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Autonomic network engineering for the self-managing Future Internet (AFI); Generic Autonomic Network Architecture; Part 2: An Architectural Reference Model for Autonomic Networking, Cognitive Networking and Self-Management

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Network Technologies (NTECH).

The present document is part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.70].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

As discussed in ETSI White Paper No.16 [3], the industry consensus is that in the digital services ecosystem, networks evolve to so-called "smart networks of the future", which are characterized by the need to be operated based on principles of dynamically adaptive Automated and Autonomic Management and Control (AMC) of networks and services (a.k.a autonomics). AMC replaces the increasingly complex and error-prone manual and static management and optimization of networks and services. Networks become smart, intelligent and self-managing or self-driving in some of their operations and behaviours, thanks to the AMC (autonomics) paradigm. The present document presents the Generic Autonomic Networking Architecture (GANA) Reference Model for Autonomic Networking, Cognitive Networking and Self-Management for Networks and Services - a model for implementing the AMC paradigm. GANA defines so-called Autonomic Functions (AFs) as autonomous and autonomic decision-making elements (DEs) for network management and control that can be instrumented at four basic complementary abstraction levels for self-management within network nodes or elements/functions and in the outer management and control realm. The main goal of the GANA reference model is prescribing design and operational principles for Decision Elements (DEs) as the drivers for cognitive, self-managing and self-adaptive network behaviours that enable to achieve OPEX reduction and other benefits "Artificial Intelligence/Cognition in AMC (autonomics)" bring to Network Operators and End User Customers, and to Enterprise Networks as well, such as:

- Dynamic and Analytics-Driven Service Fulfilment and Closed-Loop (Autonomic) Service Assurance.
- Predictive, Proactive and Advanced Customer Experience.

Autonomics algorithms in the scope of GANA are meant to be implemented by the so-called GANA Decision-making-Elements (DEs) that can be designed to operate at four basic complementary hierarchical levels for self-management behaviours within network nodes and in the outer management and control realm. Autonomics algorithms include Cognitive algorithms for Artificial Intelligence (AI)-such as Machine Learning (ML), Deep Learning (DL), Computational Intelligence, and other algorithms that can be employed in DEs' closed-loop operations.

NOTE: The ETSI White Paper No.16 [3] 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).

1 Scope

The scope of the present document is to provide the definition of the Generic Autonomic Network Architecture (GANA) as an architectural reference model for autonomic networking, cognitive networking and self-management that addresses the requirements defined in ETSI TS 103 194 [1] - a compilation of example requirements which reflect real-world problems that benefit from the application of automated management, autonomic management and self-management principles for networks and services delivered by the network to applications. The objective of the present document is to describe the GANA reference model with its associated Functional Blocks (FBs) and their associated reference points that can be instantiated onto target currently existing, emerging or future reference network architectures (including their management and control architectures) to create autonomics-enabled reference network architectures and their associated management and control architectures. The present document builds on the ETSI GS AFI 002 [2] specification by extracting key concepts of the GANA model and adding additional aspects that were not covered in ETSI GS AFI 002 [2] and also providing pointers on where to find details on the integration of the GANA model with reference models for other emerging complementary networking paradigms other than autonomics, namely:

- SON (Self-Organizing Networks).
- SDN (Software-Defined Networking).
- NFV (Network Functions Virtualisation).
- E2E Orchestration.
- Network Analytics.
- Big-Data Analytics for Autonomic Management and Control (AMC) of networks and services; and
- Closed-Loop Service Assurance.

This means is recommended that the present document is used together with ETSI GS AFI 002 [2], which contains valuable complementary details. The other goal is to describe how the human network operator could govern end to end autonomic networks and their management and control architectures.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

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The following referenced documents are necessary for the application of the present document.

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[2] ETSI GS AFI 002: "Autonomic network engineering for the self-managing Future Internet (AFI); Generic Autonomic Network Architecture (An Architectural Reference Model for Autonomic Networking, Cognitive Networking and Self-Management)".

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2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

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