“INTEGRATING ETSI AUTONOMIC MANAGEMENT & CONTROL (AMC) REFERENCE MODEL WITH SDN /NFV”

Presented by Tayeb Ben Meriem (Orange) and ETSI / NTECH / AFI Acting Chair for IEEE Globecom Industry Forum Sessions Workshop, Hosted by TMForum, Nice 2015 June 4th
Agenda

- ETSI / NTECH / AFI: What is about
- Impact of Virtualization (NFV) on ETSI / AFI Reference Model (GANA)
- Impact of SDN on ETSI / AFI GANA Knowledge Plane
- ETSI / NTECH / AFI (GANA), NFV, SDN combination
ETSI / NTECH / AFI : What is about
ETSI / NTECH / AFI (Autonomic Network Engineering for the Self-Managing Future Internet): What is it about?

* ETSI / NTECH / AFI started as an ISG (Industry Standardization Group), and is now a WG in NTECH TC: Specifications for Autonomic Network Engineering for the Self-Managing Future Internet

* Created in January 2009 and composed by major European operators, vendors and research organizations in the field of ICT technologies

* Encourage harmonization and pragmatism across the circles of both the evolutionary approaches and revolutionary approaches to Future Internet

* Specificity requirements, use cases and scenarios

* Define of a Reference Model of a holistic Generic Autonomic Network Architecture (GANA) that defines the autonomic elements, the self-manageability properties of the Future Internet that fulfils the Requirements

* Define of a viable roadmap with an evolutionary path for today’s network models, protocols and paradigms as necessitated by the Reference Model

* Address the OPEX challenges faced by network and service providers by measuring the benefit of Autonomics/Self-Managing paradigm and features

* Liaise with other SDOs and disseminate ETSI / NTECH / AFI model

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ETSI experience of Transforming Research results into standardisation in Autonomic Management & Control area.
AFI Methodology/Approach to Standardizing Autonomics: Work Items

**Work Item 1**
Scenarios, Use Cases, and Requirements for Autonomic/Self-Managing Future Internet

Feedback for adding or refining Scenarios, Use Cases and Requirements

**Work Item 2**
Architectural Reference Model for Autonomic Networking, Cognition and Self-Management

High-Level Requirements are input to WI#2

**Work Item 3**
Autonomicity-enabled Reference Architectures

Mapping (Instantiation) and implementation of Reference Model onto current network architectures, Requirements Analysis and Specification of implementation-oriented solutions for Autonomicity and Self-Management

Feedback for improving or evolving the Reference Model

Autonomics in Diverse Architectures (3GPP, BBF, ITU-T FN, NGN, Mesh/Ad-hoc/Sensor Networks) and AFI Liaisons with Other Standardisation Groups

PoC WI

Trust WI

Harmonization of Autonomic Mgt, NFV, SDN Activity

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Rationale of ETSI NTECH AFI PoC WI

* Carry out testing and assessment of implementation and operations of Autonomic Networking, Cognitive Networking and Self-Management.

* It may inspire the development and deployment of existing networks embedding those Self-Management capabilities on overlay manner (existing networks) as well as emerging networks where such Self-Management capabilities must be built-in from the outset.

* However, maturity and sustainability model are added to guide the Industry towards adoption of the Autonomic Management & Control.

* Moreover, in those PoCs we target the whole lifecycle management process as defined in NTECH AFI WIs:
  * Deployment phase
  * Optimization phase
  * Operations phase

* The attention is to provide Industry with clear guidance in order to help adoption of NTECH / AFI specifications. That means, the PoCs will take care of moving the demonstration towards “Carrier Grade” level

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* Pre-standardization Publications
- GS 001: Scenarios, Use Cases, and Requirements for Autonomic/Self-Managing Future Internet

* Transformation of Pre-standardization specifications into ETSI standards
- GS001 to TS001 done and published under: *ETSI TS 103 194 V.1.1.1 (2014-10)*
- GS002 to TS002: ongoing

* Ongoing Technical Specifications (TS)
- TS draft: Trust on Autonomic Networks
- TS draft: Autonomic Networks Proof of Concept (PoC)

* Technical Specification (TSs) on Instantiation of ETSI / AFI Autonomic Reference Model to existing or Future Architectures
- TS draft: Autonomicity and Self-Management in the Broadband Forum (BBF) Architecture
- TS draft: Autonomicity and Self-Management in the Backhaul and Core network parts of the 3GPP Architecture
- TS draft: Autonomicity and Self-Management in Wireless Ad-hoc/Mesh Networks
- TS draft: Autonomicity and Self-Management in IMS architecture

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AFI Liaisons with diverse Groups in SDOs and Fora

- **AFI and Broadband Forum (BBF):** Autonomicity and Self-Management in BBF Architecture
- **AFI and 3GPP:** Autonomicity and Self-Management Functions in the Backhaul and Core Networks to complement SON in the RAN and also their global synchronization with SON
- **AFI and NGMN:** NGCOR Requirements calling for Autonomics-Awareness in the Management Architecture. Autonomics-awareness is also in NGMN 5G initiative
- **AFI in Multi-SDO Initiative:** AFI to specify Autonomics and Self-Management for various NGCOr Use Cases and the Converged Management of Fixed and Mobile Networks
- **AFI and TMF** (liaison is going to be established on evolution of Information & Data Models as impacted by Autonomics and Self-Management) with ZOOM initiative
- **AFI and ITU-T SG13:** Autonomic Management and Control in FN Architecture and in NGN
- **AFI and ITU-T SG2, SG15:** Autonomic Management and Control in NGN and other Architectures, including Network Resilience, Autonomic Fault Management and Recovery
- **AFI and CAC in the USA and also with NIST:** CAC and AFI have regular exchange of invitations and information including invitation to events
- **AFI and IEEE** (Liaison envisaged, contacts have been established)
- **AFI and OMG SDN WG** (contacts established and a Liaison is to be established)
- **AFI and NMRG** (This Liaison/collaboration can also be formalized like the other Liaisons)
Integrating ETSI Autonomic Management & Control (AMC) Reference Model with ETSI NFV
ETSI / NTECH/ AFI  GANA (Generic Autonomic Network Architecture) links Autonomic Management and Automated Management through the concept of Network Profiles

**Automated Management** → automation of management workflows/tasks by way of special tools for automation (e.g. scripts, network planning tools, policy generators for conflict-free policies, etc) produces **input** required by the autonomic network in form of **GANA Network Profiles** that embed/encapsulate High-Level Network Objectives and Goals specified by the Operator using a High-Level Language, the Generated Conflict-free Policies that "govern" the autonomic network, as well as Configuration-Data.

→ The **input** is provided through the **GANA Network Governance Interface**.

**Autonomic Management** then involves the use of **GANA Network Profiles (input)** by GANA Decision Elements or DE (Autonomic Functions) to inductively configure the autonomic network down to the level of protocol parameters and physical resources:

→ DE control-loops then continue to listen to changes in the **input** as well as continuously observing network-state, to learn, reason and dynamically adjust the network state and configurations in order to maximize stability and optimal conditions of network operation.
GANA links Autonomic Management and Automated Management through the concept of Network Profiles.
Reference Model of a holistic Generic Autonomic Network Architecture (GANA)
AFI GANA Reference Model, and 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
- 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

**ONIX:** Overlay Network for Information eXchange

3-Levels of Hierarchical Control-Loops demonstrate how Autonomics can be introduced in architectures.

“Fast Control-Loops” in the Nodes/NEs, while “Slow but network-wide Control-Loops“ should operate in the outer centralized GANA Knowledge Plane (i.e. SDN – Controller & Net-Apps realm)
The ETSI / AFI GANA Reference Model takes into consideration the impact of virtualization on network architecture

• A virtual node (e.g. a virtual machine) may require that an associated instantiation of the ETSI / AFI Reference Model (GANA) Decision Element (DEs) be created and bound to the virtual node as its own DEs

• The ETSI / AFI Reference Model (GANA) Specification includes a way to use a Hypervisor to implement the Decision Elements (DEs)

• In Management & Control fusion, the ETSI / AFI “GANA Knowledge Plane” would also need to autonomically manage and control the Virtual Network Functions (VNFs) coming from the ETSI / ISG NFV Paradigm, while autonomically managing the legacy physical nodes/devices as well.

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Impact of Virtualization on ETSI / NTECH / AFI GANA
(ETSI / ISG / NFV mapping to be discussed)

- NFV Orchestrator
- VNF Manager
- Virtualized Infrastructure Manager (VIM)

Simplified ETSI/NFV/MANO

OSS/BSS
EMS

Introduce GANA Level 2 / 3 DEs

Virtual Storage
Virtual Computing
Virtual Network
Virtualization layer

Storage HW
Computing HW
Network HW

GANA Level 2&3 DEs can be introduced in Physical node or a Virtual Node/VNF

GANA Network-level DE

To be investigated: → Input into GANA Network Profiles

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Mapping of ETSI NTECH AFI GANA model to ETSI NFV MANO
(AF = “Autonomic Function”)
Mapping of ETSI NTECH AFI GANA model to ETSI NFV MANO (AF = “Autonomic Function”)
## Mapping of ETSI NTECH AFI GANA model to ETSI NFV MANO

<table>
<thead>
<tr>
<th>Dynamics at GANA</th>
<th>GANA Decision Element (DE) performs analytics, Creates &amp; Executes plans of action that control via Policies/Configurations/Commands lower levels (Managed Entities: MEs)</th>
<th>ETSI MANO lower level components (Managed Entities) (MEs)</th>
<th>Autonomic Control Loop’s operating region</th>
</tr>
</thead>
<tbody>
<tr>
<td>GANA Knowledge Plane (KP) Decision Elements (DEs) are modules that perform the analytics</td>
<td>EMS</td>
<td>Network &amp; Other Views input to OSS level</td>
<td></td>
</tr>
<tr>
<td>GANA Knowledge Plane (KP) Decision Elements (DEs) are modules that perform the analytics</td>
<td>VNFS</td>
<td>Network &amp; Other Views input to EMS level through its logical-links or to events local to the VNF (e.g. faults/errors/failures)</td>
<td></td>
</tr>
<tr>
<td>GANA-Level-2 and Level-3 Decision Elements (DEs) instrumented in the VNF</td>
<td>e.g. protocols STACKS instances</td>
<td></td>
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</tr>
<tr>
<td>GANA-Network-Level Decision Element (DE) (NFVO-DE as module that is part of Orchestrator SW and is controled and augmented by GANA KP DEs’ algorithms)</td>
<td>VNFM, VIM</td>
<td>Network &amp; Other Views input to NFVO level</td>
<td></td>
</tr>
<tr>
<td>GANA-Network-Level Decision Element (DE) (VNFManager-DE as module that is part of VNFManager SW)</td>
<td>VNFS</td>
<td>Network &amp; Other Views input to VNFM level</td>
<td></td>
</tr>
<tr>
<td>GANA-Network-Level Decision Element (DE) (VIM –DE as module that is part of VIM SW)</td>
<td>Infrastructure resources</td>
<td>Network &amp; Other Views input to VIM level</td>
<td></td>
</tr>
</tbody>
</table>
Integrating ETSI Autonomic Management & Control (AMC) Reference Model with SDN
Proposal on integrating ETSI / NTECH / AFI GANA Knowledge Plane Decision Elements (DEs) with SDN Controllers to enable Autonomicity

Approach 1

ETSI / AFI GANA Knowledge Plane Decision Elements (DEs) as second party logic with algorithms that drive an SDN Controller via the API → Using the same Northbound API as Network Application

Approach 2

ETSI / AFI GANA Knowledge Plane Decision Elements (DEs) as Modules of an SDN Controller
1. GANA Knowledge Plane DEs as second party logic with algorithms that drive an SDN Controller via the API → Using the same Northbound API as Network Application
Act of SDN on ETSI / AFI GANA Knowledge Plane

Proposal on integrating GANA Knowledge Plane DEs with SDN Controllers, Enable Autonomcity (Approach 2)

GANA Knowledge Plane DEs can use the same Northbound API as used by Network Applications

GANA Knowledge Plane DEs as Modules of an SDN Controller

API i.e. SDN Controller Northbound API

Slower network-wide Control-Loops realized by the GANA Knowledge Plane DEs, loaded as Modules of the SDN Controller. With Inter-DE Coordination → avoid Decisions Conflicts

SDN Controller

ONIX (Overlay Network for Information e(xchange) Servers

Publish/Subscribe, Query & Find Paradigm for Info.

Network Level Routing Management DE
Network Level Fault Management DE
Other Network Level DEs e.g. Network Level QoS Management DE

MBTS Libraries

API i.e. SDN Controller Southbound API
Multi-Protocols: OpenFlow; SNMP; NetConf; TR69; CMIP; COPS, etc.

Data Plane Network Elements/Nodes

With GANA Level-3 DEs (Node-Level) and GANA Level-2 DEs embedded or loadable into the Nodes

GANA also incorporates concepts the 4D architecture upon which
Combination of ETSI Autonomic Management & Control (AMC) Reference Model with SDN & NFV
NTECH / AFI Harmonization of Autonomic Mgt, NFV, SDN Activity

TECH / AFI /GANA, NFV, SDN combination :Proposal for discussion purpose

ETSI

SG / NFV / EVE WG is already addressing NFV & SDN combination

GANA Network Governance Interface

Simplified  ETSI /NFV / MANO

NFV Orchestrator

VNF Manager

Virtualized Infrastructure Manager (VIM)

To be investigated: 
→ Input into GANA Network Profiles

GANA Level 2 & 3 DEs can be introduced in Physical node or a Virtual Node/VNF

GANA Network-level DE

Other Network Level DEs
  e.g. Network Level QoS Management DE

ONIX
(Overlay Network for Information Exchange) Servers

SDN Controller
MBTS Libraries

API i.e. SDN Controller
Northbound API

Multi-Protocols: OpenFlow; SNMP;
NetConfi; TR609; CMIP; COPS; etc

Data Plane Network Elements/Nodes

With GANA Level-3 DEs (Node-Level) and GANA Level-2 DEs embedded or loadable into the Nodes

Network-wide Control-Loops realized by the GANA Knowledge Plane, with Inter-DE Coordination → avoid Decisions Conflicts
Thanks