

Presentation at ITU ETSI IEEE Joint SDOs Brainstorming Workshop on Testbeds Federations for 5G & Beyond: Interoperability, Standardization, Reference Model & APIs Workshop

ITU-ETSI-IEEE joint SDOs
brainstorming workshop
**Testbeds federations for 5G
and beyond: interoperability,
standardization, reference
model and APIs**

Free | Virtual
15-16 March 2021
14:00 to 17:30 CET

<http://itu.int/go/BTF4-5G>



Session 2

16th March 2021

Presenter: *Dr. Muslim Elkotob: Vodafone, ETSI TC INT, ITU, IEEE*



The Standards People



Federated AMC by ETSI GANA KPs for Autonomic/Autonomous 5G Networks, Example Use Case for Federated Testbeds as required by CSPs (Telecom Operators) Systems

Dr. Muslim Elkotob, Vodafone

ITU ETSI IEEE Joint SDOs Brainstorming Workshop on Testbeds Federations for 5G &
Beyond: Interoperability, Standardization, Reference Model & APIs

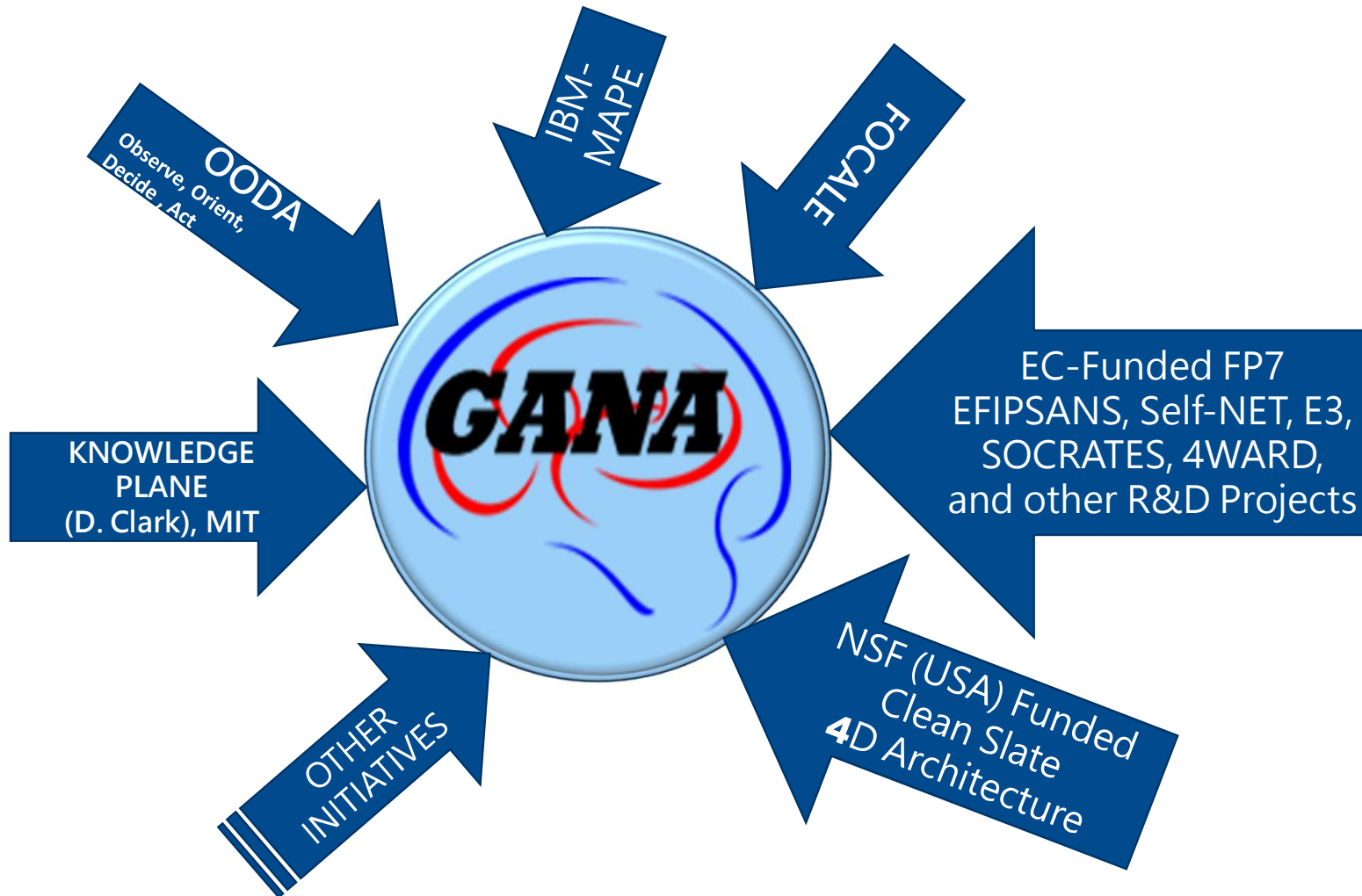
March 16th 2021

Outline

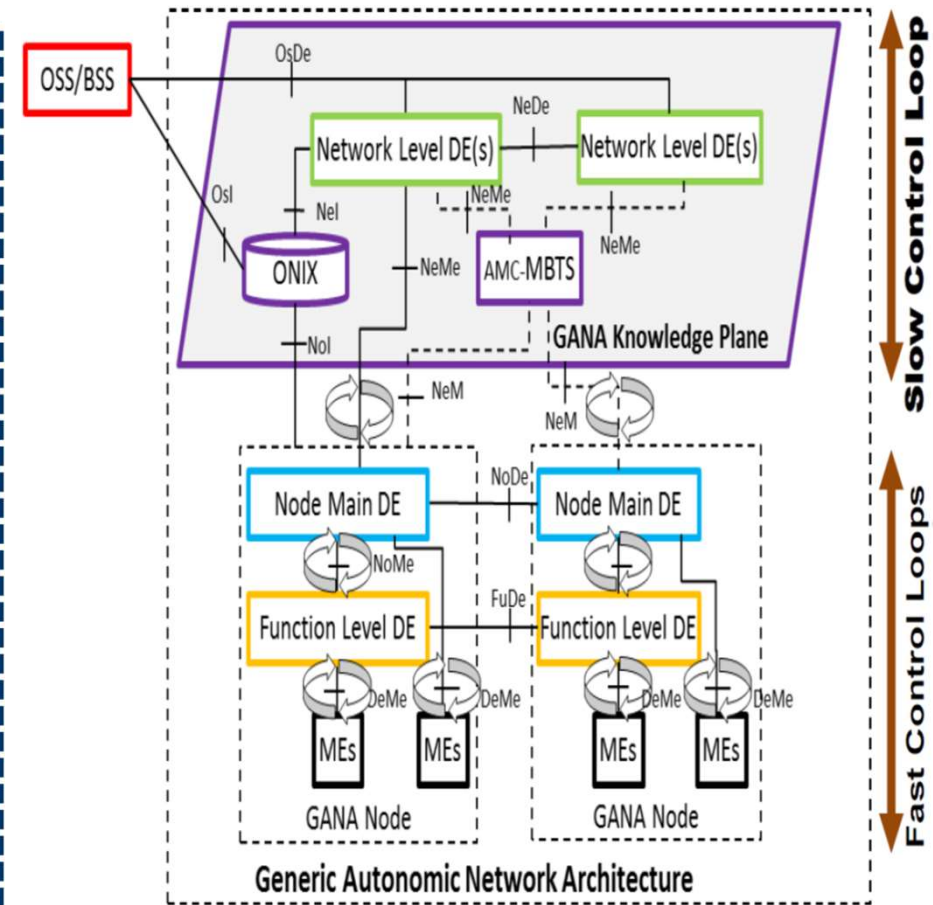
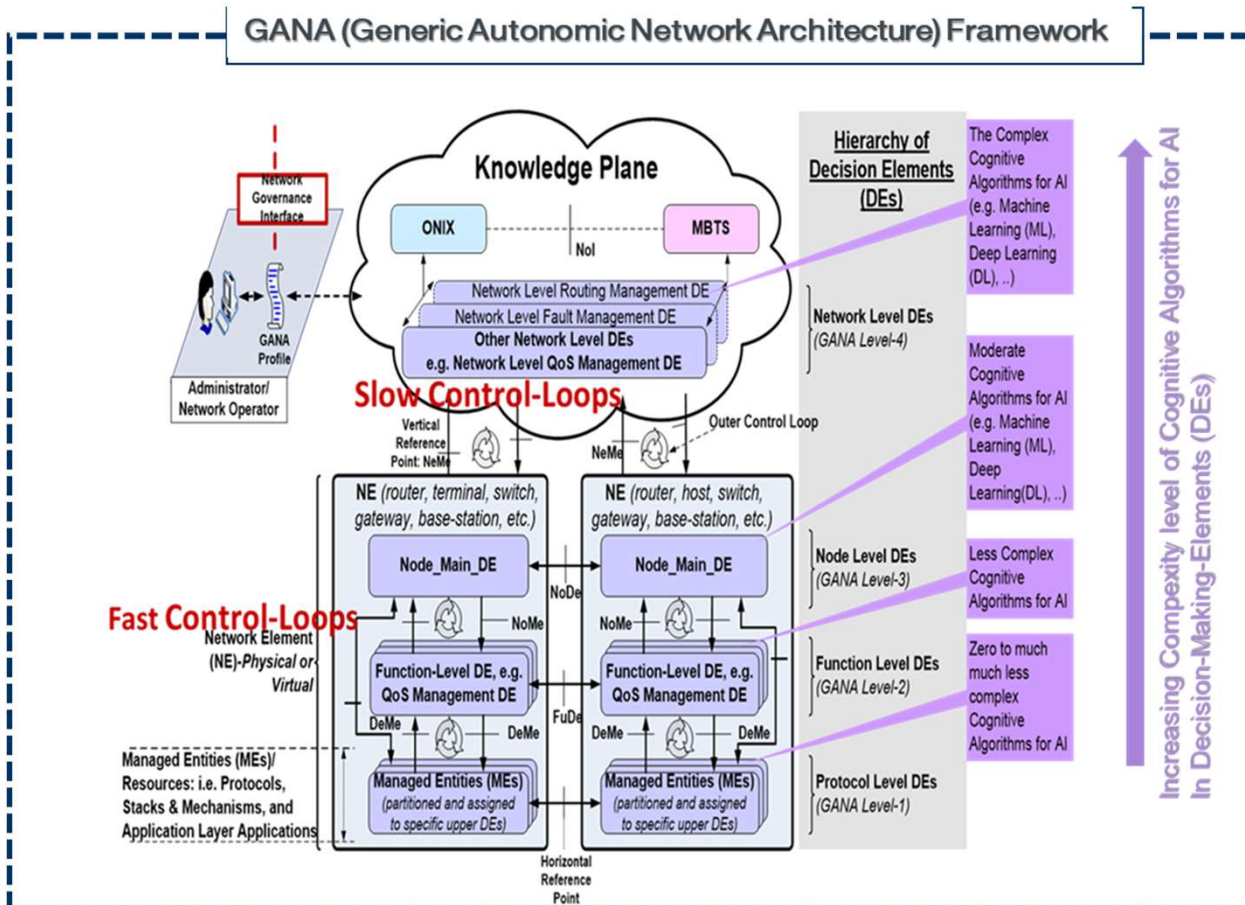
- Autonomic Management & Control (AMC) and GANA Knowledge Plane (KP) Concept
 - GANA Background, Reference Model & Functional Architecture
- Federation of GANA Knowledge Planes (KPs) as Platforms for E2E Cross Domain AMC
 - Concept, Variations: Inter-Segment, Inter-CSP, Horizontal & Vertical
- Federated Testbeds Use Cases:
 - Need for Testbed as a Service (TaaS) in GANA KP & Federations Context
 - Security as a Service (SaaS) as Use Case for Federated Testbeds
 - Inter-SDO GANA KP Federations Testing benefit from Federation of Testbeds: Federated AMC across the BBF & 3GPP Architecture Domains using GANA Knowledge Plane Platforms
- Conclusion & Outlook

ETSI GANA as a Holistic & Unifying Model for AMC (Autonomic Management & Control) that fuses together the well-established models for AMC:

(Reference : ETSI TS 103 195-2)



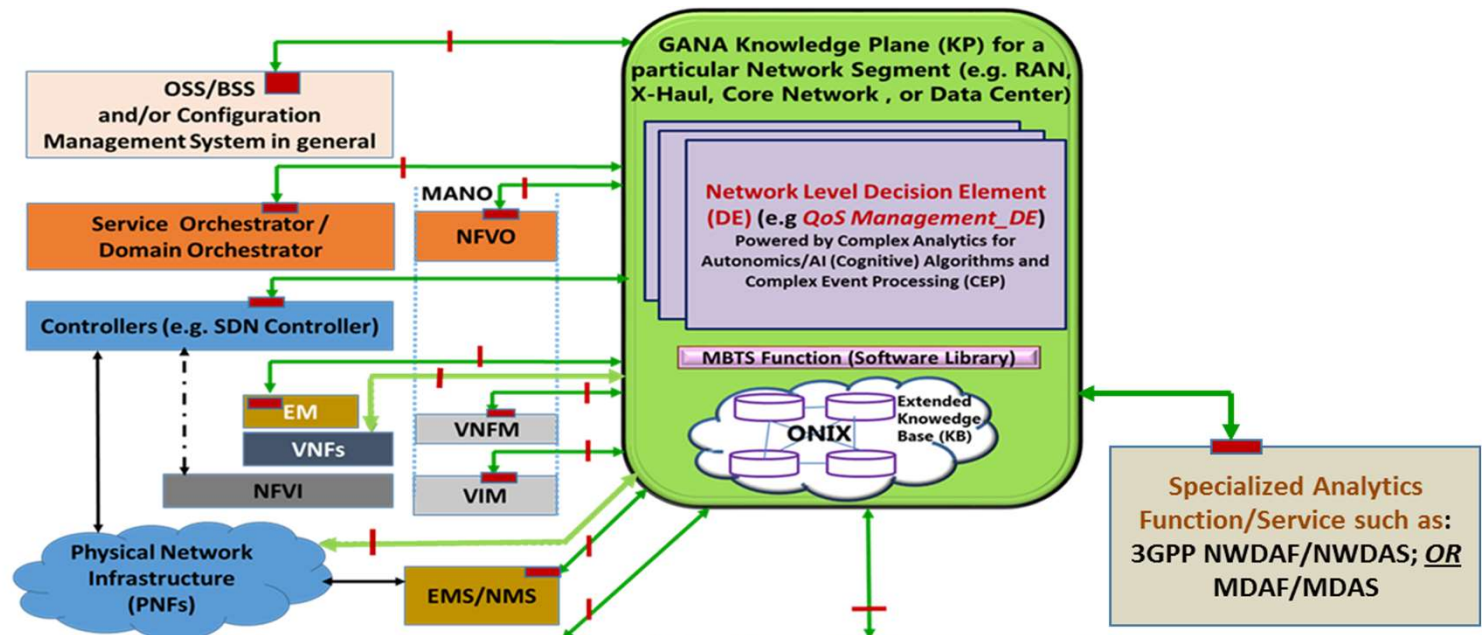
ETSI GANA (Generic Autonomic Networking Architecture) Reference Model / Functional Architecture (ETSI TS 103 195-2)



GANA is Framework for Multi-Layer Autonomic Management & Control (AMC)/Autonomics & Multi-Layer AI/ML for AMC © ETSI 2020

GANA Knowledge Plane (KP) Structure: Functional Blocks

GANA Multi-Layer Autonomics & AI and ETSI GANA Knowledge Plane(KP) Integration with other Systems



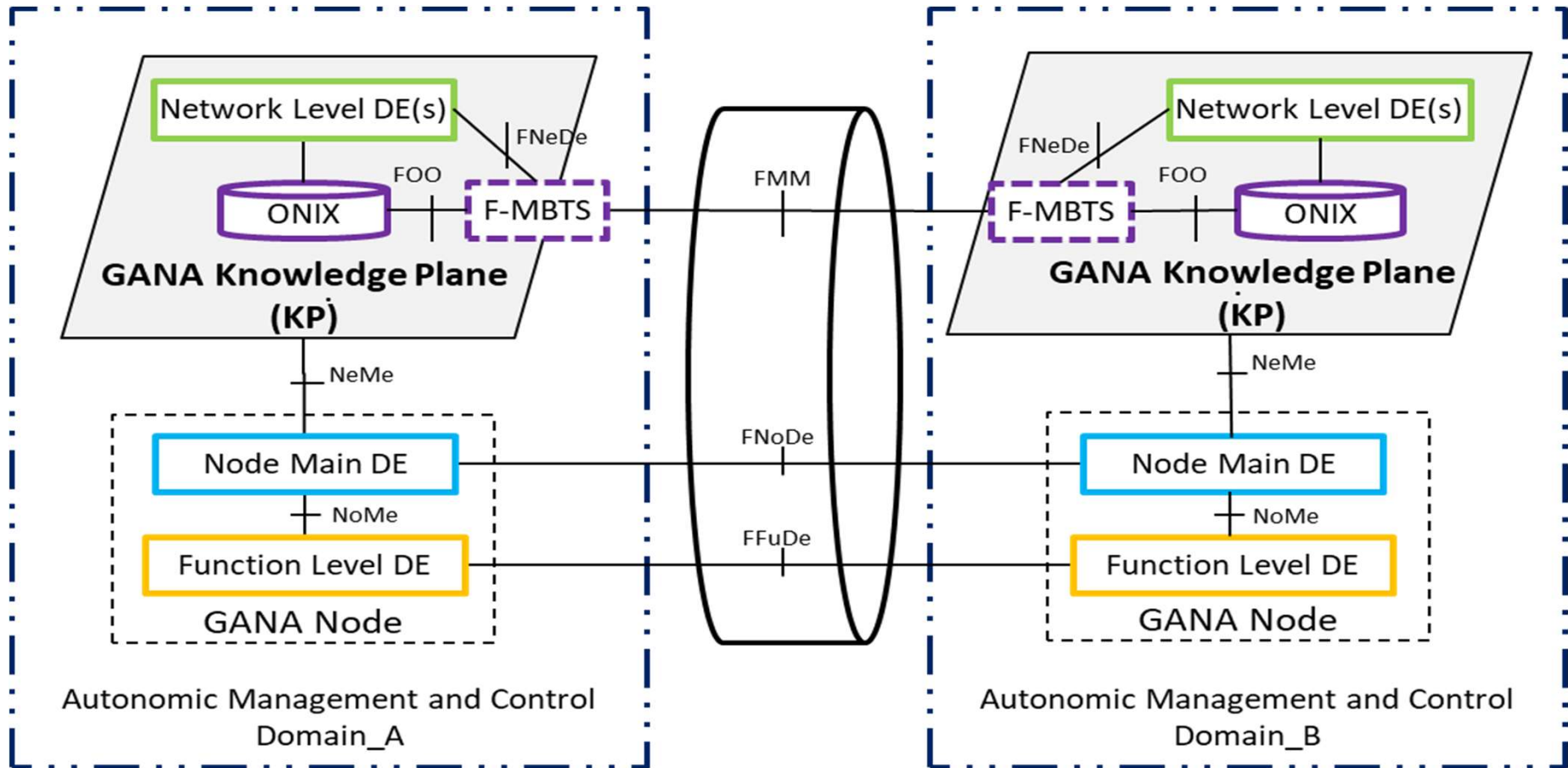
Legend:
 = **NBI (NorthBound Interface)** implemented as an **API** (e.g. RESTful API) or **Protocol**. The GANA KP uses the NBI exposed by the entity to program the network or services, or to configure the entity to export Data, Info, Knowledge, or Events to the GANA KP or other consumers

Certain **Big-Data Applications & other Applications** (e.g. Optimization Apps) that should interwork with the KP or can be invoked by KP— *if such Applications couldn't be implemented as integral parts of the KP* (either as embedded parts of DE logic or as Analytics Modules commonly shared by the multiple KP DEs)

Other Types of Data/Info/Knowledge Sources & Event Sources:

- *Meta-Data from NEs/NFs; Syslog; SNMP; NetFlow/IPFIX/sFlow; Telemetry Data; Fault-Management (FM) and Performance Management (PM) Systems; Configuration Management (CM) Platform; Trouble Ticket Systems; Data Collectors; Topology Info; HealthScores Data; Config-Data; Service Definitions and any mappings to QoS Classes, SLA Definitions & Customer Identifiers Info/Data; Other Data/Info Sources;*

Federation of GANA Knowledge Planes (KPs) Framework (ETSI TS 103 195-2)



Importance&Need for Diaggregated GANA KP Platforms for Specific Network Segments

- SDOs such as **ETSI TC INT AFI WG** and **NGMN** advocate fo **Disaggregated GANA KP Platforms** for specific network segments/domains, due to the **call by CSPs for Disaggregated Networks, Control Planes & Data Planes and Software Platforms** for AMC
- **Intra-CSP Federations** of GANA KP Platforms across Network Segments and **Inter-CSPs GANA KP Platforms Federations** inherently and correspondingly require **Federated Testbeds** to Test the Cross-Domain AMC Operations
- CSPs sometimes need Testbeds/Testbed Assets from other stakeholdersto build the E2E Network and its corresponding KPs in order to Test the federated AMC Operations across the various network domains (e.g. E2E Self-Optimization/Protection/Defence to address security challenges)

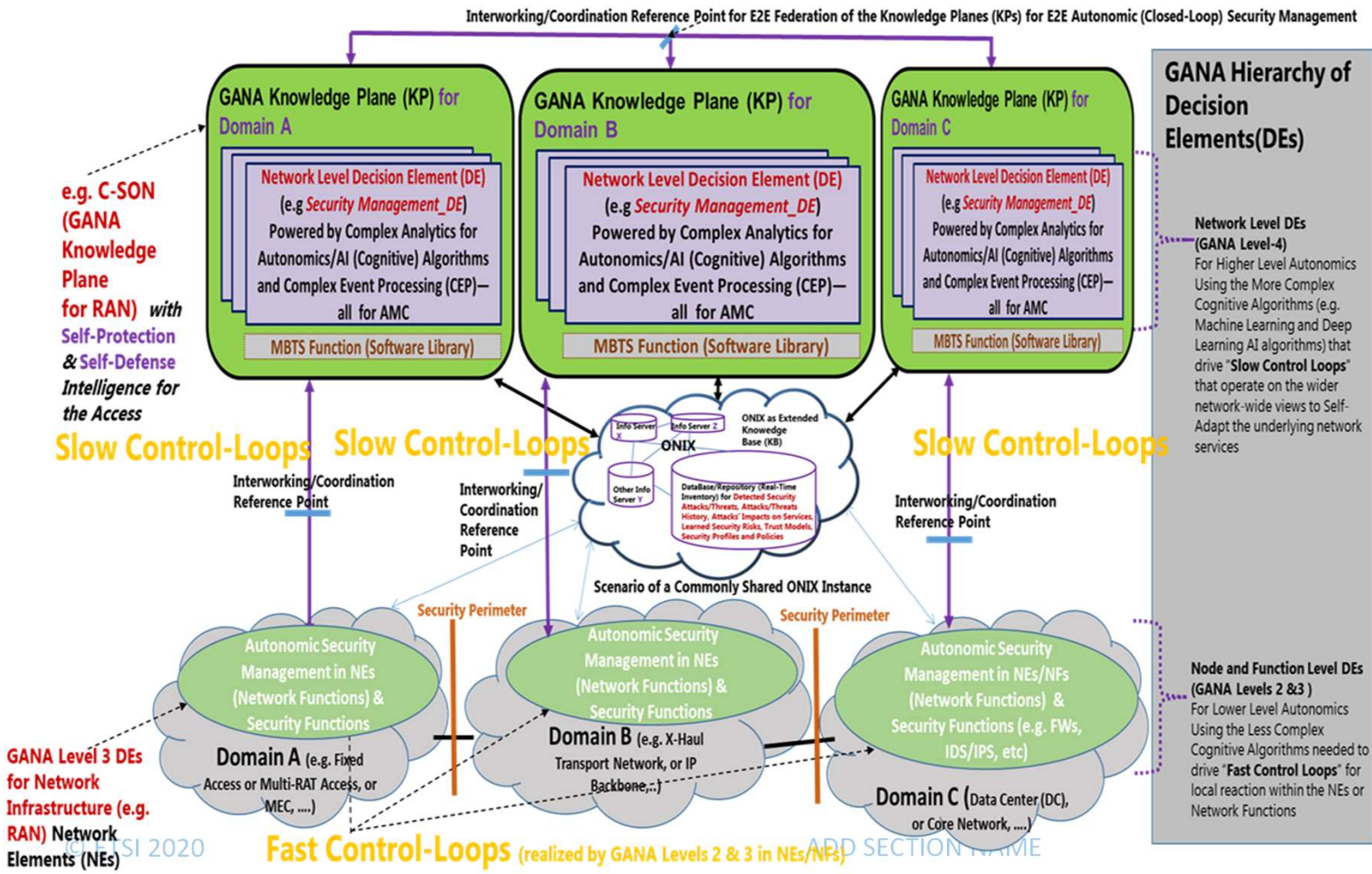
Inherent Need & Importance of Federated Testbeds to Test Cross-Domain AMC Operations E2E



- **NGMN & ETSI TC INT AFI** achieved consensus on the importance of KP Platforms for AMC to be *disaggregated* (per asset or segment e.g. RAN, X-Haul Transport, Core).
- Both SDOs agree that *E2E Autonomic (Closed-Loop) Service and Security Management & Control in 5G* shall be achievable by way of **Federation of the KP-Level Security-Management-DEs** across multiple network segments/domains; an important step towards building **Security-as-a-Service (SaaS)** and **Testbed-as-a-Service (TaaS)**
- CSPs & Enterprises need solution suppliers for Autonomics software (DEs), AMC Platforms, for specific ICT network segments not to be from the same supplier (to leverage value, support competitive solutions sourcing, and maintain flexibility). **Disaggregation** thus eliminates “vendor lock-in” and enables **competition & innovation** among suppliers

Federation of GANA KPs for E2E Autonomic Service & Security

Assurance of 5G Slices **Horizontal Federation of KPs**



GANAs Hierarchy of Decision Elements (DEs)

Network Level DEs (GANAs Level-4)

For Higher Level Autonomics Using the More Complex Cognitive Algorithms (e.g. Machine Learning and Deep Learning AI algorithms) that drive "Slow Control Loops" that operate on the wider network-wide views to Self-Adapt the underlying network services

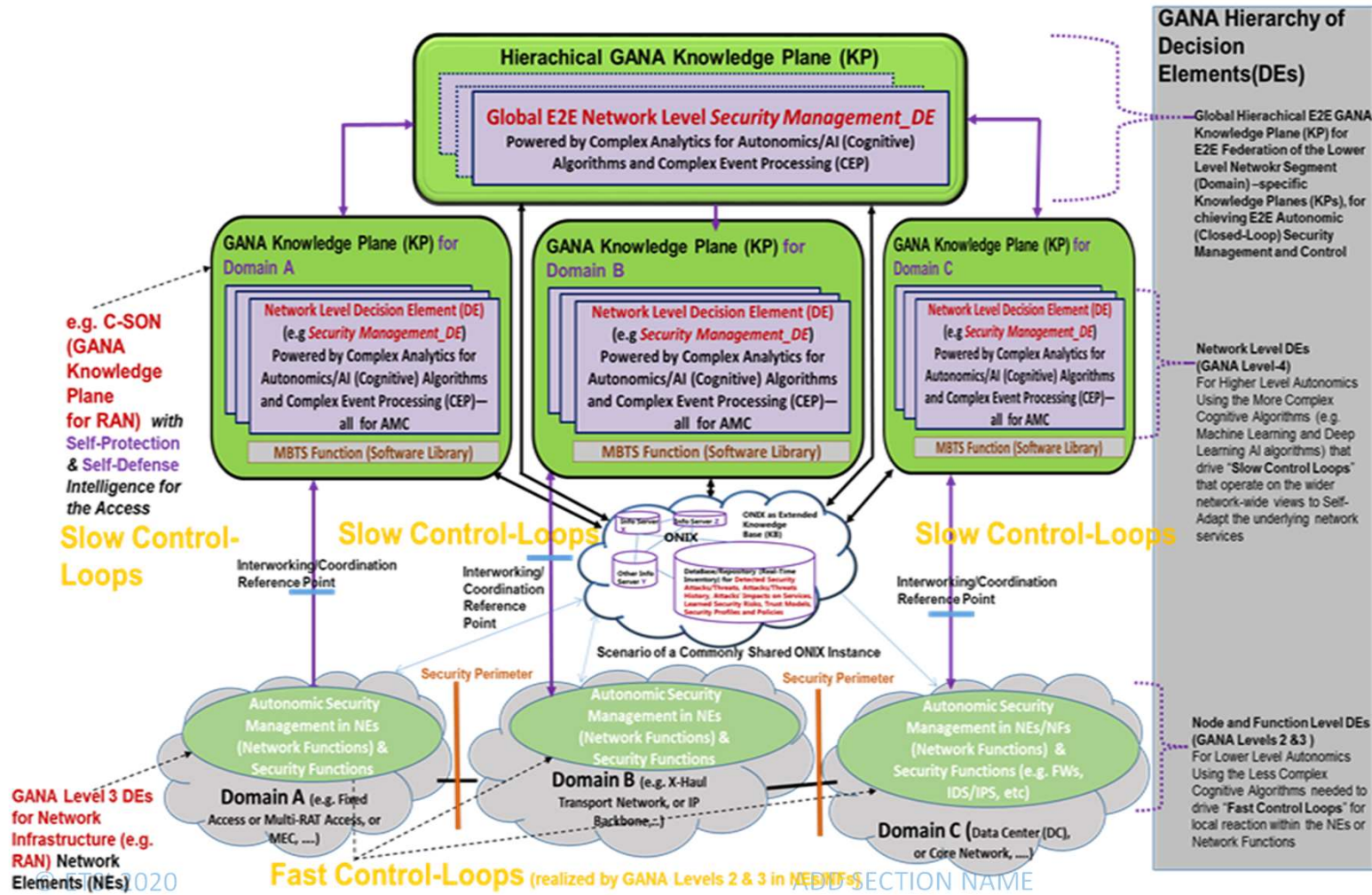
Node and Function Level DEs (GANAs Levels 2 & 3)

For Lower Level Autonomics Using the Less Complex Cognitive Algorithms needed to drive "Fast Control Loops" for local reaction within the NEs or Network Functions

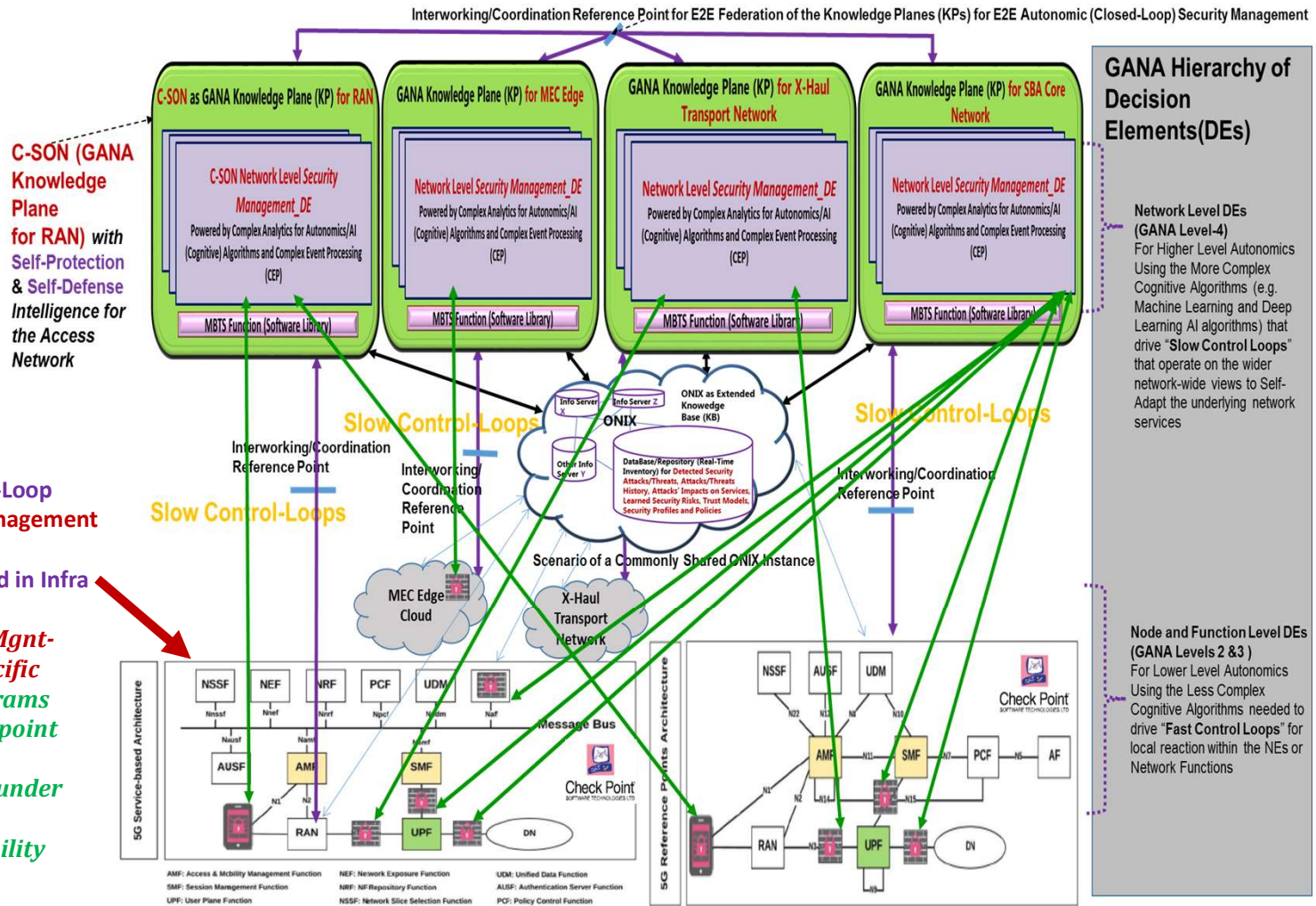
GANAs Level 3 DEs for Network Infrastructure (e.g. RAN) Network Elements (NEs)

e.g. C-SON (GANAs Knowledge Plane for RAN) with Self-Protection & Self-Defense Intelligence for the Access

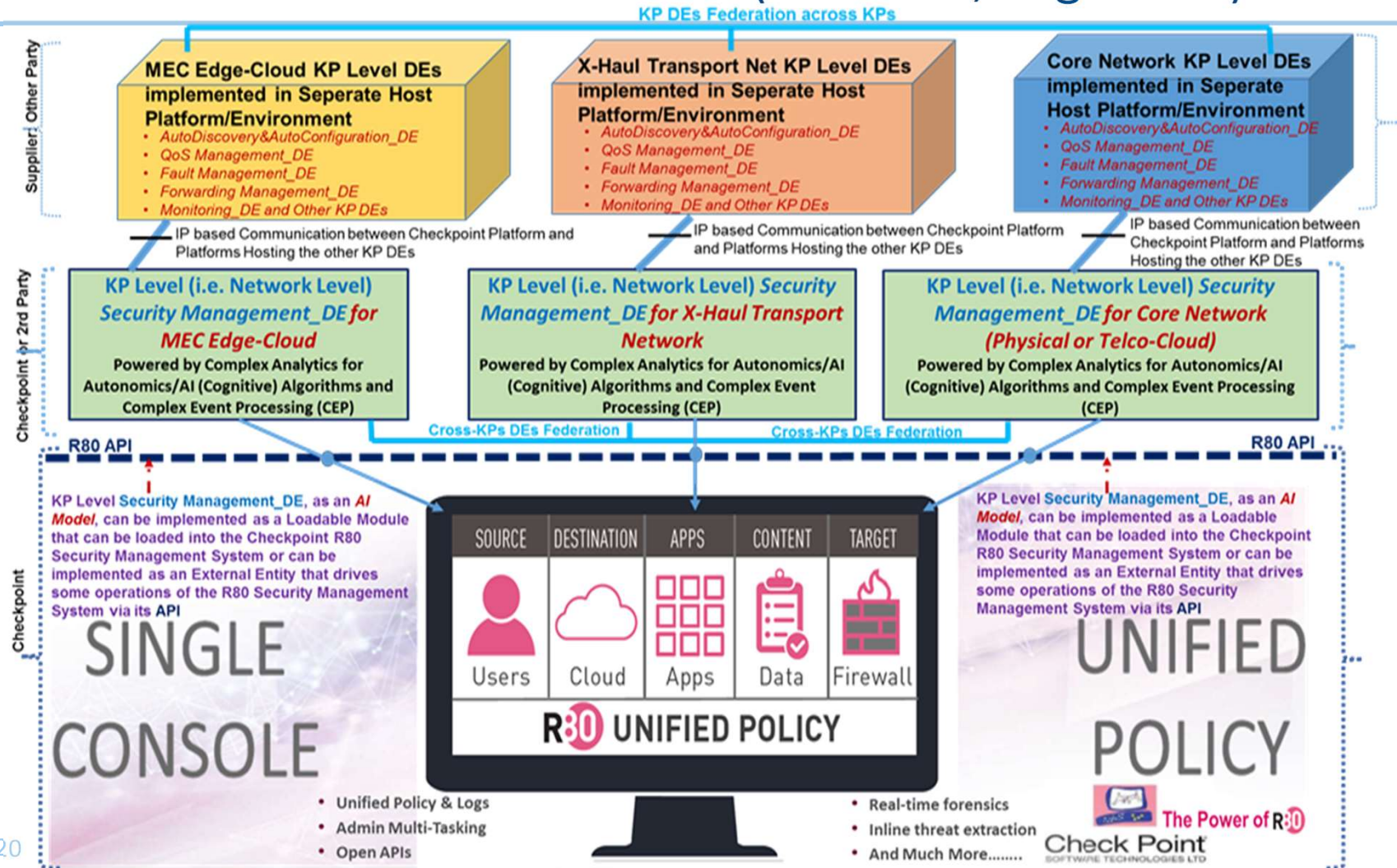
Federation of GANA KPs for E2E Autonomic Service & Security Assurance of 5G Slices **Vertical/Hierarchical Federation of KPs**



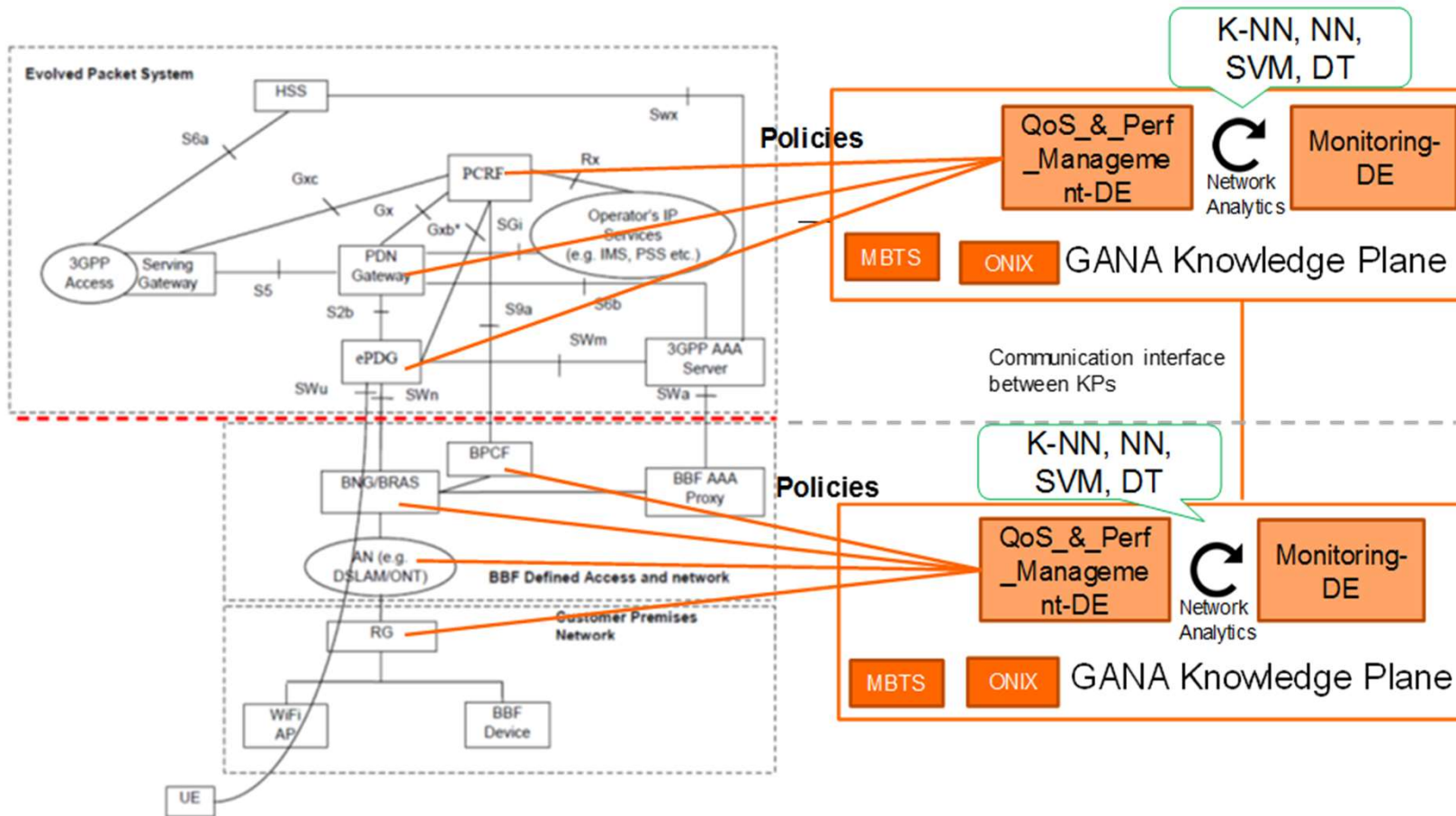
Horizontal GANA KP Federations & Need for Testbed as a Service (TaaS)



Security as a Service (SaaS) Implementation Example in Intra and Inter-CSP KP Asset Federation (Testbeds, Segments)



Federated AMC across the BBF & 3GPP Architecture Domains using GANA Knowledge Plane Platforms



Conclusion & Outlook

- SDOs such as ETSI TC INT AFI WG and NGMN advocate for Disaggregated GANA KP Platforms for specific network segments/domains, due to the call by CSPs for Disaggregated Networks, Control Planes & Data Planes and Software Platforms for AMC
- Intra-CSP Federations of GANA KP Platforms across Network Segments and Inter-CSPs GANA KP Platforms Federations inherently and correspondingly require Federated Testbeds to Test the Cross-Domain AMC Operations
- When applied to testbeds, GANA allows asset exposure and Testbed-as-a-Service (SaaS) modelling and with federation provides significant advantages for (especially) CSP stakeholders
- The Standardized Testbeds Federation Reference Model for aligning and streamlining various stakeholder architectures strengthens the eco-system and value-chain for increased collaboration and leveraging of Testbeds for 5G & Beyond among stakeholders (CSPs, vendors, testbed-operators, open-source and „disruptive players“, ..)

Backup

GANA as a Hybrid Model for Multi-Layer Autonomics and associated Multi-Layer AI Algorithms



❑ GANA is a Hybrid Model

- ❑ It guides and offers flexibility to implementers on the choice to implement certain autonomics as distributed software and algorithms within certain Network Elements/Functions (NEs/NFs), i.e. „**Micro Autonomics**“, while being able to also choose to implement some algorithms as centralized algorithms in the KP Platform („**Macro Autonomics**“)

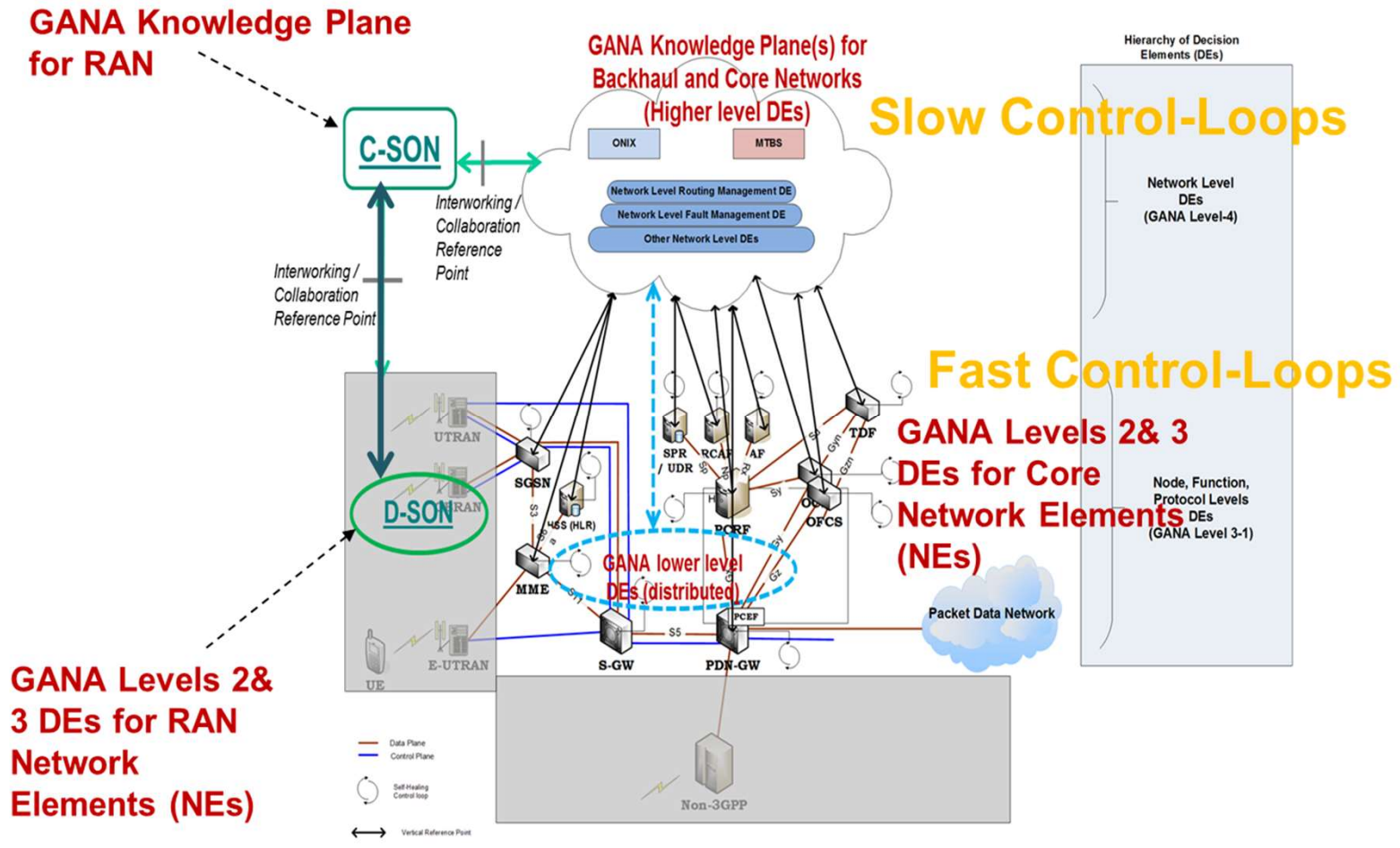
❑ Hybrid SON Model is compatible with GANA

- ❑ Hybrid SON (C-SON(**Centralized SON**) & DSON(**Distributed SON**)) are considered as an implementation of the GANA Model for the RAN

Example of a GANA Instantiation onto a particular Network Architecture and its associated Management & Control Architecture



Instantiation of GANA onto 3GPP EPC Core & Backhaul Network (ETSI TR 103 404); and Federated/Interworking GANA Knowledge Planes for RAN-, Backhaul- and 3GPP EPC Core Networks complemented by low level autonomies



ETSI GANA PoC Consortium



- Orange
- Verizon
- NTT
- Telecom Italia
- Vodafone
- Altran
- Cellwize
- Huawei
- Incelligent
- QalyCloud
- IPV6 Forum
- Big Switch Networks
- Asocs Networks
- Softwell Performance AB
- Rohde & Schwarz
- DATAKOM
- Check Point



- Spirent
- Siemens
- Fraunhofer Fokus
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