A Design of Platform for Autonomic Management and Control in 5G

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***Abstract*— One important phenomenon occurring in future network is that the management and operation of networks and services are becoming increasingly complex, and to address this, the telecommunications industry and research community have been working on autonomic management and control (AMC) technologies. This paper introduces standardization activities for AMC and provides a design of AMC platform.**

Keywords—AMC, GANA, KP, MEC, 5G

I. INTRODUCTION

There are currently three networking paradigms driving the transformation of the ICT and telecommunications industries: Software Defined Networking (SDN), Network Functions Virtualization (NFV), and Autonomic Management and Control of Networks and Services (AMC). Research on the core technologies underlying these paradigms is reaching maturity, and some of these technologies are being commercialized and applied. However, the synergies that can be achieved by properly fusing these individual paradigms are expected to be very large, and research on efficient fusion is needed.

In particular, the recent emergence of 5G communication technology has enabled new business models and software reform opportunities in various industries, and one important service is "Network Slicing". "Network Slicing" is the division of physical network resources to create a group of resources to provide independent virtual network services to vertical industries or markets. In 5G, service providers can quickly and dynamically provide network services according to user needs as "Network Slice - as-a-Service" and create and provide "End-to-End Network Slice" [Access Networks, x-Haul (Fronthaul and Backhaul) and Core Networks].

One important phenomenon occurring in future networks, including 5G, is that the management and operation of networks and services are becoming increasingly complex, and to address this, the telecommunications industry and research community have been working on autonomic management and control (AMC) technologies. Thanks to network automation and artificial intelligence technologies that allow the management and operation of networks and services to be managed and controlled using self-adaptive software, the AMC paradigm can provide OPEX savings for network operators[1].

The standardization of AMC, an autonomous management and control technology, is centered around the Generic Autonomous Networking Architecture (GANA) Reference Model developed by ETSI and is already in its final stages of completion[2].

This paper introduces standardization activities for AMC and provides a design of AMC platform.

II. STANDARDIZATION ACTIVITY ON AMC

The organizations driving the future network services paradigm are attempting convergence in their own ways. For example, the Open Networking Foundation (ONF), which is leading SDN, is working on structures to accommodate NFV, and the ETSI NFV ISG, which is leading NFV, is working on structures to incorporate SDN, The ETSI NTEC/AFI WG, which is leading AMC by developing the AMC reference model, is also working in parallel to accommodate SDN and NFV technologies in AMC, and various organizations that are not leading each paradigm but need to use these technologies, such as TMF, OMA, IEEE NGSON, ITU-T SG13 JCA_SDN, 3GPP Multi-SDO, MGNM NGCORE, and others, are also working on how to converge them.

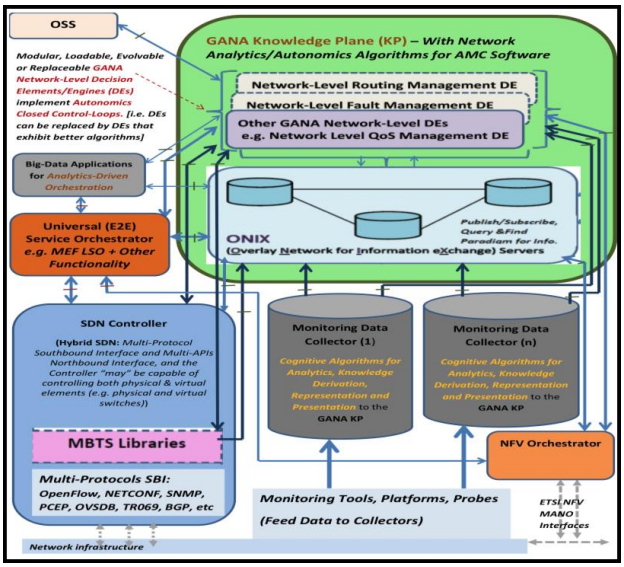
To realize AMC, various self-management functions across the infrastructure layer, which consists of networking equipment, the virtualization layer, which virtualizes the physical resources of the infrastructure layer to provide various virtual networking resources, and the management and orchestration layer, which manages and orchestrates them at the network-wide level, must be seamlessly connected, and various solutions are required for each layer. A diverse ecosystem is expected to be established, including equipment vendors such as routers and switches at the infrastructure layer, virtual networking software vendors at the virtualization layer, and management and orchestration solution vendors. Of these, the infrastructure and virtualization layers are expected to provide solutions by expanding the capabilities of existing vendors in related industries, while the management and orchestration layers are expected to

provide new opportunities for new entrants, including existing OSS vendors, and ISVs (Independent Software Vendors). In particular, the fact that the core of AMC is focused on the management and orchestration layer rather than the infrastructure or virtualization layer is expected to be a good opportunity for ISVs.

In recent years, the industry has been demanding autonomous 5G communications, including AMC capabilities, and 5G enabler technologies that structurally merge and integrate each of the core technologies. A complementary networking paradigm for configuring and establishing these network services has emerged as an important 5G enabler in the industry, which is the convergence/integration of network service orchestration, SDN, NFV, AMC, and Big-Data analytics technologies for service orchestration and AMC. The basic research on each of these technologies is already in a mature stage, and recent research has focused on innovative technologies that complement and integrate each other using a unified standard framework and open source project technologies.

Recently, ETSI created the '5G Network Slices Creation, Autonomic & Cognitive Management & E2E Orchestration; with Closed-Loop (Autonomic) Service Assurance for the Internet of Things (IoT) Use Cases' PoC project. The PoC project will enable network operators and manufacturers to service 5G network slices using AMC and orchestration automation frameworks. For this purpose, ETSI has defined a single structure for the integration of AMC, SDN, NFV, E2E orchestration and Big-Data analytics for AMC based on the ETSI GANA Model (ETSI White Paper No. 16). It is expected that a market of various SMEs/ISVs will be formed that can supply GANA-based AMC software with defined Functional Blocks developed with reference to this unified standard structure.

Figure 1 is a block diagram of the ETSI-defined unified AMC framework for E2E network services adopted in this paper. To realize an E2E integrated AMC, an AMC Knowledge Plane is required, which has Decision Elements (DEs) for autonomy at each layer and coordinates them at the network-wide level, and a unified structure to enable efficient, flexible, standards-based and open autonomous control and management by leveraging SDN, NFV, network services and Big-Data collection and analysis for AMC. Therefore, this paper shows aims to design and develop Generic Building Blocks based on the standard integrated GANA AMC model to enable SMEs/ISVs to innovatively adopt and commercialize AMC in the broad field of AMC[3].



(Figure 1) Unified architecture for AMC, SDN, NFV, E2E orchestration, and Big Data analytics for AMC based on the ETSI GANA model.

III. PLARFORM FOR AMC

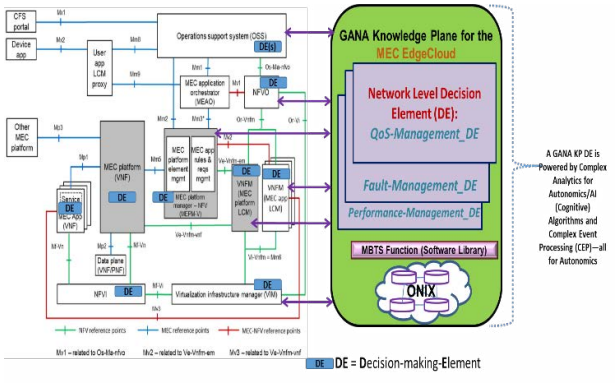
This paper describes the Knowledge Plane platform, architecture, and functional design for Autonomic Management and Control (AMC), Software Defined Networking (SDN), Network Function Virtualization (NFV), Orchestration, and Machine Learning element technologies for 5G Mobile Edge Computing and Transport network autonomy based on the ETSI GANA Model.

GANA Knowledge Plane (KP) Platform Design for 5G MEC & Transport Network Autonomous Management is followings as shown Figure 2 and Figure 3;

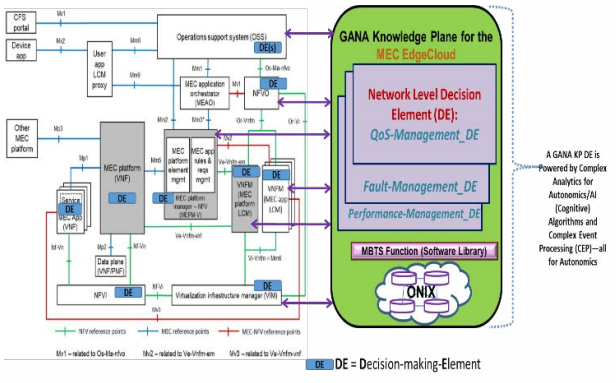
- Design of Decision-making Element (DE) structure and functions for 5G MEC and Transport networks
- Design of ACUMOS and ONAP related component integration and interworking structure for DE implementation
- Define Data Source for DE algorithm
- Design of Big Data Platform (IRIS) structure and functional extensions to existing components for ONIX implementation
- Design of existing Orchestrator and SDN Controller structure and functional extension (MBTS)

Design of GANA Knowledge Plane (KP) Platform and Interface with Underlying Network Orchestrators for 5G MEC & Transport Network Autonomous Management is followings;

- Design of KP platform and interface protocols with MEC orchestrators
- Design of interface protocols between KP platform and Transport orchestrators



(Figure 2) AMC Platform full integration diagram for 5G MEC networks



(Figure 3) AMC Platform Full Integration Diagram for 5G Transport Networks

IV. CONCLUSION

This paper introduced an AMC platform. The platform based on GANA Network-Level DEs (Decision Entities), ONIX (Overlay Network for Information eXchange), and MBTS (Model-Based Translation Service), which are ETSI GANA Generic Building Blocks (software modules and libraries) for AMC, SDN, NFV, E2E/Service Orchestration based KP platform for 5G Mobile Edge Computing and Transport network autonomous management.

It includes a MEC & Transport integrated Orchestrator structure that applies AMC, SDN, NFV-based Knowledge Plane (KP) platform for autonomous management of Edge Computing and Transport networks.

To realize a unified and integrated AMC for E2E network services, we utilize the GANA reference model. GANA is named as four kinds of layers: protocol, function, node, and network, and the KP corresponds to the Network layer. KP is composed of components and DEs to autonomously control the entire network according to the operator's intent. This will provide efficient and flexible autonomous control and management by utilizing SDN, NFV network services and the collection and analysis of big data.

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