5G Network Slicing PoC Demo-2 Datasheet

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

Demo-2 Name: C-SON Evolution for 5G, Hybrid-SON Mappings to the ETSI GANA Model, and Federation of GANA Knowledge Planes for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices through a Real Implementation

NOTE: This Demo 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. **Demo-1** of the overall PoC covered the aspect of Smart Insurance Providers as Key Requesters and Consumers of 5G Network Slices Delivery Services by Service / Slice Providers.

Date: February 13th 2018
Location: Demo hosted by Orange in Paris, France
Room: 1E-6-Big
Address : Orange Gardens, 40 - 44 AVENUE DE LA REPUBLIQUE / 92320 - CHATILLON

Agenda

Session-1: 09:45 -10:45

- ***Overall Presentation on C-SON Evolution for 5G, Hybrid-SON Mappings to the ETSI GANA Model, and Federation of GANA Knowledge Planes for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices***

Break

Session-2: 11:00 -12:00

- ***Connected Cars Use Case and associated requirements on C-SON***

Session-3: 12:00 -13:00

- ***Demo of Cellwize C-SON GUI and its Provisioning GW as an Implementation case for the ETSI GANA MBTS (Model-Based Translation Service) Functional Component***

Lunch

Session-4 (Repeat of Session-3 for those who could not attend morning): 14:00 -15:00

- ***Demo of Cellwize C-SON GUI and its Provisioning GW as an Implementation case for the ETSI GANA MBTS (Model-Based Translation Service) Functional Component***

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Problem Statement from Service Providers perspective in Digital Ecosystems space

Service Providers (SPs) need innovative technologies to address increasing customer expectations and new regulation requirements such as the European GDPR and regulations in force in other regions. Customer service demands are becoming more and more challenging. The newly desired Service Provider's environment for digital services design, creation and delivery (service fulfilment) to service consumers need to be smarter in the automation of processes, in supporting more autonomous on-demand service instantiation and consumption by service consumers. And in supporting agility and flexibility in enabling to instantiate and deliver the services that the customer really wants anytime anywhere. In this respect, a customer as a Service Consumer is to be given a more active role by the Service Providers in the dynamic service design and delivery processes and more generally in the whole Service life cycle (DevOps / CI / CD). In this regard, SPs are departing from the traditional rigid model by which Service Providers used to handle all the processes solely without delegation of some of the processes to service consumers directly in such a way as to enable them to instantiate services on-demand wherever they need the services to be delivered by the SP's Networks and Service Delivery Platforms. Hence the Customer becomes a key actor within the Digital Ecosystem.
These new service delivery environments of the SP and new Digital Ecosystems are to interact and exchange personal information, and at the end, they will only prevail if Service Provider first and then the other Partners/Actors of the Digital Service Ecosystem respect the customer's most important asset, which is their data. This is especially important in the "Insurance Business" that manages mainly personal information.

For the Service Provider (SP), the success on delivering various types of 5G Network Slices of varying requirements and SLAs (Service-Level Agreements) as services to various Service Consumers of the SP (including Smart Insurance Players as Network Slice Service Requesters and Consumers), the SP must implement a *Framework for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices*. E2E Autonomic (Closed-Loop) Slice Assurance shall be achievable through Federation/Interworking of GANA Knowledge Planes for RAN (C-SON), Fronthaul & Backhaul and Core Network (e.g. EPC); complemented by low levels autonomics in RAN, Transport and 5G Core Network for Multi-domain correlation (RAN, Fronthaul, DC, Backhaul, Core Network). Such a Framework must address the following key aspects:

- Federation of GANA Knowledge Planes (KPs) for E2E Autonomic (Closed-Loop) Service Assurance for 5G Slices through the interworking of a GANA Knowledge Plane for RAN (realized through Centralized SON (Self-Organizing Networks) with cognitive SON functions), GANA Knowledge Plane for the Transport Network (e.g. x-haul/Backhaul) and a GANA Knowledge Plane for the Core Network, for correlated assurance of RAN Slices, Backhaul Slices and Core Network Slices
- How NE (Network-Element) internal Autonomics Control-Loops and Distributed Control-Loops across NEs in the RAN, Fronthaul, Backhaul and Core Network complement higher Level Autonomics Control-Loops in achieving E2E Autonomic Service Assurance for 5G Slices. Noting that for the RAN, low level autonomics is realized through D-SON (Distributed SON), which is then complemented by higher level autonomics (namely C-SON), and that autonomics for the other network segments beyond RAN is also required.
- KPIs specific to 5G network segment slices and their communication to the Autonomics Decision-making Elements/Engines and associated Control-Loops for Slice SLA Assurance; and KPIs exchanged between the GANA Knowledge Planes (KPs) to effect E2E Collaborative Autonomic Service Assurance (Self-Optimization) for 5G Slices by the Knowledge Planes

The Key Requirements that belong to the Problem Statement that underpins the ETSI NTECH AFI WG "5G Network Slicing" PoC:

- In 5G, it is envisaged that SPs will offer to various types of network service consumers the flexibility to instantiate and consume network services on-demand and with agility, and among such network services would be "Network Slice –as-a-Service", and Verticals providing IoT Services Delivery are some of the SP's customers that will trigger the creation of Network Slices in the SP's End-to-End environment—spanning Access Networks, x-Haul (Fronthaul and Backhaul) and Core Networks. Insurance Platforms are bound to be some of the SP external systems that will trigger the creation of Network Slices in an SP environment on-demand, as they would be an actor in service instantiation processes.

- 5G Network Slices can span multiple network segments from Access Networks through to x-Haul and Core Networks—thereby creating the notion of E2E concatenated slices that consist of access network slices (e.g. RAN slices), x-Haul slices and core network slices that form an Aggregate Network Slice that may be required by a vertical market oriented stakeholder as service consumer of an SP
- The Service Assurance for Network Slices should be achieved through E2E Closed-Loop (Autonomic) Service Assurance of the E2E network slices by means of a Federation of Autonomic Service Assurance Components that collectively work together in an E2E fashion to deliver Network Slices assurance and adaptive network resource programming across the network segments delivering the aggregate network slices, e.g. across Access Networks, x-Haul (Fronthaul and Backhaul) and Core Networks. SON (Self-Organizing Network) functions for the 5G RANs should interwork with GANA components such as GANA Knowledge Plane components to deliver E2E Autonomic (Closed-Loop) Service Assurance of Network Slices for Self-* features for network slices, such as ***Self-Optimization and Self-Healing of Network Slices***.
- GANA empowered Autonomic (Closed-Loops) Service Assurance for 5G Network Slices
- Achieving E2E Autonomic (Closed-Loop) Slice Assurance through Federation/Interworking of GANA Knowledge Planes for RAN (C-SON), Fronthaul & Backhaul and Core Network (e.g. EPC); complemented by low levels autonomics in RAN, Transport and 5G Core Network for Multi-domain correlation (RAN, Fronthaul, DC, Backhaul, Core Network)
- Integration/Convergence of Autonomic (Closed-Loop) Service Assurance with Orchestrated Assurance
- Considering IPv6 in the picture on 5G, it is worthy to note that while IPv6 is expected to play a big role in 5G (e.g. in mMTC 5G slices) there are IPv6 specific features that bring value to 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

Smart Insurance Providers as Key Requesters and Consumers of 5G Network Slices Delivered by Service Providers in fulfilment of the Slice Requests

From Service Providers point of view, the "Smart Insurance" market is of high interest because it is an opportunity to create high value added services for SP's existing customers (or new customers) and can trigger technical drivers to evolve an SP' infrastructures towards 5G arena in the way that can better monetize the SP's assets —thanks to the "Slicing" concept, and this transformation is bound to open up new business models—highly profitable and recurrent. The 5G Network Slice "Factory" Service Providers are about to deploy in the coming years, is expected to deliver numerous Network Slice Types as described by 3GPP such as eMBB (SST 1), uRLLC (SST 2), mIoT (SST 3) and V2X (SST 4) which are the first standardized ones. Indeed, as stated in the Problem statement, in the IoT world, exiting technologies e.g. NB-IoT, LTE-M can partially answer this need. However, in Smart Insurance and infotainment (4K /8K, Augmented and /Mixed Reality), Autonomous Cars, Smart Factories, Smart Building / Smart Home, and others, 5G is expected to meet those eMBB, uRLLC, IoT, V2X related characteristics. The ability of Service Providers (5G Slice Providers) to deliver those four key Slice Types and more in the future as enablers for such services or so to say "5G Slice as-a-Service (5G Slice aaS)" in terms of very large bandwidth and very low latency, will unlock some existing applications to new service models and pave the way for development of innovative applications we don't imagine today but will emerge in the future.
NOTE: Demo-1 of the overall PoC covered this aspect of Smart Insurance Providers as Key Requesters and Consumers of 5G Network Slices Delivery Services by Service Providers.

5G Slice Provider and Consumer Business View of the Overall PoC (consisting of multiple Demo Cases)

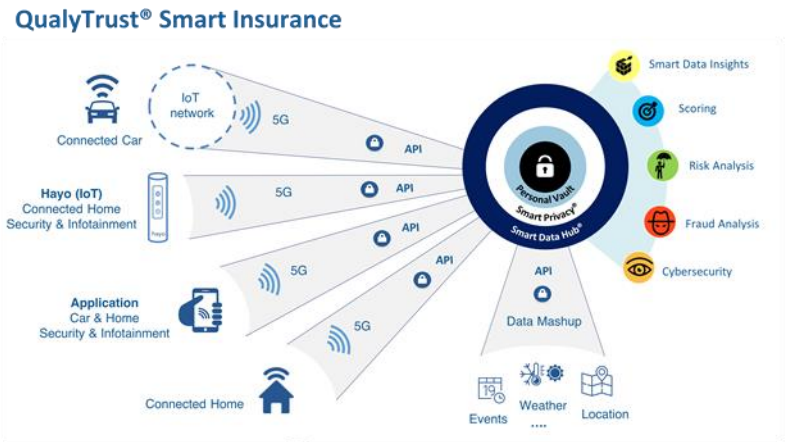
The overall PoC is looking into the practicalities of delivering Smart Insurance in complex digital environments while protecting user privacy, while taking into consideration Smart Insurance Providers as Key Requesters and Consumers of 5G Network Slices Delivery Services by Service Providers. Smart Insurance creates a fully customer-oriented ecosystem, centered on a platform that connects every stakeholder in the insurance business – insurance companies, brokers and their customers — in order to digitize, secure and automate all transactions.

The ecosystem covers the complete 'Business to Business' (B2B) and 'Business to Business to Consumer' (B2B2C) process management, from the stakeholder to the customer, including customer onboarding, contract management, claims handling and extending as far as confidential medical records management.

The 'Smart Insurance' lifecycle is further enhanced by connected devices, including the connected car, which allows offering flexible coverage perfectly adapted to every customer.

Creation of an end-to-end workflow from the user to all parties

Smart Insurance enables creation of an ecosystem specially built for the insurance stakeholders allowing the end customer to contract insurance services online and follow the complete lifecycle of their insurance policy through a secure platform, while allowing interaction with all Parties of the Ecosystem. The workflow includes the points when a Smart Insurance Provider issues requests for 5G Network Slices Delivery Services by a Service Provider. The figure below illustrates a Smart Insurance ecosystem.



Enforcing end-user Privacy in Usage-Based Insurance (UBI) and or IoT-Based Insurance

Usage-based insurances are migrating from "declarative" to "IoT-enabled" usage of a service/good. In the context of connected cars, Pay As You Drive (PAYD) refers to an insurance calculated dynamically according to the kilometers driven. In the near future, environmental sensors in houses and even in cities will have an impact on tariffs.

Probably, the most sensitive usage of IoT in Insurance concerns health Insurance or mortgage Insurance: even though existing processes are simple, mandating a clear separation between commercial processes and health-related communication is essential. Such separation must be driven by clearly defined rules, embedded within the Smart Insurance platform.

With a "privacy-enabled" workflow, and providing sealing between parties and their roles, end-to-end privacy can be enforced.

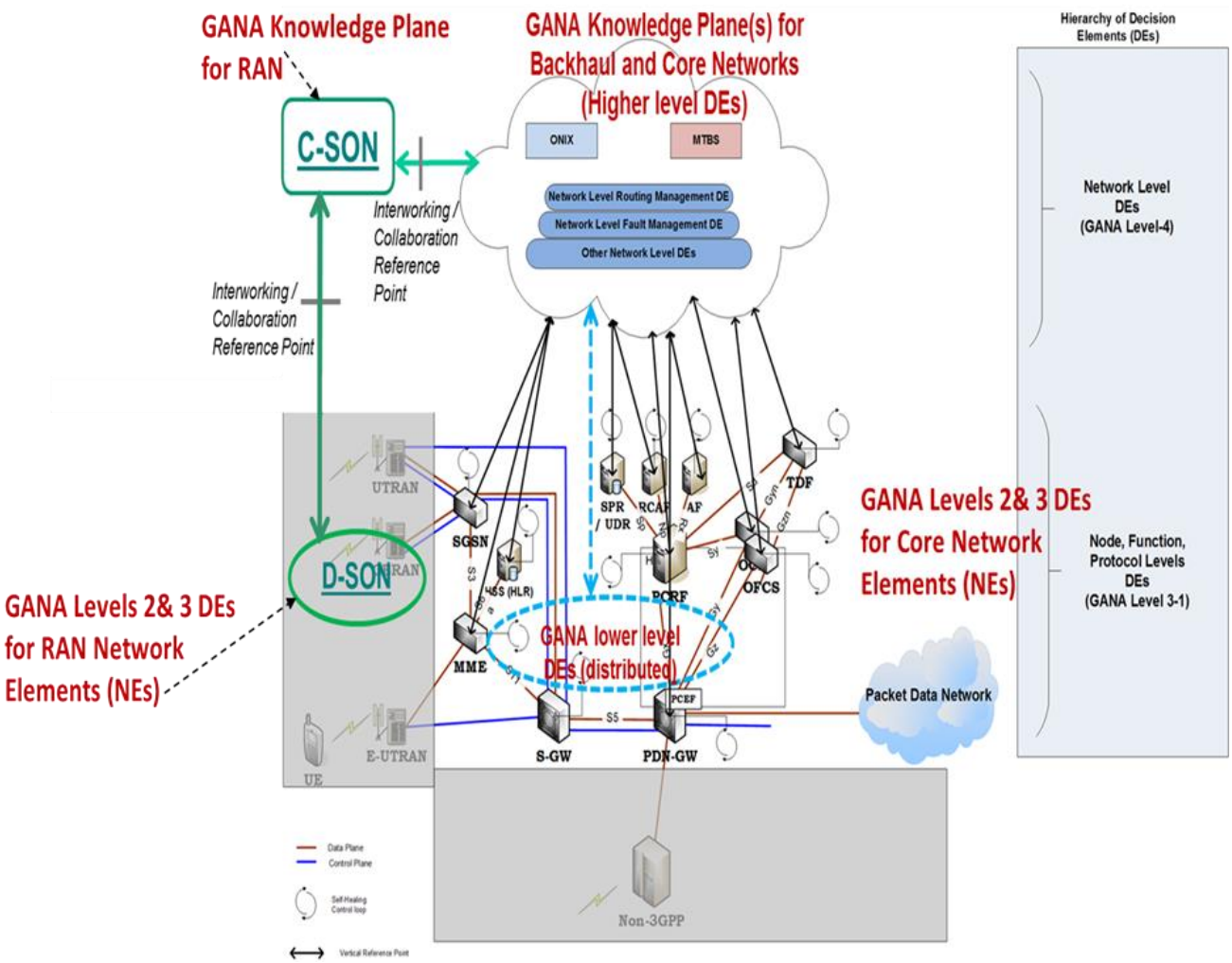
Smart Insurance, privacy and the new General Data Protection Regulation

After four years of work, the European parliament has voted the new General Data Protection Regulation (GDPR), re-enforcing the principles of Privacy by Design, consent, the right to be forgotten and data portability. All stakeholders

are obliged to enforce GDPR in 2018. In that context, the 5G ecosystem we create to support the PoC use cases must ensure the law (GDPR) will be applicable in the PoC timeframe.

Vendors' Business View of the Overall PoC (consisting of multiple Demo Cases): Supplying GANA conformant Software for E2E Closed-Loop Service Assurance for 5G Network Slices

The ETSI White Paper No.16 describes the two categories that determine the actors or players the GANA model is addressing, namely: Suppliers (vendors) of GANA Functional Blocks (FBs); and Provider of assets required by the developers of GANA Functional Blocks (FBs). The business value described in ETSI White Paper No.16 for Suppliers (vendors) of GANA Functional Blocks (FBs) concerns both ISVs (Independent Software Vendors) and Networking Equipment Manufacturers—both of which can be providers of GANA AMC software such as Decision Elements (DEs) and their vendor differentiation autonomics Algorithms (e.g. Artificial intelligence for dynamic configuration and control of resources and parameters) ; GANA MBTS; GANA ONIX; and GANA Knowledge Plane Software in general. **Remark:** This Demo-2 is mainly focused on Suppliers of GANA conformant Autonomic (Closed-Loop) Service Assurance pertaining to the GANA Knowledge Plane for the RAN as realized by C-SON implementation as illustrated on the figure below that captures the need for low-level (micro) autonomics that is policy controlled by higher-level (macro) autonomics in a holistic model that can be instantiated/adapted to the 5G context as well.

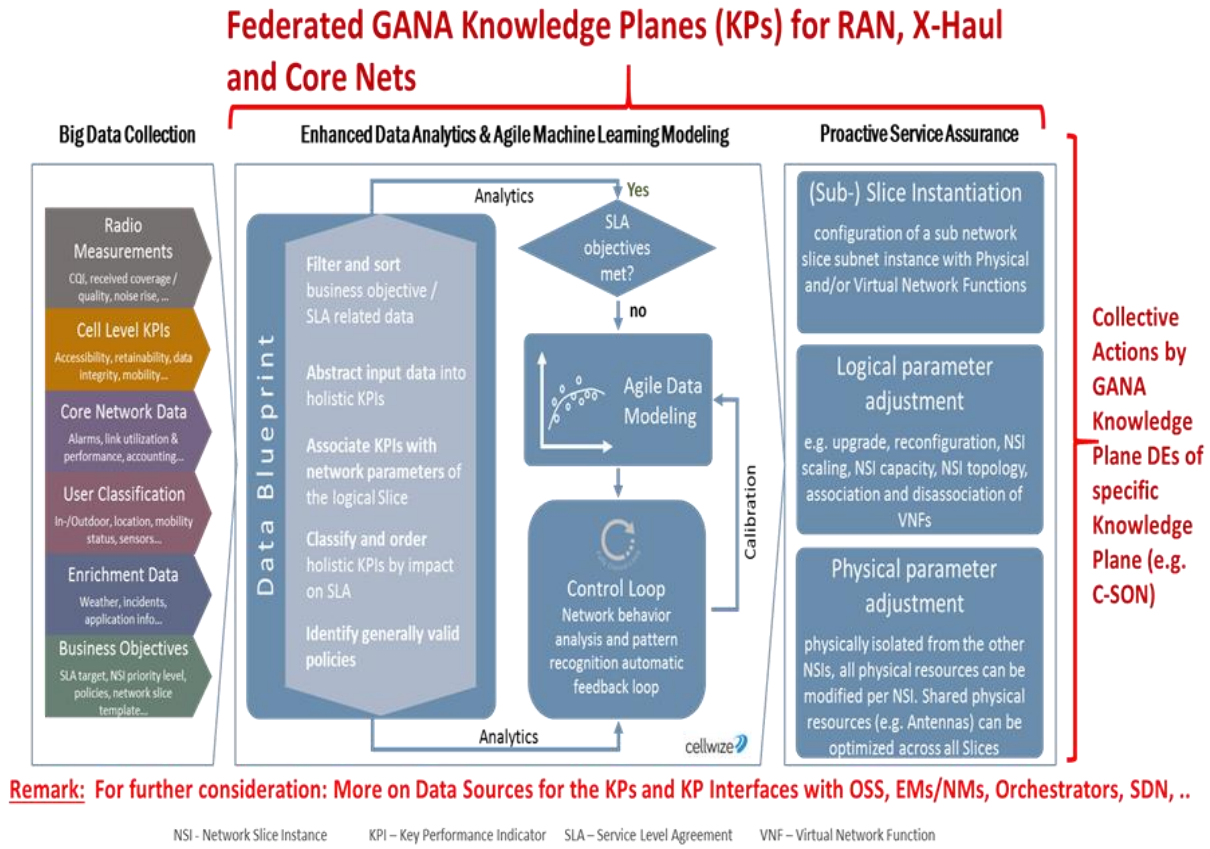


Demo-2 Scope: Autonomic (Closed-Loop) Service Assurance Use Case for 5G Network Slice(s) and the coverage in a Framework for E2E Autonomic (Closed-Loop) Service Assurance for 5G Net Slices

This Demo-2 of the PoC is focused on C-SON Evolution for 5G, Hybrid SON Mappings to the ETSI GANA Model, and Federation of GANA Knowledge Planes for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices through a Real Implementation achieved by a partner of the PoC Consortium. The Demo presents and discusses the following:

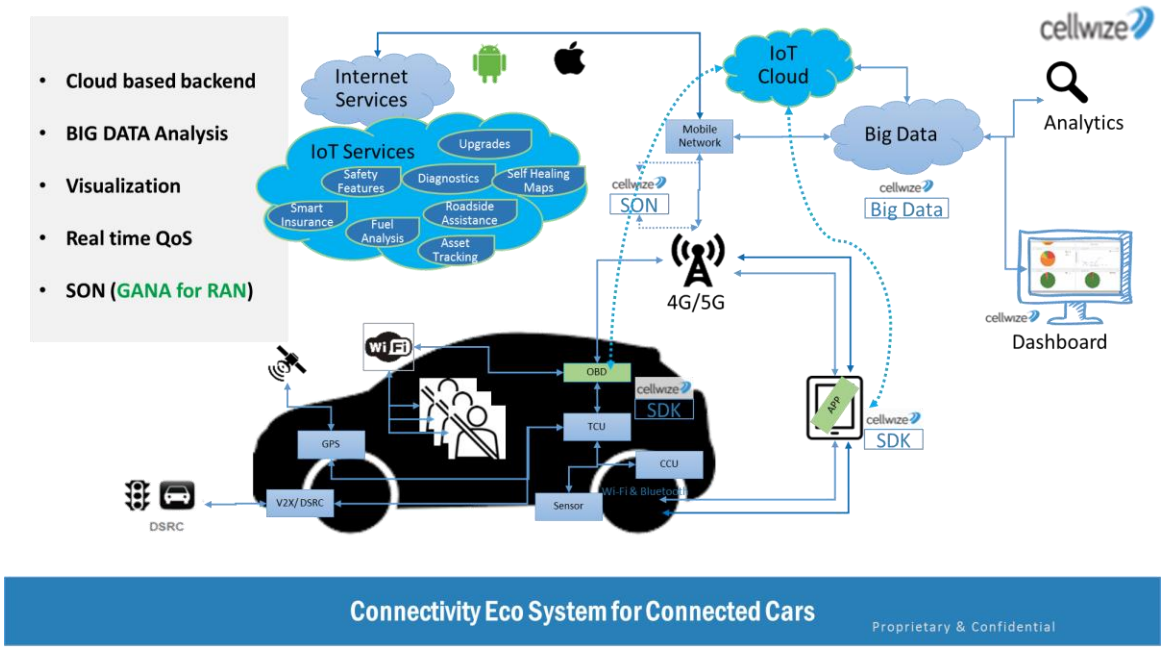
- How Cellwize C-SON and its framework for policy control of D-SON implements the GANA Knowledge Plane for the RAN
- Cellwize provides an implementation of the GANA Knowledge Plane for the Backhaul of some degree and this software has been implemented as an integral part of Cellwize C-SON
- Demo of Cellwize C-SON GUI and its Provisioning GW as an Implementation case for the ETSI GANA MBTS (Model-Based Translation Service) Functional Component
- How GANA for the RAN is realized by Hybrid SON (C-SON (cognitive) complemented by D-SON in eNBs)
- How Cellwize C-SON and its framework for policy control of D-SON implements the GANA Knowledge Plane for the RAN
- Cellwize implementation of the GANA Knowledge Plane for the Backhaul of some degree and how this software has been implemented as an integral part of Cellwize C-SON
- The GANA as enabler for Vendors to Implement Components required by Telecom Operators in implementing a Framework for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices and the Roadmap to achieving that goal.
- The value in the following ETSI documents: ETSI GANA Model (ETSI TS 103195-2); GANA Instantiation onto the 3GPP Backhaul and Core Network Architectures (ETSI TR 103 404); and GANA Instantiation onto the BroadBand Forum (BBF) Architecture Scenarios (ETSI TR 103 473).

The figure below provides more details on the covered aspects in this Demo-2 against further targets.



The 5G Slice Autonomic (Closed-Loop) Service Assurance Use Cases demonstrated in this Demo-2 are:

- Connected Cars Use Case and associated requirements on C-SON



- Manage Customer Experience (SLA violations, claims and trouble tickets) in proactive and predictive manner by tacking advantages from Autonomic and Cognitive Service Assurance Closed Control Loop(s) that implement the ETSI GANA Framework in 5G Network
- Standards Gaps being revealed in attempting to specify a Framework for E2E Autonomic (Closed Loop) Service Assurance for 5G Network Slices. This is the case when considering Federation of GANA Knowledge Planes (KPs) for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices through the interworking of a GANA Knowledge Plane for RAN (realized through Centralized SON (Self-Organizing Networks) with cognitive SON functions), GANA Knowledge Plane for the Transport Network (e.g. x-haul/Backhaul) and a GANA Knowledge Plane for the Core Network, for correlated assurance of RAN Subnetwork Slices, Backhaul Subnetwork Slices and Core Network Subnetwork Slices

Remark: Four Applications are considered in the Overall PoC's Network Slicing Use Cases. Whereby, each application (e.g. Smart Insurance Application) is ordering the required Network Slices via an order API interacting with Network Slice Provider's BSS. The table below depicts the mapping between PoC targeted Applications to required Network Slice Types.

Application	Network Slice Type required
Connected Car & Infotainment	• eMBB (SST 1) • uRLLC (SST 2) • IoT (SST 3) • V2X (SST 4)
Car & Home Security & Infotainment	• eMBB (SST 1) • uRLLC (SST 2)
Hayo (IoT) Connected Home Security & Infotainment	• eMBB (SST 1) • uRLLC (SST 2) • IoT (SST 3)
Smart Buildings & Smart Homes	• eMBB (SST 1) • uRLLC (SST 2) • IoT (SST 3)

Technical view of the PoC

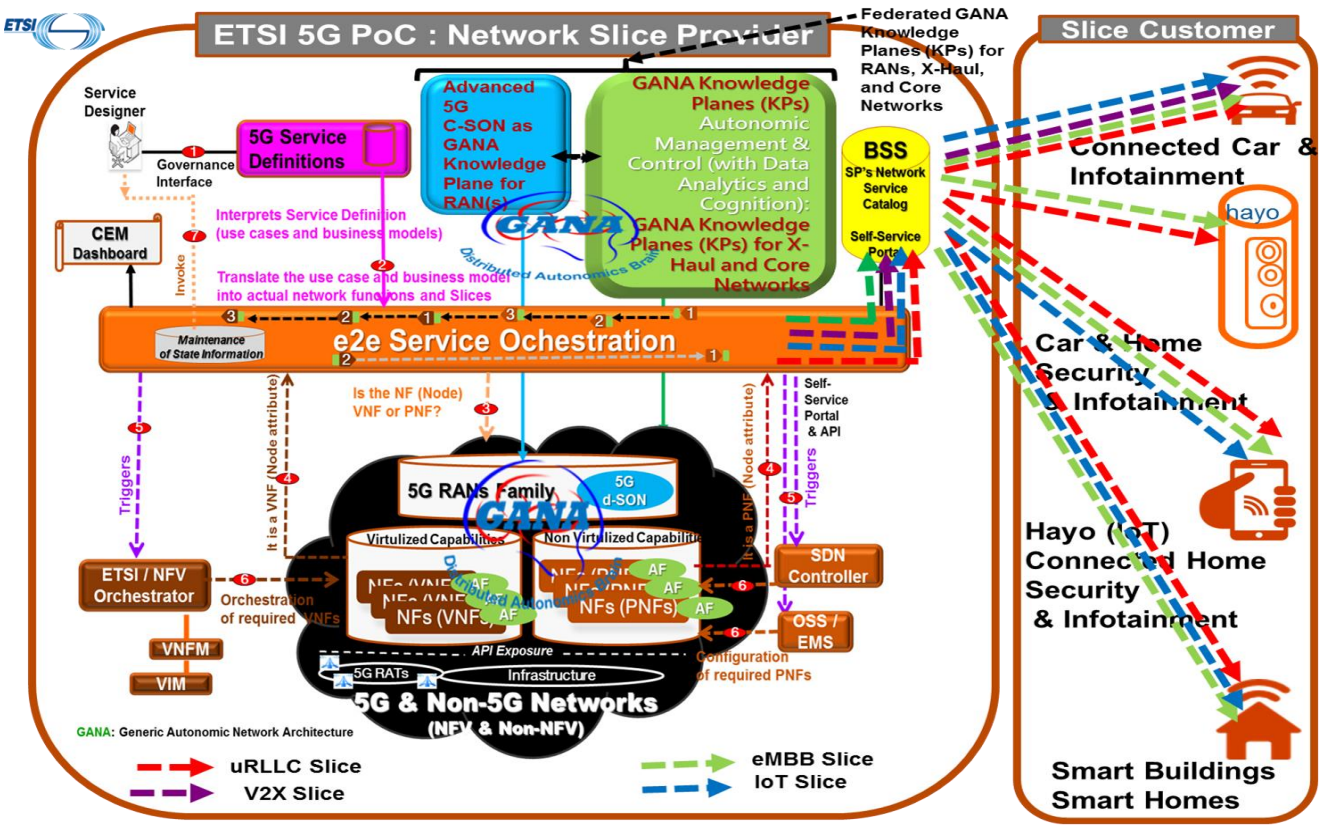
The plan is to use this 5G Network Slicing PoC as an instrument for the following aims: **(1)** enabling the "Telecom Operators" to provide a clear holistic picture to "Solution Suppliers" as to how their 5G networks would look like and the complementary roles to be played by the following technologies/paradigms in 5G: ETSI GANA components for Closed-Loop (Autonomic) Management & Control of network resources and parameters in Autonomic (Closed-Loop) Service Assurance of Network Slices; SDN; NFV; E2E Orchestrators; Big-Data Analytics for Autonomic/Cognitive Management & Control; SON (Self-Organizing Networks); specialized interfaces (including the network governance interfaces); network automation; and GANA intelligence software for Autonomic/ Cognitive management and control of networks and services (i.e. Software for Autonomic (Closed-Loop) Service Assurance); **(2)** Breaking from silos on standards and R&D efforts linked to the complementary paradigms, by promoting and progressing the Unifying and Harmonizing Architecture that integrates the ETSI GANA, SDN, NFV, E2E Orchestration, and specialized Big Data Analytics for Autonomic / Cognitive Management & Control; **(3)** Enabling "Solution Providers" of SON; SDN; NFV; GANA Knowledge Plane (with the Autonomics/Analytics Algorithms and Knowledge Synthesis and Representation from raw monitoring data, and the dynamic application of various forms of Knowledge obtained from diverse data/information sources by the GANA Knowledge Plane's Decision-making-Elements (DEs) in realizing the *Self-Adaptation (e.g. Self-Optimization) management and control operations for Network Resources and Parameters for the overall Closed-Loop Assurance of Network Slices)*; Probing and Service Assurance Platforms that should act as

data/information sources to the GANA Knowledge Plane's Des, Data Analytics required to be performed or exploited by GANA DEs in the network infrastructure Network Elements (physical or virtual) and in the GANA Knowledge Plane; "Network Infrastructure Suppliers"; "RAN elements cloudification Vendors"; and other players; to use the PoC instrument to identify gaps in standards and initiate activities (e.g. in ETSI NTECH AFI Working Group) to close any gaps in standards that may be identified during the PoC.

The Figure below depicts high level design principle of the PoC ecosystem and associated actors / roles relationships and interactions. Two main actors are considered at 5G operation time (run-time):

- a) **Network Slice Provider (SP)** with its associated partners (5G RAN Vendor, 5G Core Network Vendors, 5G OSS & Network Slice Management Software Vendors, GANA Algorithms and Software Components Developers and Suppliers, 5G BSS Vendors, 5G SON Vendors, …) whose components are required by an SP in creating, delivering, operating and assuring the four Network Slice Types: eMBB (SST 1), uRLLC (SST 2), IoT (SST 3), V2X (SST 4)

- b) **Network Slice Customer** or Network Slice Consumer who orders/ Self-Orders via a dynamic Ordering API the required Network Slice Types according to dynamic SLAs per Network Slice Type by interacting with the Network Slice Provider's BBS (Network Slice Self-Care Portal)



Network Slice Life Cycle Management (choreography)

1) Slice Designer (Human Operator), via the Governance API, accesses its 5G Slice Design / Service Definition Tool-Chain (pink box) and stores the Network Slice Template once populated, in a repository. **NOTE:** This process is automated in the case of a self-care portal through the BSS that can be used by external customers
2) Network Slice Template is pushed to the Service Orchestrator

3) Service Orchestrator interacts with ETSI MANO components, SDN Controller and Legacy OSS to translate the content of the Template onto required VNFs / PNFs (RAN ones and Core Network ones) which are stored in the Virtualized Capabilities Repository and in the Non-Virtualized Repository (for Core Network). The diagram shows a dedicated Repository for RAN capabilities. All those capabilities are executed on the substrate layer (Hybrid Infrastructure: Black Cloud)
4) The identified VNFs and PNFs descriptions (descriptors) are sent to Service Orchestrator
5) Service Orchestrator launches Network Slice Life Cycle Management process
6) The Network Slices ordered by the customers via Service Provider's BSS (Yellow Box) are instantiated, configured and delivered to each of the four Customers (5G applications) at the right hand side of the diagram.
7) GANA Knowledge Plane and "Distributed GANA" (Green boxes) embedded in the VNFs and PNFs as AI / ML/ Cognitive algorithms along with Hybrid SON (Centralized and distributed: Blue Boxes) take care of configuration of the NEs (Network Elements, i.e. PNFs and VNFs) in the infrastructure if not already performed through the traditional management systems, and then proceed to perform E2E federated Autonomic and Cognitive "Service Assurance" of each Network Slice Instance the Customer is consuming.
8) BSS (Yellow Box) embeds the Network Slice Billing System that shall offer billing capabilities per Network Slice Instance allowing billing each Network Slice Instance individually, in same way as an 5G OSS that shall offer management capabilities per Network Slice instance as an "Individual Network Slice Instance Manager"

ETSI-GANA Model as key Enabler for 5G: High Level Design Principle

The AFI Working Group in ETSI's NTECH Technical Committee (TC), as the leading group in the standardization landscape for Autonomic / Cognitive Management & Control of Networks and Services, has a comprehensive work programme which comprises deliverables on: a reference model for a Generic Autonomic Network Architecture (GANA); an implementation guide for the GANA reference model; and autonomics-enabled implementation-oriented architectures and their associated management and control architectures that are a result of GANA instantiations onto various reference network architectures and their associated management and control architectures defined by standardization organizations such as 3GPP, BBF, IEEE, ITU-T and other Standards Developing Organizations (SDOs).
http://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp16_gana_Ed1_20161011.pdf

Indeed, TC NTECH AFI WG has made significant progress in developing standards that prescribe methods and mechanisms for introducing "intelligence" in the management and control operations of networks and services and on how to operationalize GANA. Namely the application of the "Autonomics" paradigm, with the goal of prescribing design and operational principles for self-managing and self-adaptive networks that enables to achieve OPEX reduction through Autonomic & Cognitive Fulfillment & Service Assurance. http://appledoreresearch.com/product/closed-loop-automation-new-role-assurance-research-note/

Other benefits "Autonomics" brings to Network Operators such as creation of new revenue stream in 5G arena where Autonomics and specifically GANA can be key Enabler: http://www.iwpc.org/workshops/2016/2016-06-DT/agenda.html

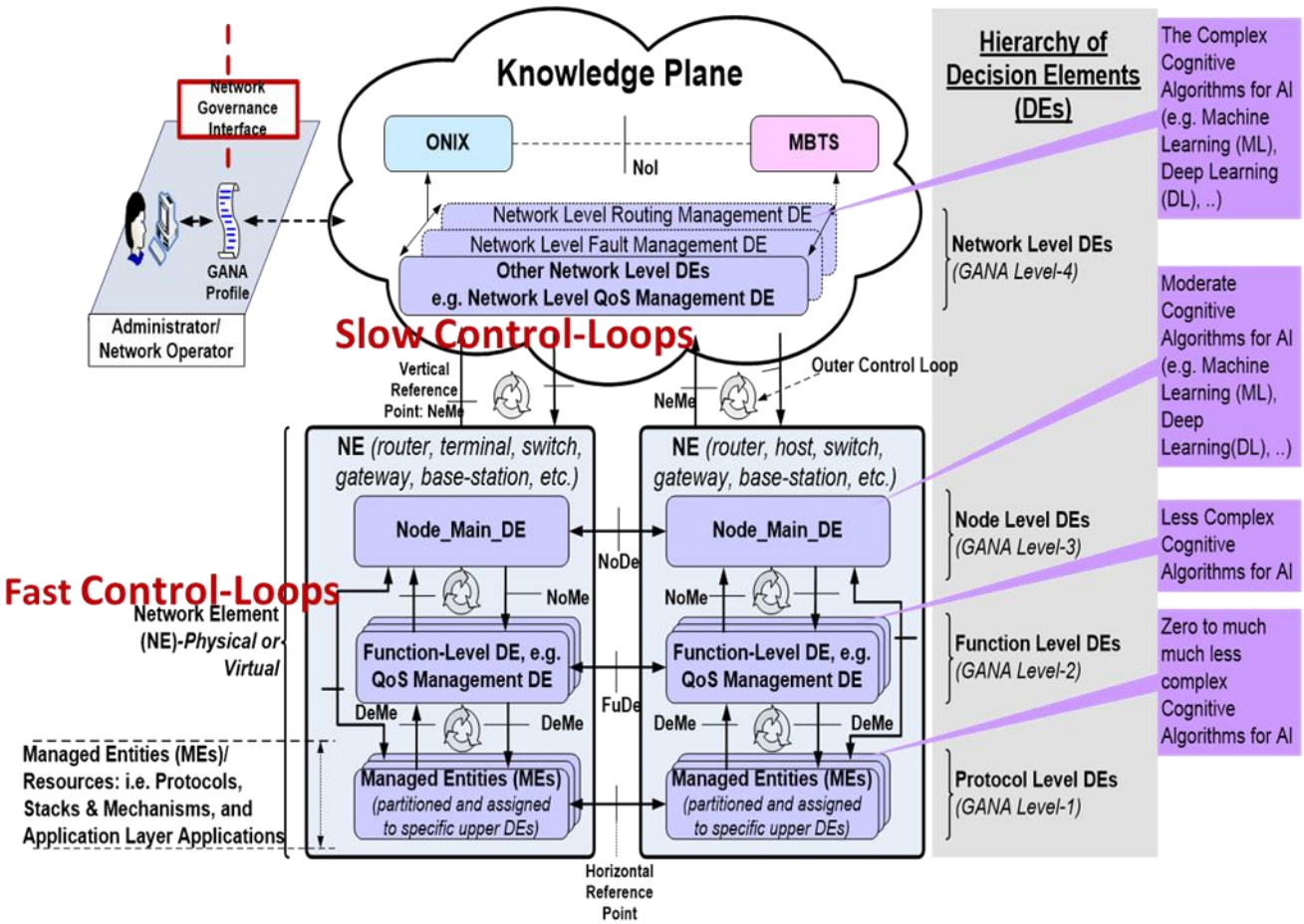
ETSI NTECH AFI 5G Network Slicing PoC (with Autonomic Service Assurance for Slices) and 5G PoCs landscape

After the first 5G related standardization round (NGMN's 5G White Paper, E2E 5G Architecture, SCT), 3GPP (R14, R15) efforts that took off, ITU efforts on 5G that took off, and the initial 5G roadmaps that were laid out by the diverse players in 5G, an acceleration process was undertaken in 2017. Most of key Mobile Operators are pushing things this way by announcing aggressive roadmaps and seizing key events (sport) to use them as 5G playgrounds where all 5G players try to deliver their best products and solutions and to demonstrate the first benefit 5G brings and the huge promises and perspectives on how 5G will complement nicely 4G. This acceleration will pave the way for the commercial deployment of 5G.
From Testing & Trialing side, various initiatives have been launched and there is a need for harmonization in terms of methodology, assessment approaches, interoperability, KPIs consolidation as a foundation to facilitate this move.

This is the reason why this ETSI NTECH 5G Network Slicing PoC aims at collaborating and liaising with other 5G PoCs initiatives but not limited to initiatives such as NGMN 5G_TTI, TMForum "5G Service Operations" Catalyst, and BroadBand Forum (BBF) 5G related PoCs programs.

GANA in a Nutshell

TC NTECH AFI WG works on standards for Autonomic Networking (which includes self-manageability and properties within network nodes/functions and "in-network" self-management), Autonomic Management and Control (AMC) of networks and services by Autonomics introduced in the outer (logically centralized) Management and Control Planes of network architectures. The ETSI TC NTECH AFI **"GANA"** Reference Model combines perspectives on these aspects, so as to capture the holistic picture of Autonomic Networking, Cognitive Networking and Self-Management design and operational principles. TC NTECH AFI WG performs GANA instantiations onto Evolving and Future Network Architectures and their Management & Control Architectures. Autonomics algorithms in the scope of NTECH AFI work are meant to be implemented by the so-called GANA Decision-making-Elements (DEs), and such algorithms include Cognitive algorithms for Artificial Intelligence (AI)—such as Machine Learning (ML) and Deep Learning (DL), and other algorithms that can be employed in DEs' closed-loop operations.
GANA Model helps to achieve Closed-Loop (Autonomic) Service Assurance through the complementary abstraction levels for introducing self-management functionality and Closed-Loops.
Moreover, GANA is addressing OPEX challenges faced by Network and Service Providers by measuring the benefit of Autonomics/Self-Management for networks and services. The figure below is a snapshot of the GANA model (extracted from the ETSI TS 103195-2 to be published in Q1 of 2018).



Key Takeaways from the Demo-1 and Demo-2 of the Overall PoC

- Instrumentation of Network Elements (NEs) with collaborative, autonomic Decision-making-Elements (DEs)
- Hierarchy of DEs in 4 basic levels of abstraction of self-management functionality: *protocol, function, node, and network levels defined by the GANA reference model*. Monitoring information or other type of knowledge concerning the state of the network resources and parameters is used by GANA DEs at GANA levels 2, 3 and 4, depending on the DE algorithm's inputs requirements.
- Over its Control-Loop(s), a DE sends commands, objectives, policies to its lower-level DEs and the rest of all its Managed Entities (MEs) and receives feedback on the state of operation of the Managed Entities (MEs), which may be those at the so-called resources layer in GANA (as illustrated on the GANA snapshot diagram below). Protocol Level DEs represent protocols, TCP/IP application-layer or OSI Application layer services, and other fundamental mechanisms running in the target nodes/network and considered as Managed Entities (MEs) and exhibiting Control-Loops. However, some MEs at protocol level may need no intrinsic Control-Loops.
- GANA Knowledge Plane (KP) = Network Level DEs + distributed, scalable Overlay Network system of information servers for Information eXchange (ONIX) + Model-Based-Translation Service (MBTS) for translating information and commands/responses towards/from NEs.
- Governance is implemented through the Network Governance Interface meant for the Human Administrator /Network Operator to provide input to the Autonomic Network through the GANA Knowledge Plane
- The Complexity of Cognitive Algorithms for AI (e.g. Machine Learning, Deep Learning) decreases from GANA level 4 to level 1 as depicted in the diagram below (purple rectangles)
- The Service Assurance for Network Slices should be achieved through Closed-Loop (Autonomic) Service Assurance of the E2E Network Slices by means of a Federation of Autonomic Service Assurance Components that collectively work together in an E2E fashion to deliver Network Slices Assurance and adaptive network resource programming across the network segments delivering the aggregate Network Slices, e.g. across Access Networks, x-Haul (Fronthaul and Backhaul) and Core Networks. SON (Self-Organizing Network) functions for the 5G RANs should interwork with GANA components such as GANA Knowledge Plane components to deliver E2E Autonomic Service Assurance of Network Slices for Self-* features for network slices, such as *Self-Optimization and Self-Healing of Network Slices*. For Telecom Operators, all this constitutes a *Framework for E2E Autonomic (Closed-Loop) Service Assurance for 5G Network Slices* that should be implemented by Operators
- Cellwize C-SON and its framework for policy control of D-SON implements the GANA Knowledge Plane for the RAN, whereby a D-*SON Function* is a *GANA Decision Element (DE)* and *C-SON with Cognitive SON Functions is GANA Knowledge Plane for the RAN*
- GANA for the RAN is realized by Hybrid SON (C-SON (cognitive) complemented by D-SON in eNBs)
- 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 of some degree and how this software has been implemented as an integral part of Cellwize C-SON
- Need to evaluate whether the DCAE in ONAP is actually implementing the GANA MBTS and/or how the ONAP component can be evolved to implement the GANA MBTS Functional Block
- Need to evaluate whether the AI&I component in ONAP is actually implementing the GANA MBTS and/or how the ONAP component could be evolved to implement the GANA ONIX Functional Block

PoC Partners

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

Contact

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