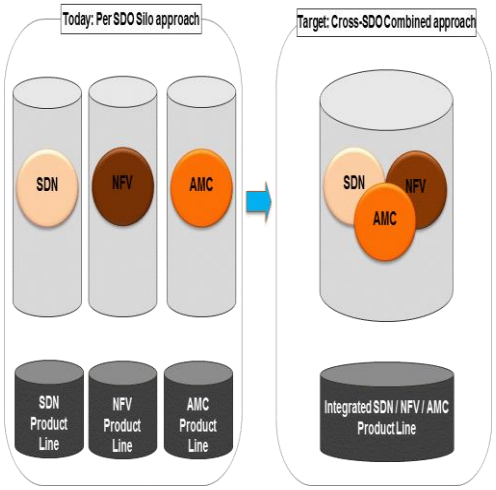
Unified Architecture for ETSI GANA Knowledge Plane, SDN NFV, E2E Orchestration, Big-Data driven analytics for AMC



The GANA Knowledge Plane as the Brain for Implementers to Design and Implement Advanced Cognitive Management & Control (AMC) DE Algorithms

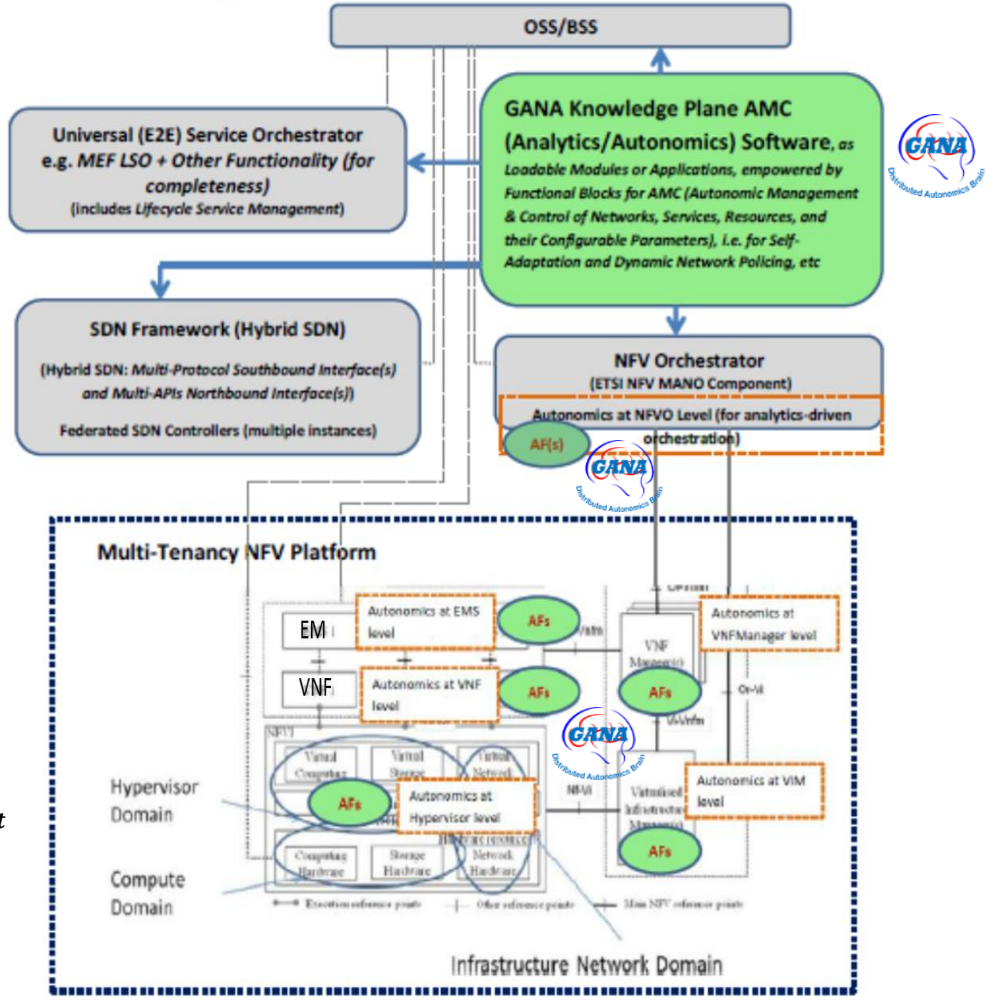
AMC of Networks and Services at various ETSI GANA Abstraction Levels for Autonomics

Remark: *Telecom Operators and Enterprises want Integrated Product line for SDN, NFV and AMC*



Extract *from the Report of the Initiative: Joint SDOs/Fora Industry Harmonization for Unified Standards on AMC, SDN, NFV, E2E Orchestration: Report from the Joint SDOs/Fora Workshop hosted by TMForum during TMForum Live 2015 Event Nice, France (June 4th, 2015).*

Enabling "*Advanced Management & Control Intelligence*" at *various Layers of Abstraction* through *Autonomic Management & Control (AMC) Software with Real-Time and Predictive Analytics, as Loadable Modules or Applications*



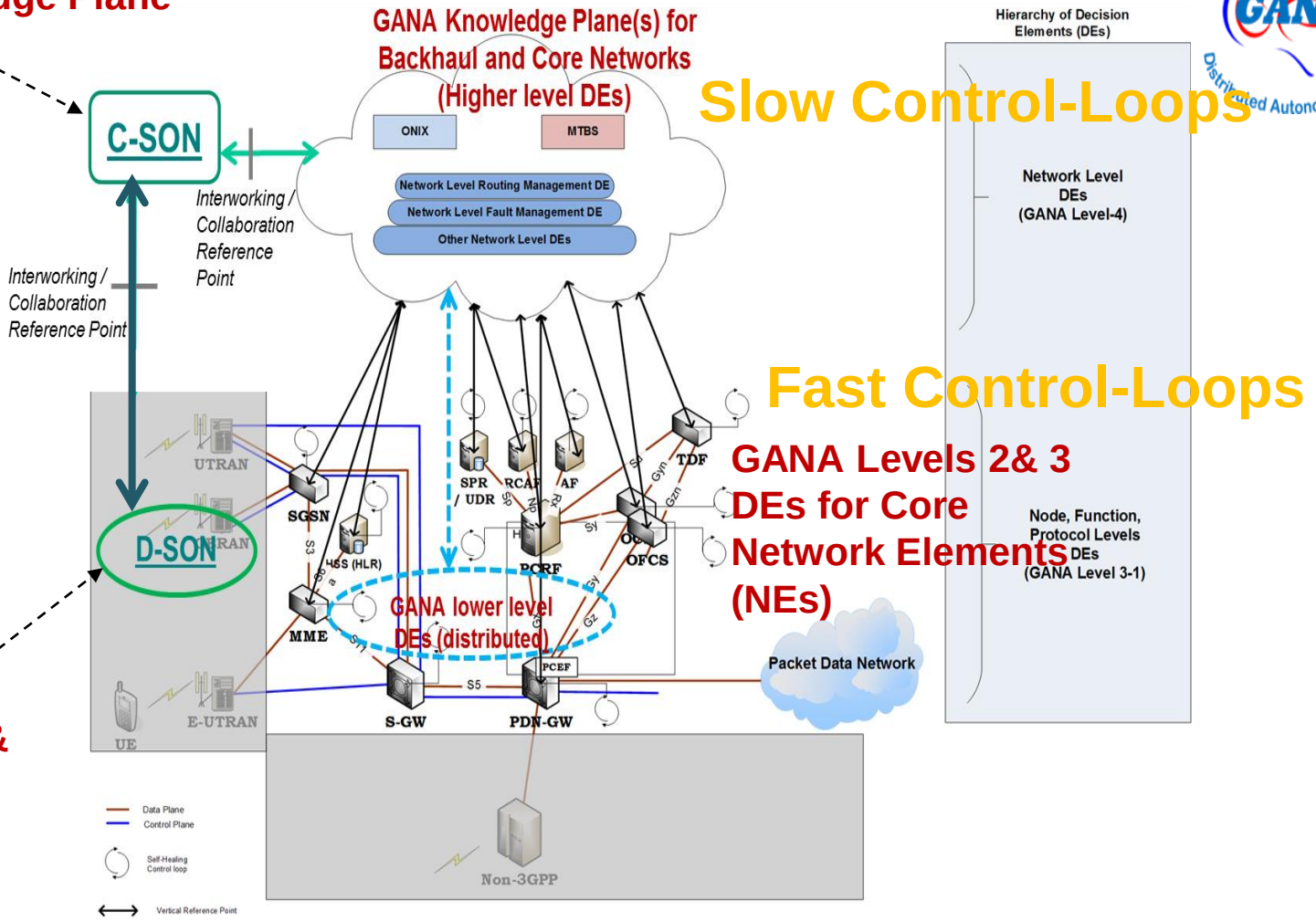
Key: AF = Autonomic Function (i.e. Decision-making Logic that realizes a Control-Loop(s) over Managed Entities (MEs) under its control)

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

Federated/Interworking GANA Knowledge Planes for RAN-, Backhaul- and 3GPP Core Networks complemented by low level autonomics

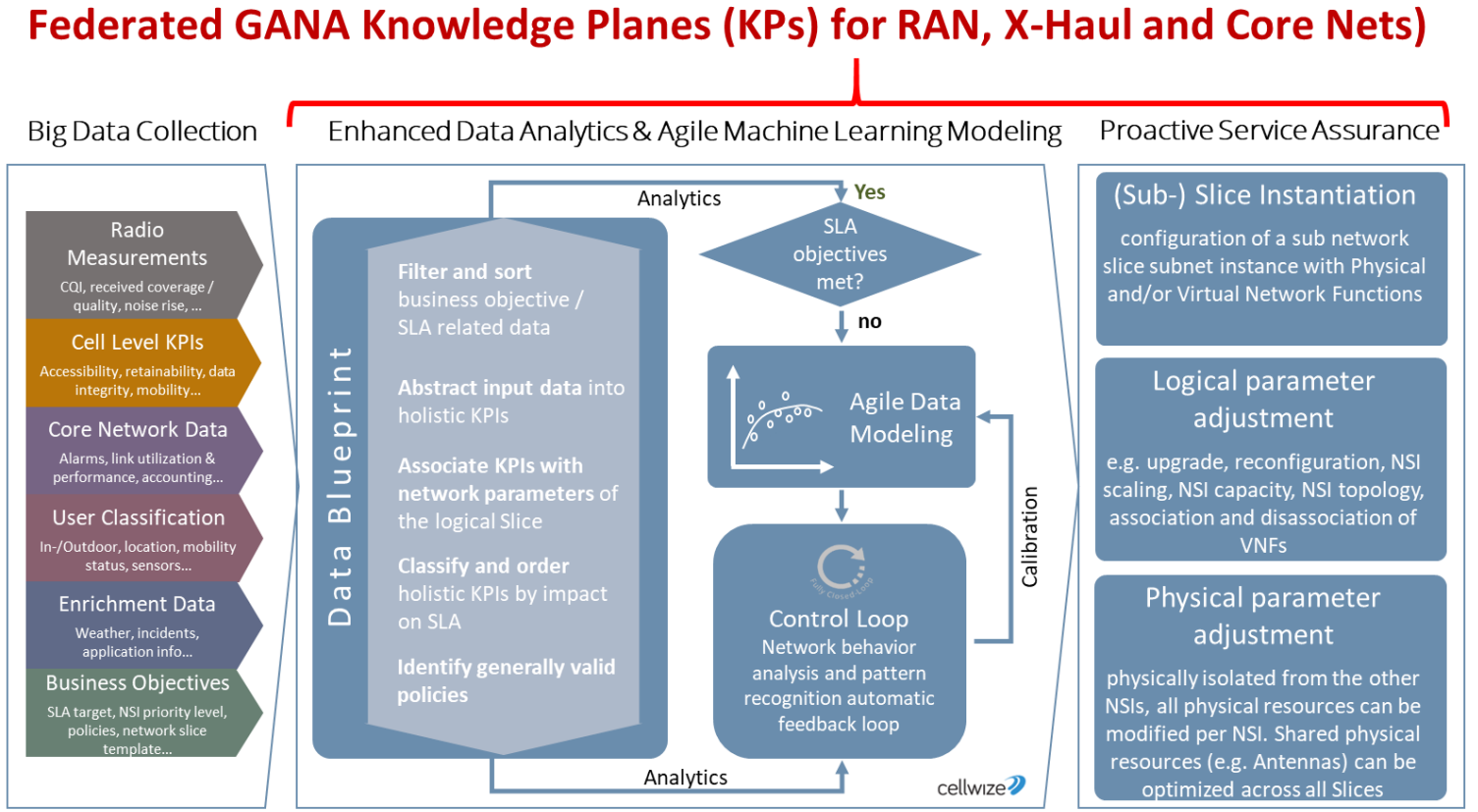
ETSI TR 103 404

GANA Knowledge Plane for RAN



GANA Levels 2& 3 DEs for RAN Network Elements (NEs)

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

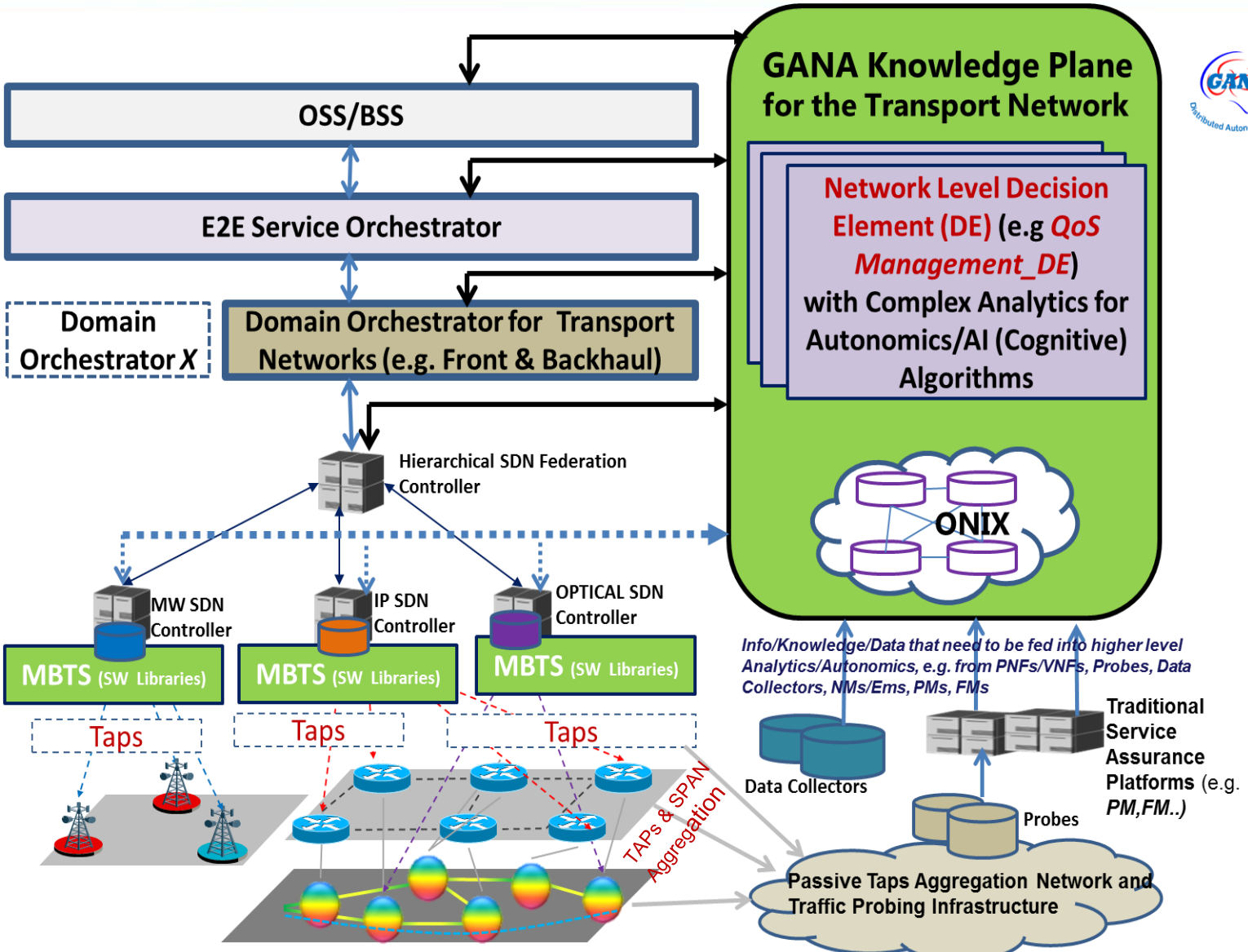


Remark: There is More on Data Sources for the KPs and KP Interfaces with OSS, EMs/NMs, Orchestrators, SDN, ..

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

cellwize

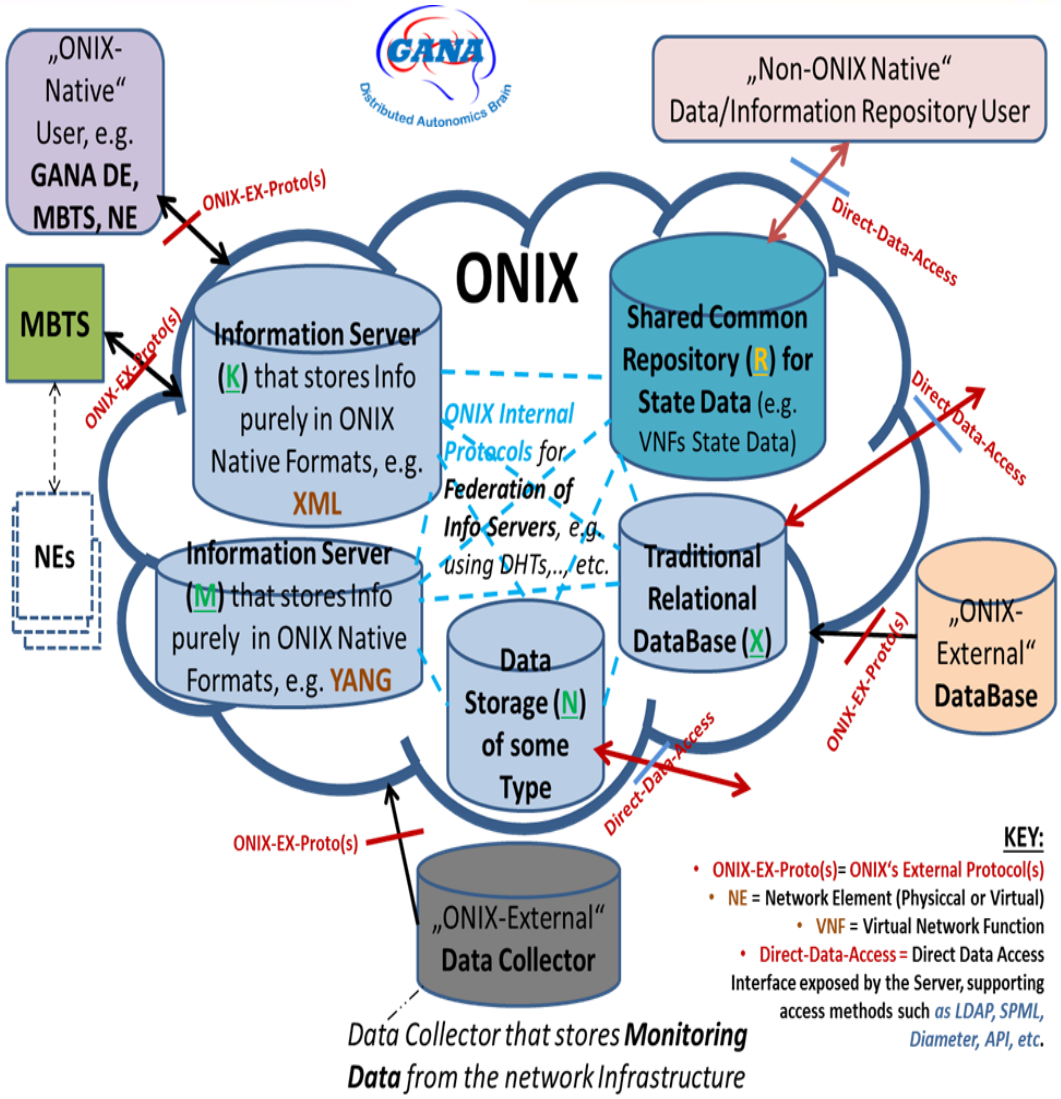
Architecture and Role of the GANA Knowledge Plane for the Transport Network (e.g. Fronthaul and Backhaul) in Autonomic (Closed-Loop) Service Assurance for 5G Slices



A Single Shared Instance of a GANA ONIX for the RAN GANA Knowledge Plane (C-SON), Transport Network GANA Knowledge Plane and Core Network GANA Knowledge Plane is Possible Scenario

ONIX as Real-Time Inventory

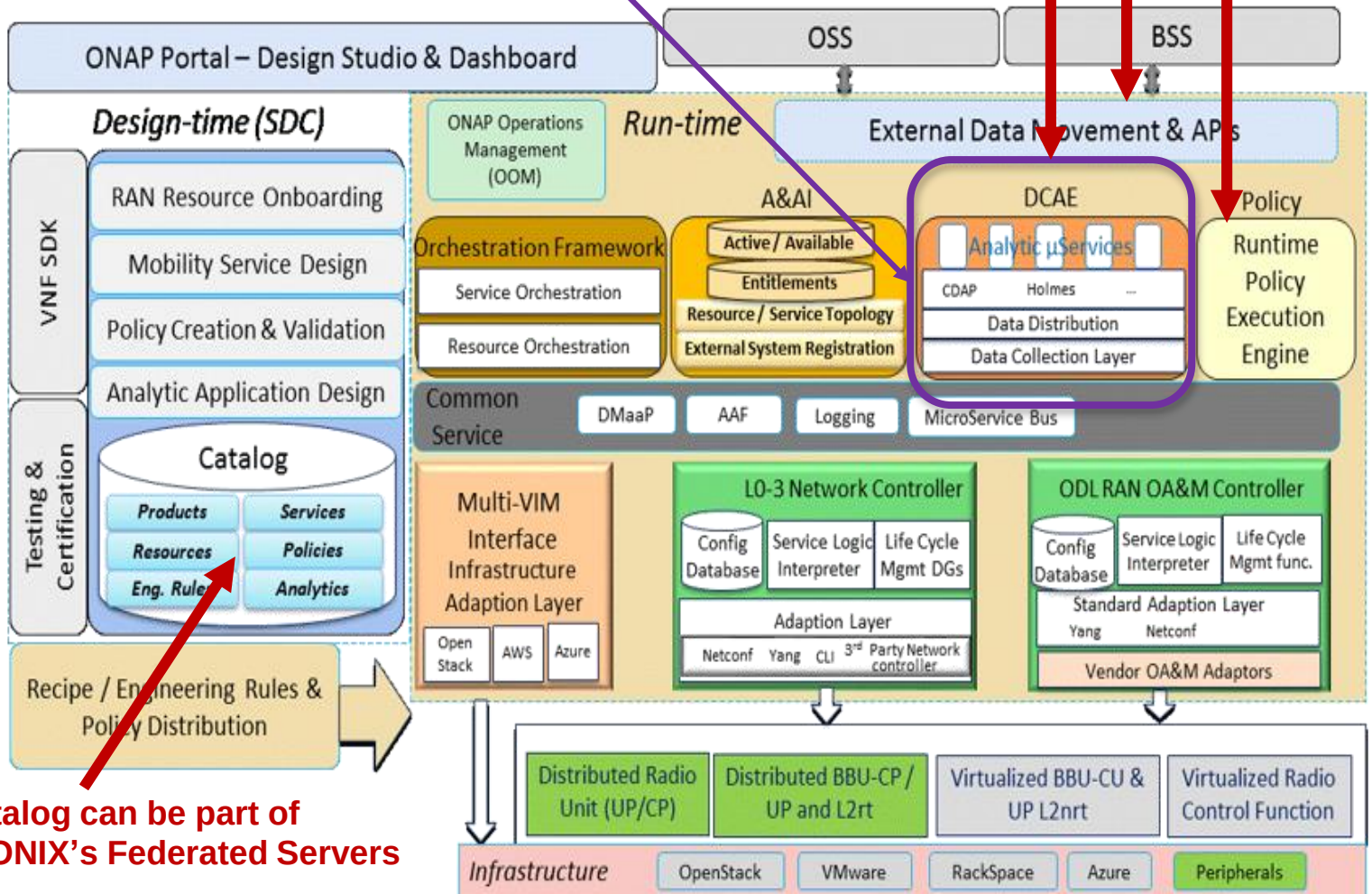
- Useful for Inventory awareness of changes over time, including Cache of Historical Decisions
- Near real time updates and extended auto-discovery, thanks to Publish/Subscribe Paradigm employed by ONIX
- Cognitive Algorithms running on some Information Servers in the management of certain information and knowledge makes ONIX a Cognitive inventory
- ONIX can be used for dynamic maintenance of Slice configurations



ONAP Architecture for RAN Deployment

DCAE - Data Collection, Analytics and Events gathers performance, usage, and configuration data from the managed environment

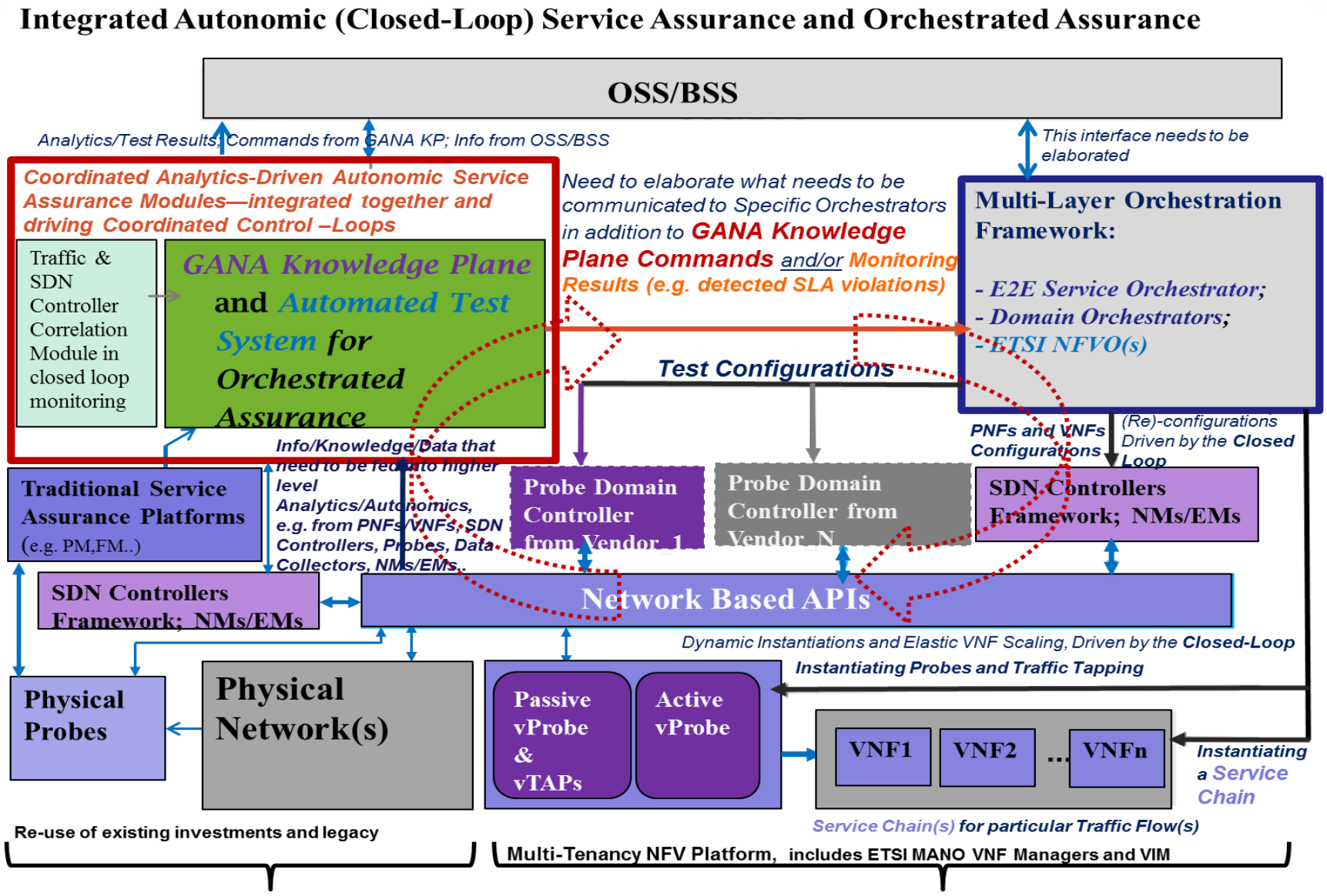
Can be used to Implement GANA Knowledge Plane DEs' and MBTS Features



The Catalog can be part of GANA ONIX's Federated Servers

Need for Integration/Convergence of Autonomic Service Assurance with Orchestrated Assurance

Architectural Framework for Integration of Orchestrated Assurance and Probing with Autonomic (Closed-Loop) Service Assurance for 5G Slices



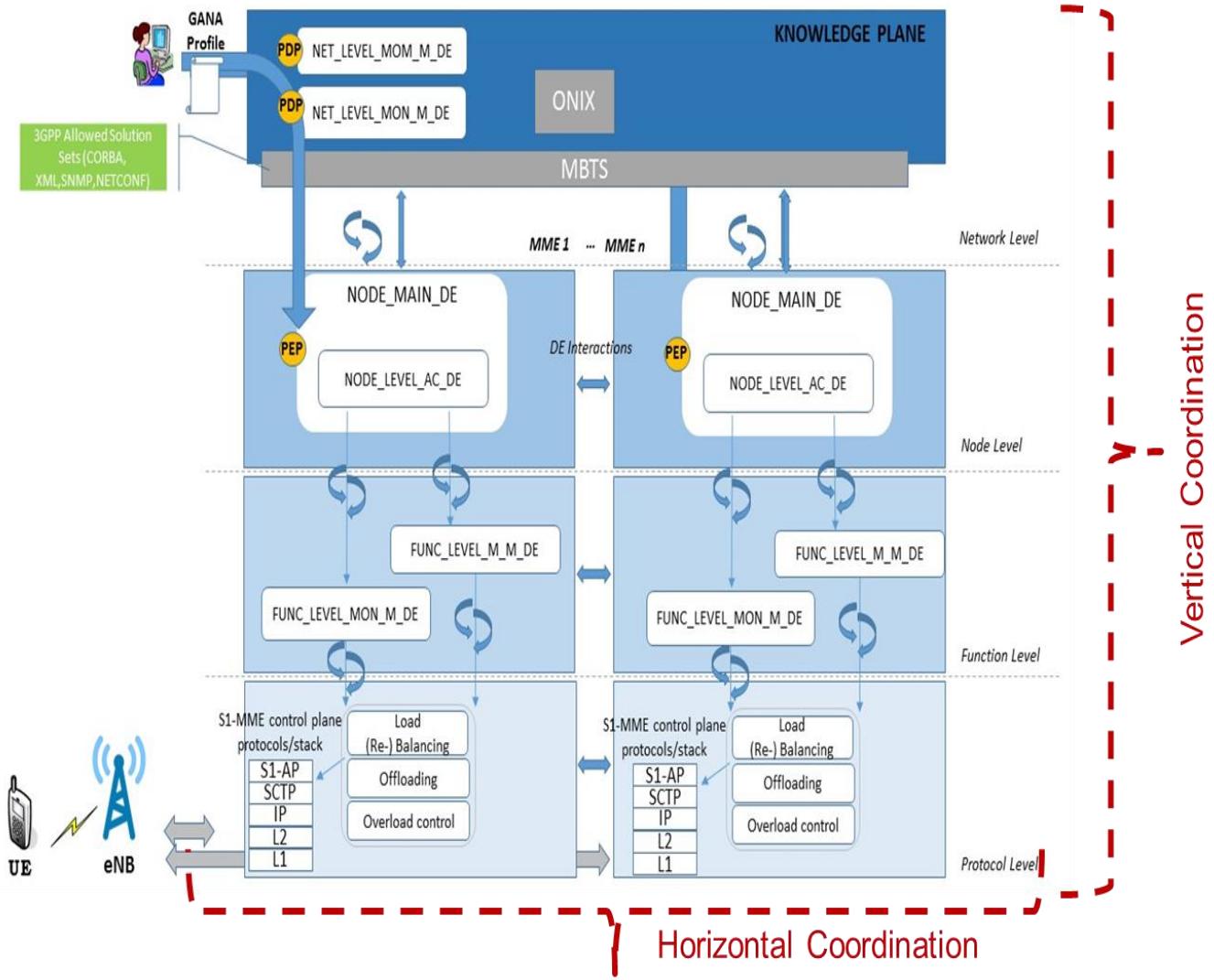
NE-Local (Node-Internal) and Distributed DE Algorithms for GANA Levels 2& 3 Autonomics in the Core Network

Example illustration of MME-Local (Internal) and Distributed DE Algorithms for GANA Levels 2& 3 Autonomic (Closed-Loop) Service Assurance for 5G Slices

Extract from ETSI TR 103 404 *on NE-Local (Internal) and Distributed DE Algorithms for GANA Levels 2& 3 Autonomics*

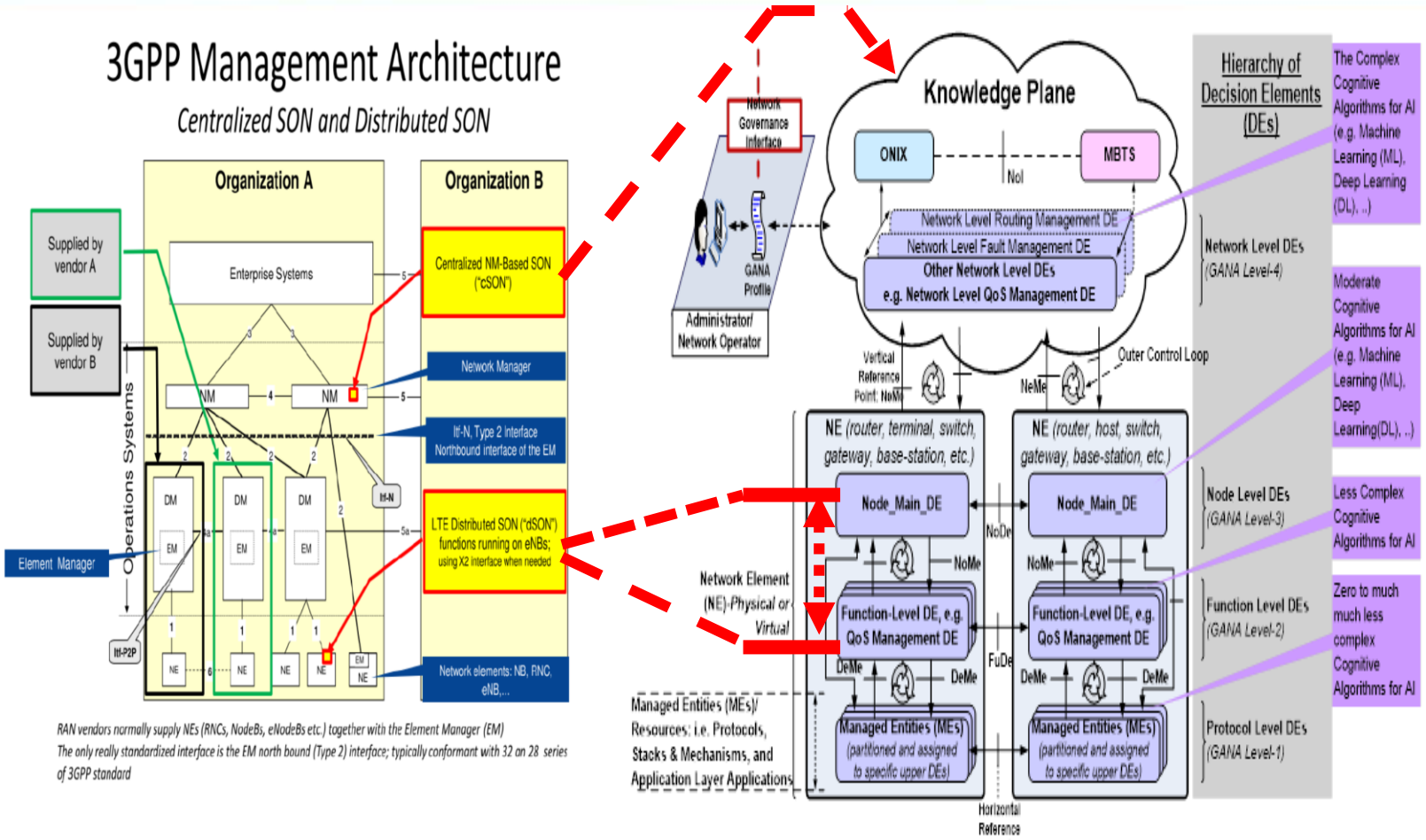
Examples of Requirements for NE level autonomics (GANA Levels 2&3) in the core:

- *NE Auto-Configuration*
- *MME Pooling*
- *Energy Saving*
- *Signalling Optimization*
- *Latency Optimization*
- *Fast Gateway Convergence with Bidirectional Forward Detection*
- *Dynamic IP Pooling*



Hybrid-SON Mappings to the ETSI GANA Model

Hybrid-SON Model Mappings to the ETSI GANA Model



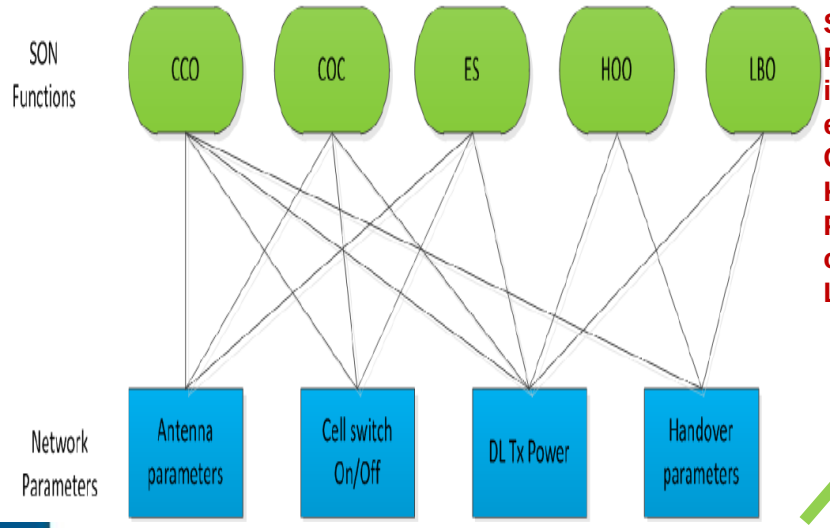
GANA for the RAN is realized by Hybrid SON (C-SON (cognitive) complemented by D-SON in eNBs)

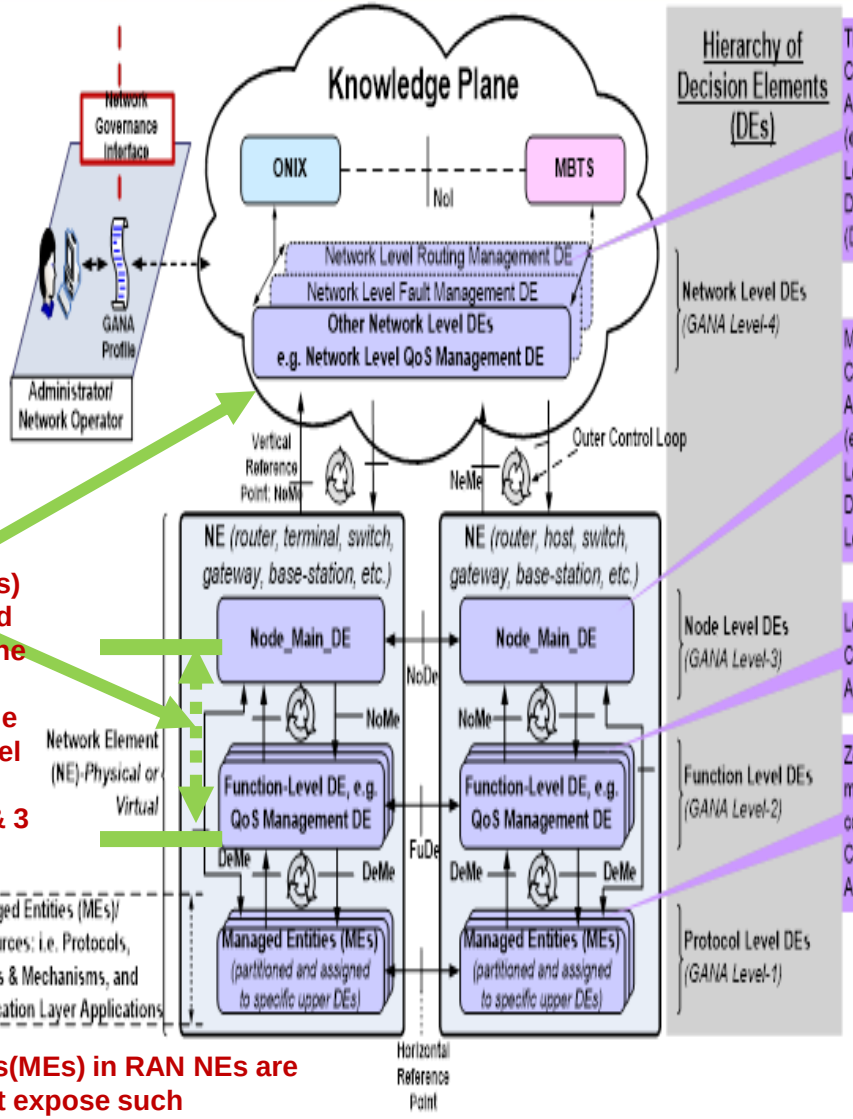
SON Function = GANA Decision Element (DE)

C-SON with Cognitive SON Functions = GANA Knowledge Plane for the RAN

SON Mappings to the ETSI GANA Model; D-SON = GANA Levels 2 and 3 DEs Implementation

SON Function	Specialization of GANA DE as SON Function(s)
Plug & Play; CCO; ANR; RACH Optimization ; 0-Touch NR Rollout	Auto-Configuration-DE
Cell Degradation Management; COC	Fault-Management-DE; Resilience & Survivability-DE
ES (Energy Saving); Unified NSI Policy; Dual Connectivity; Carrier Aggregation	Auto-Configuration-DE
H00; Mobility Assurance & MRO	Mobility_Management_DE
LBO;MLB (Load Balancing & Traffic Steering); APO;	QoS_Management_DE





SON Function(s) introduced either in the GANA Knowledge Plane Level or GANA Levels 2 & 3

Managed Entities(MEs) in RAN NEs are NE's entities that expose such Configurable Parameters

GANA Knowledge Plane Level Autonomics vs. Lower Level Autonomics on the Example of C-SON

	D-SON (GANA Levels 2&3)	C-SON (GANA Level 4)
Network View	Micro edge network view limited to the equipment vendor eNodeBs	Entire Network (bigger picture) view spanning across vendors and technologies
Data Accessibility	D-SON functions have access to a limited data set of the edge eNodeB and its local neighbourhood	C-SON has access to a wide data set covering all node types (eNodeB, NodeB and BTS) and external data sources (e.g., analytics and crowdsourcing)
Operational Restrictions	D-SON functions operate with knowledge limited to local surrounding environment and only control own node. Local execution at the network edge.	C-SON functions operate with complete visibility of all nodes and control the entire cluster. Centralized execution at the OSS level.
Multi-Vendor	D-SON only works on own equipment	complete Multi-Vendor support
Cross Technology	4G only (*) Proprietary D-SON solutions exist in 3G (ANR, Scrambling Code collision detection)	2G, 3G, 4G
Customization flexibility	Proprietary "black-box" functions with limited (complex) flexibility	High degree of flexibility, simple to adapt to MNO policies
HetNet Orchestration	Islands of D-SON functions	Entire network orchestration & coordination covering both C-SON and D-SON functions across vendors, technologies and network layers
Data Correlation	limited to eNodB data	Multi-dimensional data
Cycle time	Short cycle time (mSec) - Real Time use-cases	longer cycle time (min) - Near Real Time use-cases
Performance Load and Coordination	UEs required to read CGI of neighbouring cells, hence can impact inter-node communication (LTE X2 I/F). Coordination overhead increases as the network is densified creating possibility of inconsistencies/conflicts (e.g., PCI confusion)	C-SON collects centralized information through existing North Bound Interfaces (NBI) and has no impact UE performances. High degree of coordination across a wide geographic area including D-SON islands.
CCO (Antenna tilt Optimization)	Not available	Multi-band & technologies CCO supported
PCI	PCI collision detection (only)	PCI detection and automatic correction
Policy enforcement	Not available	Seamless policy enforcement and consistency management
Inter-RAT	Not available (e.g., ANR IRAT)	Cross technology support LTE to/from UMTS & GSM
RACH Optimization	Not available (RSI & Cell Range)	RSI & Cell Range optimization use-cases supported
Integrated into eNB RRM activities (layer3)	Utilized by D-SON MLB & MRO edge functions	Infeasible for a centralized architecture
Swap/Rehoming process	limited support as D-SON functions utilize 3GPP CGI as the unique identifier of each node	C-SON flexibility allows for MNOs customs node identifier to be utilized for equipment swap or rehoming procedures
Cell Outage Detection and Compensation (CODC)	ANR based compensation	Cluster level ANR and CCO based compensation with embedded rollback mechanism triggered when outage has seized

Key Takeaways

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- **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