5G Management and Orchestration Architecture Framework

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Abstract

The 5G network is expected to be service oriented with the premise that it will support various services of vastly different requirements on configuration including automation, performance, accounting and network status reporting. In support of this premise 3GPP agreed to adopt a service based management architecture framework in Rel-15, providing amongst other aspects the flexibility for integration with other architecture framework(s) to jointly fulfil the 3GPP service and network management requirements.

Keywords: 5G, Management, Orchestration, Management Service, Management Function, Service Consumer, Service Producer, Service Interface, Management Data Analytics, Life Cycle Management.

1 Service Oriented Management Architecture Framework

1.1 Management Services (MnS)

The 3GPP management architecture framework developed by working group SA5 adopts a service-oriented approach, which is described as interaction between a Management Service (MnS) consumer and an MnS producer. For

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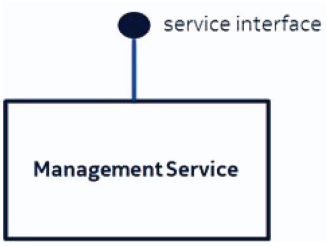

Figure 1 Management service as referred to 3GPP TS 28.533 [1] Section 4.1.

example, an MnS consumer can request operations from an MnS producer on fault supervision service, performance assurance service, provisioning service and notification service, etc. An MnS offers management capabilities. These management capabilities are accessed by MnS consumers via standardized service interfaces, depicted in Figure 1, composed of individually specified MnS components.

The basic elements of an MnS include a group of management operations and/or notifications agnostic of managed entities (Management service component type A), management information represented by an information model of managed entities (Management service component type B), and performance information of the managed entity and fault information of the managed entity (Management service component type C). The advantage of separating the basic elements into management service components is to allow the management service components to develop independently according the needs of the network technology managed, and the automation requirements from the network (and service) operations.

An MnS may contain the combination of the following:

(1) management service component type A and management service component type B
(2) management service component type A, management service component type B and management service component type C.

The instances of MnSs carry information about specified management service components in the metadata attributes. Figure 2 illustrates examples of management service instances with various management service components of type A, type B and type C (more details on entities in Figure 2 can be found in [2] and [3]):

Deployment (or the use) of management services is flexible and they may reside in different management layers. For example, a network provisioning

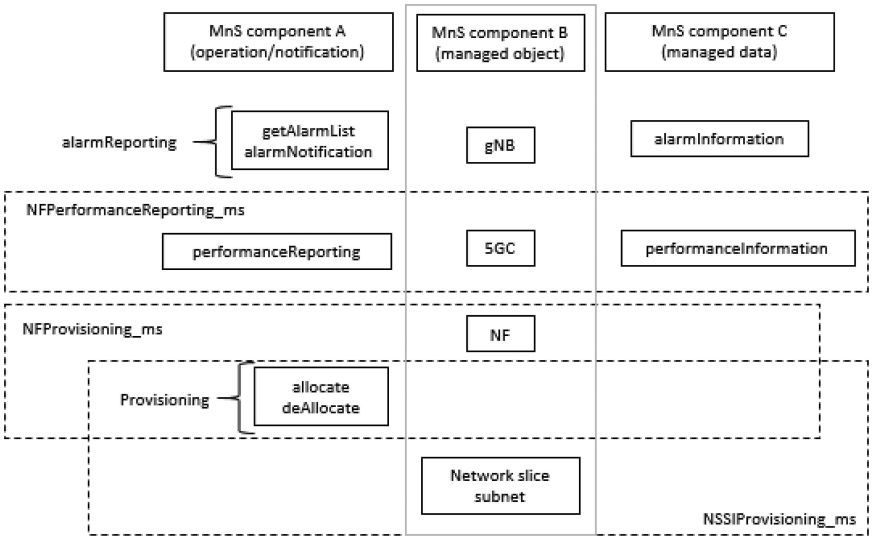

Figure 2 Examples of MnSs and component type A, B and C as referred to 3GPP TS 28.533 [1] Section 4.3.

service may reside at the network and network slice management layer, and a subnetwork provisioning service may reside at the subnetwork and network slice subnet management layer. SA5 recognizes the need for automation of management by introducing new management functions such as a Communication Service Management Function (CSMF), Network Slice Management Function (NSMF) and a Network Slice Subnet Management Function (NSSMF) to provide an appropriate abstraction level for automation. Having identified the need or existence of a CSMF in Rel-15 further work on management service aspects regarding this function is being carried out in Rel-16 timeframe.

1.2 Management Function (MnF)

In the service-based management architecture framework a Management Function (MnF) plays the role of either Management (MnS) Service producer or MnS consumer. An MnS produced by an MnF may have multiple consumers. The MnF may consume multiple MnSs from one or multiple MnS producers. An example of an MnF playing both roles (MnS producer and MnS consumer) is illustrated in the Figure 3.

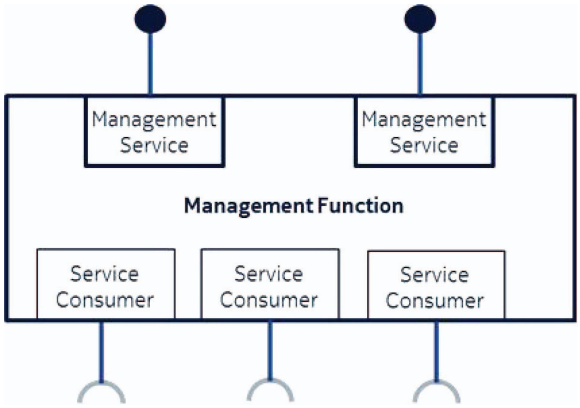

Figure 3 Example of MnF and MnS as referred to 3GPP TS 28.533 [1] Section 4.5.

1.3 Management Functions (MnF) and Management Services (MnS)

Management functions may interact by consuming management services produced by other management functions. Figure 4 below illustrates multiple scenarios:

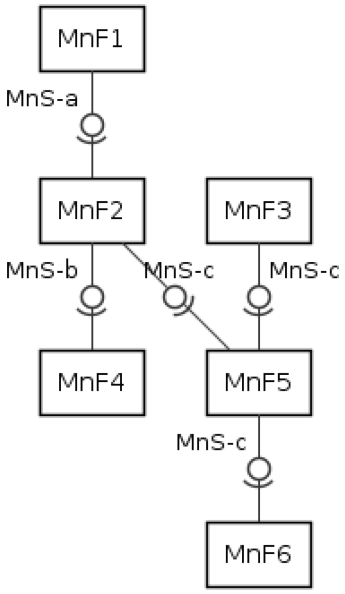

Figure 4 Example of interactions between management functions as referred to 3GPP TS 28.533 [1] Section 4.5.

- MnF1 produces management service MnS-a;
- MnF2 consumes management service MnS-a produced by MnF1 and produces management services MnS-b and MnS-c;
- MnF3 produces management service MnS-c;
- MnF4 consumes management service MnS-b produced by the MnF2;
- MnF5 consumes management services MnS-c produced by the MnF2 and MnF3, and in turn produces the same management service MnS-c. The behaviour of MnF5 may be seen as aggregation of management services MnS-c.

1.4 Interaction Paradigm Between MnS Producer and MnS Consumer

The interactions between the management service producer and a management service consumer follows one of the two following paradigms:

- "Request-response": A management service producer is requested by a management service consumer to invoke an operation, which either results in the management service producer to perform an action or to provide information or both. The management service producer provides its response based on the request by management service consumer. See Figure 5 below.
- "Subscribe-notify": A management service consumer requests a management service producer to establish a subscription to receive network

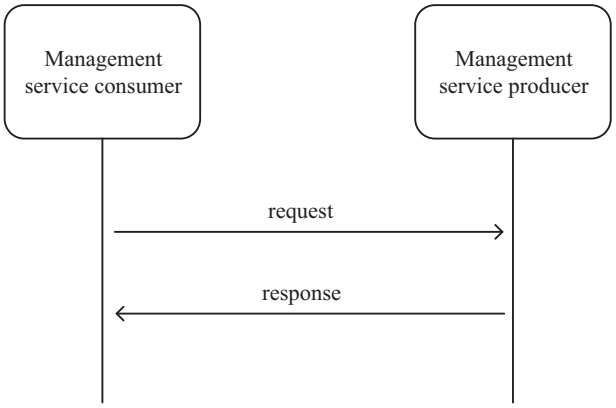

Figure 5 Request-response communication paradigm as referred to 3GPP TS 28.533 [1] Section 5.1.2.

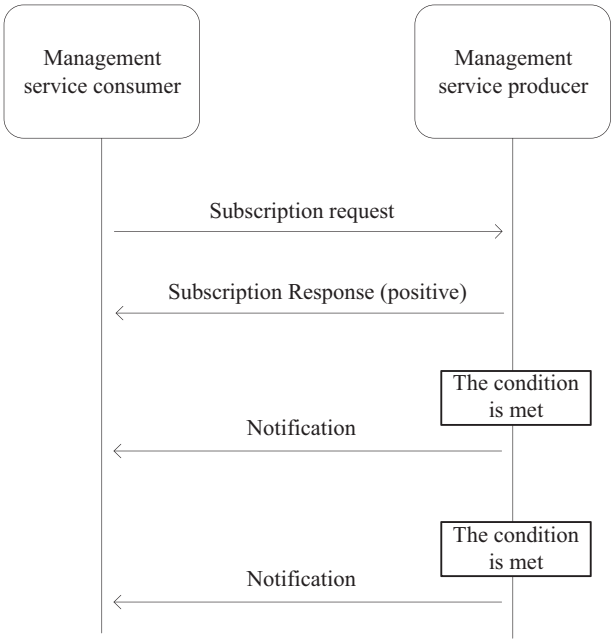

Figure 6 Subscribe-notify communication paradigm as referred to 3GPP TS 28.533 [1] Section 5.1.2.

events via notifications, under the filter constraint specified in this operation. See Figure 6. Subscriptions can be created also by other means than by using such operation.

2 Examples of Management Service Deployment Scenarios

2.1 Deployment Scenario for Network and Network Slice

Figure 7 shows an example of a deployment scenario for management of a mobile network including network slicing.

In this deployment scenario:

- Network and Network Slice Management Function provides the management services for network or Network Slice Instance (NSI) which includes RAN part, CN part and TN part to the Consumer. Network and Network Slice Management Function consumes management services for RAN SubNetwork or NSSI produced by RAN Management Function,

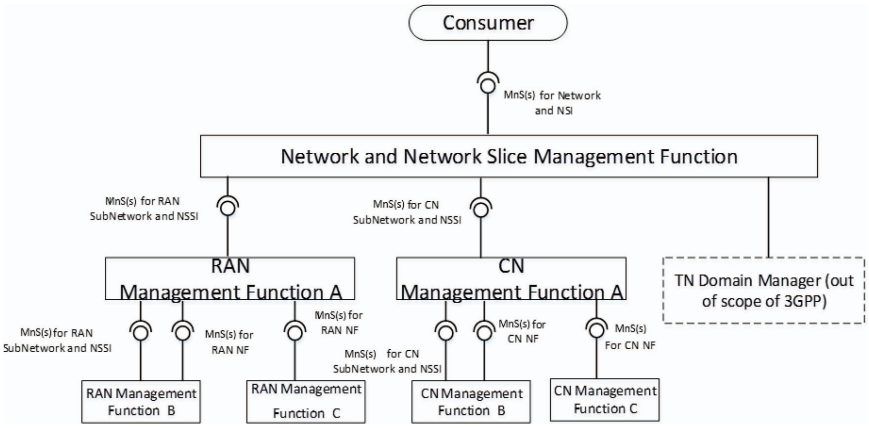

Figure 7 An example of deployment scenario for management of a mobile network including network slicing as referred to 3GPP TS 28.533 [1] A.8.

management services for CN SubNetwork or NSSI produced by CN Management Function and interface produced by TN Manager.

- The RAN Management Function provides the management services for the RAN SubNetwork or NSSI and/or management services for RAN NF(s). The RAN Management Function may consume management service for RAN SubNetwork or NSSI and management services for RAN NF.
- The CN Management Function provides the management services for CN NSSI and/or management services for CN NF. The CN Management Function may consume management service for CN NSSI and management services for CN NF.

2.2 Deployment Example for Management Data Analytics Services (MDAS)

A Management Data Analytics Service (MDAS) provides management data analytics to support network management and orchestration. MDAS can be deployed at different levels, for example, at domain level (e.g., RAN, CN, NSSI) or in a centralized manner (e.g., in a PLMN level). A domain-level MDAS provides domain specific analytics, e.g., resource usage prediction in a CN or failure prediction in an NSSI, etc. A centralized MDAS can provide end-to-end or cross-domain analytics service, e.g., resource usage or failure prediction in an NSI, optimal CN node placement for ensuring lowest latency

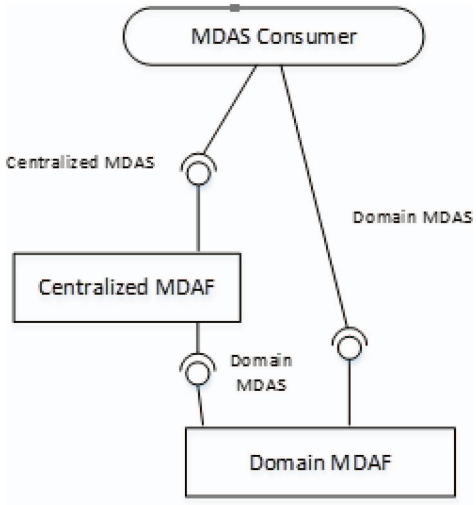

Figure 8 MDAS provided at different levels as referred to 3GPP TS 28.533 [1] A.7.

in the connected RAN, etc. Figure 8 illustrates an example of deployment model of the MDAS:

- The domain MDAF produces Domain MDAS(s)
- The domain MDAS(s) is consumed by the Centralized MDAF and other authorized MDAS Consumers (for example, infrastructure manager, network manager, slice manager, slice subnet manger, other 3rd party OSS, etc.)
- The Centralized MDAF produces Centralized MDAS(s)
- The Centralized MDAS is consumed by different authorized MDAS Consumers

2.3 Deployment Example with NFV-MANO

In this deployment scenario, see Figure 9:

- The entity denoted as NSSMF (Network Slice Subnet Management Function) is capable of consuming the VNF LCM and NS LCM related services provided by the NFV-MANO (NFVO). The same entity is also a provider of the NSS related management services.

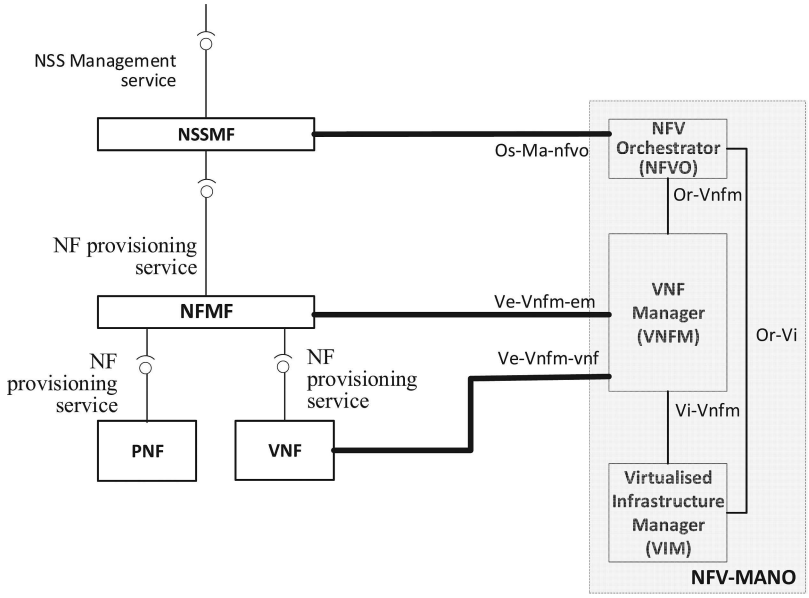

Figure 9 Deployment scenario for NSSI management with interface to NFV-MANO as referred to 3GPP TS 28.533 [1] A.4.

- The entity denoted as NFMF (NF Management Function) is capable of application level management of VNFs and PNFs and is a producer of the NF Provisioning service that includes Configuration Management (CM), Fault Management (FM) and Performance Management. The same entity is consumer of the NF Provisioning service produced by VNFs and PNFs.

2.4 Deployment Example with Exposure Governance Management Function (EGMF) Provided Management Services

In Figure 10, the EGMF produces exposure governance management capability that operators can apply on MnF 1 MnS for exposing different derivation of MnF 1 MnS to:

- MnF 2 (e.g. from another Operator) and
- 3rd party (e.g. from vertical industry).

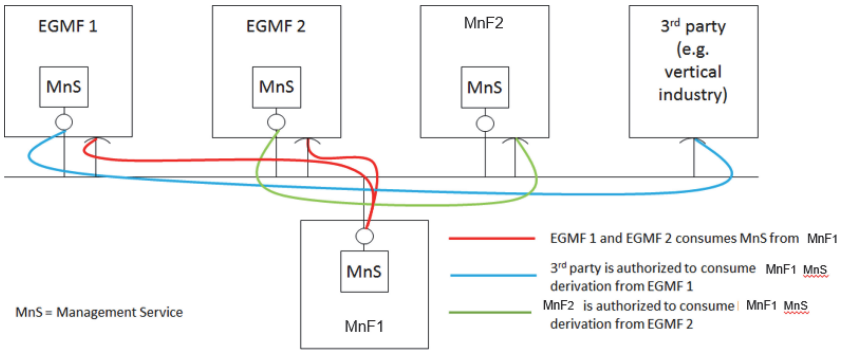

Figure 10 Example of deployment of exposure governance management function as referred to 3GPP TS 28.533 [1] A.3.

3 Conclusion

The road to 5G lies ahead of us and we are moving along it swiftly while leaving behind the service oriented 5G management specifications in 3GPP Release 15. The journey will not end here; the Release 15 specifications provide building blocks for standardisation of new management services, extended information models and new measurements, that enable network and service operations to be automated allowing the service provider or network operator to respond faster to their customers' requirements and the requirements of the network evolution (or changing network technologies).

The journey of specifying service-based interfaces for management and charging of the evolving 3GPP 5G eco-system will continue into Release 16, including, but is not limited to new management features such as for, example communication service management, management automation, intent driven management, the integration of ONAP and 3GPP 5G management framework.

References

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[3] 3GPP TS 28.541: "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3". Rel. 15.1.0.

Biographies

Jan Groenendijk is a Rapporteur of 3GPP SA5 and works in Ericsson Solution Area OSS, Product Development Unit OSS in Athlone, Ireland. He has received his engineering degree in Electrical and Electronics Engineering from the Technical University Delft in the Netherlands. He has worked for KPN Research and KPN Network Services for ten years, after which he joined Ericsson Expertise Ireland in 1998.

He has been working as a standardization delegate representing Ericsson since 2015 in NGMN and from 2016 in 3GPP SA5.

Zou Lan is Huawei wireless OSS standard prime delegate. She has received master degree in Computer Science from Xi'an Jiao Tong University, China before she joined Huawei. She has strong technical background in network management and extensive experience in standards. She has been actively participating in standardization and research activities such as 5G network and network slicing management, self-organizing network, network virtualization, fixed and mobile converged management. Zou Lan is an active player both in 3GPP SA5 and ETSI ZSM. She has held numerous rapporteurships in 3GPP SA5 since 2008.