**3GPP TSG-SA5 Meeting #142-eS5-222189**

**e-meeting, 04 -12 April 2022**

**Source: Ericsson, Orange, AT&T, Telefonica, Deutsche Telekom**

**Title: Management capability exposure using CAPIF**

**Document for: Discussion**

**Agenda Item: Exposure**

# 1 Decision/action requested

**Agree on how the deployment options to be supported for CAPIF and MnS.**

# 2 References

[1] 3GPP TS [28.532](https://www.3gpp.org/DynaReport/28532.htm): "Management and orchestration; Generic Management Service"

[2] 3GPP [TS 28.550](https://www.3gpp.org/DynaReport/28550.htm): "Management and orchestration; Performance assurance"

[3] 3GPP [TS 28.537](https://www.3gpp.org/DynaReport/28537.htm): "Management and orchestration; Management capabilities"

[4] 3GPP TS [28.623](https://www.3gpp.org/DynaReport/28623.htm): "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions"

[5] 3GPP TS [28.541](https://www.3gpp.org/DynaReport/28541.htm): " Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3"

[6] 3GPP [TS 28.536](https://www.3gpp.org/DynaReport/28536.htm) : "Management and orchestration; Management services for communication service assurance; Stage 2 and stage 3"

[7] 3GPP TS [28.622](https://www.3gpp.org/DynaReport/28622.htm): " Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP) Information Service (IS)"

[8] 3GPP [TS 29.122](https://www.3gpp.org/DynaReport/29122.htm): "Technical Specification Group Core Network and Terminals; T8 reference point for Northbound APIs."

[9] 3GPP [TS 29.522](https://www.3gpp.org/DynaReport/29522.htm): " Technical Specification Group Core Network and Terminals; 5G System; Network Exposure Function Northbound APIs; Stage 3"

[10] 3GPP TS [23.222](https://www.3gpp.org/DynaReport/23222.htm): "Common API Framework for 3GPP Northbound APIs".

[11] 3GPP TS [29.222](https://www.3gpp.org/DynaReport/29222.htm): "Common API Framework for 3GPP Northbound APIs"

[12] 3GPP TS [28.533](https://www.3gpp.org/DynaReport/28533.htm) : "Management and orchestration; Architecture framework"

[13] 3GPP TS [32.254](https://www.3gpp.org/DynaReport/32254.htm): "Telecommunication management; Charging management; Exposure function Northbound Application Program Interfaces (APIs) charging"

[14] 3GPP TS [28.201](https://www.3gpp.org/DynaReport/28201.htm): "Charging management; Network slice performance and analytics charging in the 5G System (5GS); Stage 2"

[15] 3GPP TS [28.202](https://www.3gpp.org/DynaReport/28202.htm): "Charging management; Network slice management charging in the 5G System (5GS); Stage 2"

# 3 Rationale

The definition of what is included by the term “management capability exposure governance” needs to be described, as well as the relationship with the CAPIF.

# 4 Detailed proposal

## 4.1 Service overview

### 4.1.1 Management service overview

The management services a producer of management information can provide are documented in TS 28.532 [1] and TS 28.550 [2] and can be found in table 4.1.1.

|  |  |  |  |
| --- | --- | --- | --- |
| **Management service (API)** | **Supported HTTP operations** | **Yaml definition file name (.yaml)** | **Reference** |
| Provisioning MnS | PUT, GET, PATCH, DELETE | provMnS | TS 28.532 [1] |
| Fault Supervision MnS | GET, PATCH, POST, DELETE | faultMnS | TS 28.532 [1] |
| Performance Measurement Job Control MnS | POST, GET, DELETE | perMeasJobCtlMnS | TS 28.550 [2] |
| Performance Data File Reporting MnS  | POST, GET, DELETE | fileDataReportingMnS | TS 28.532 [1] |
| Performance Threshold Monitoring MnS | POST | perfMnS | TS 28.532 [1] |
| Heartbeat Notifications | No operations defined | heartbeatNtf | TS 28.532 [1] |
| Streaming Data Reporting MnS | POST, GET, DELETE | streamingDataMnS | TS 28.532 [1] |

Table 4.1.1.1 Overview of management services (MnS)

A management service is provided by an MnS producer and consumed by an MnS consumer this is shown in figure 4.1.1. A management function may contain multiple MnS producers and multiple MnS consumers but should at least contain one MnS producer. Specification of management functions, MnS consumers and MnS producers is outside the scope of SA5.



Figure 4.1.1 MnS\_Consumer consumes service produced by MnS\_Producer

For an MnS producer to be able to provide management services it needs to have management capabilities. The minimum set of management capabilities an MnS producer needs is documented in TS 28.537 [3]. The capabilities and the network resource models are documented in TS 28.623 [4], TS 28.541 [5], and TS 28.536 [6] and give context (meaning) to the management services and can be found in table 4.1.2.

| **Management and network resource models**  | **Supported HTTP operations** | **Yaml definition file name (.yaml)** | **Reference** |
| --- | --- | --- | --- |
| Generic NRM | No operations defined | genericNrm | TS 28.623 [4] |
| Common NRM definitions | No operations defined | comDefs | TS 28.623 [4] |
| NR NRM | No operations defined | nrNrm | TS 28.541 [5] |
| 5GC NRM | No operations defined | 5gcNrm | TS 28.541 [5] |
| Slice NRM | No operations defined | sliceNrm | TS 28.541 [5] |
| Communication service assurance NRM | No operations defined | coslaNrm | TS 28.536 [6] |

Table 4.1.1.2 Overview of management and network resource models

NOTE: TS 28.541 [5] and TS 28.536 [6] include both stage 2 (UML) and stage 3 (YAML) definitions, TS 28.623 [4] includes only stage 3 (YAML) definitions, stage 2 (UML) can be found in TS 28.622 [7].

Notifications are specified as part of the management services in table 4.1.1.1, see TS 28.532 [1] and as configuration change notifications for NRM in table 4.1.1.2 also in TS 28.532 [1].

### 4.1.2 Network provided services

The services a 3GPP network is capable of providing to a 3rd party have been document in TS 29.122 [8] and extended in TS 29.522 [9]. TS 29.122 [8] specifies the services a Service Capability Exposure Function (SCEF) provides to a Services Capability Server/Application Server (SCS/AS) and TS 29.522 [9] extends the list of services where the SCEF is replaced with Network Exposure Function (NEF) and SCS/AS is replaced with Application Function (AF). Full list of services can be found in Annex A table A.1.

Abbreviations:

SCEF Service Capability Exposure Function

NEF Network Exposure Function

SCS/AS Services Capability Server/Application Server

AF Application Function

## 4.2 Management capability exposure

A precondition for management service capability exposure is that a producer of management service to be exposed has access to the management service components and instances of management services.



Figure 4.2.1: Management capability exposure without exposure governance applied

Figure 4.2.1 describes when a Management Service A (MnS A) is exposed as is without any transformation or constraints (limitations), this means that management service A consumer (e.g., 3rd party) can access all management capabilities offered by management service A producer.



Figure 4.2.2: Management capability exposure with exposure governance applied

Figure 4.2.2 describes when management service A (MnS A) is exposed as management service A' (MnS A') where the transformation(s) and constraint(s) (limitation) are controlled by the management service C, this means that management service A' consumer (e.g., 3rd party) can only access the capabilities offered by the management service A producer that management service C has configured.

One MnS can potentially be exposed as several services or even combined with other service(s) before being exposed. For instance, MnS A could be exposed as MnS A' to an operator while at the same time being exposed as MnS A" to a 3rd party, it could also be combined with MnS B and then exposed as MnS AB



Figure 4.2.3: Management Service (MnS) A is exposed as MnS A' and MnS A", while at the same time being exposed in combination with MnS B as MnS AB

## 4.3 Management service exposure relationship with CAPIF

### 4.3.1 General

The table 4.3.1.1 shows the relationship between management service exposure and CAPIF. The details of exposure using CAPIF is specified in 3GPP TS 23.222 [10].

Table 4.3.1.1: CAPIF relationship with management service exposure

|  |  |  |
| --- | --- | --- |
| Aspects | CAPIF | OAM |
| Entity providing the APIs to external or 3rd party applications | API exposing function | MnS producer |
| Entity representing the external or 3rd party applications | API invoker | MnS consumer |
| Entity providing framework related services to the applications (discovery, authentication, authorization, etc) | CAPIF core function | Not specified |
| Entity providing framework related services to support the APIs operation and management (publish, policy enforcements, charging) | CAPIF core function | Not specified |
| Interface/Reference point for exposing framework services as APIs (discovery, authentication, and authorization) | CAPIF-1 and CAPIF-1e | MnS discovery, authentication, and authorization service |
| Interface/Reference point for exposing management services as APIs | CAPIF-2 and CAPIF-2e (non-service specific aspects) | MnS (only service specific aspects) |
| Interface/Reference point for exercising access and policy related control on service API communications | CAPIF-3 and CAPIF-3e | Internal to MnS producer, charging can be supported using notifications |
| Interface/Reference point for publishing the service API information | CAPIF-4 and CAPIF-4e | MnS registration (to discovery service) |
| Interface/Reference point used for management of service API, API invoker and API provider domain function information | CAPIF-5 and CAPIF-5e | Internal to MnS producer |

### 4.3.2 Deployment models

There are three basic deployment models for how the MnS exposure could be viewed from CAPIF:

- All services specified as MnS (scenario A)

- Having the MnS as the API provider (scenario B)

- Having the MnS as services that can be used by the API provider (scenario C)

#### 4.3.2.1 Scenario A

Scenario A is depicted in figure 4.3.2.1.1.



Figure 4.3.2.1.1: The MnS producers as both API providers and CAPIF Core service provider

In this case all services provided by the CAPIF core would need to be specified as MnS, this means that the all refence points (CAPIF-1 to 5) would be seen as MnSs. Which MnS that would be specified to support the exposure would depend on requirements.

#### 4.3.2.2 Scenario B

Scenario B is depicted in figure 4.3.2.2.1.



Figure 4.3.2.2.1: The MnS producers as API providers

In this case the current MnS could be provided as service APIs as is and the MnS producer would then reuse the services provided by the CAPIF core, wherever to support the reference points CAPIF-3, 4, and 5 from the MnS produces would depend on requirements e.g., CAPIF-5 could either be seen as a separate MnS producers and consumers or part of the MnS producer, see management service C producer in figure 4.1.2.

For example, one service API on CAPIF-2 would be the provMnS.

The functions in the API provider consists of several CAPIF service consumers.



Figure 4.3.2.2.2: The API provider as service consumers and producers

The CAPIF core function provided services can in some cases be mapped to MnS(s).

Table 4.3.2.2.1: Mapping of CAPIF supported capability to MnS supported capability for scenario B

|  |  |  |
| --- | --- | --- |
| **CAPIF reference point** | **CAPIF supported services** | **Supported by MnS** |
| CAPIF 1/1e | - CAPIF\_Discover\_Service\_API- CAPIF\_Events\_API- CAPIF\_API\_Invoker\_Management\_API- CAPIF\_Security\_API Specified in TS 29.222 [11] | - MnS consumer management is not specified |
| CAPIF 2/2e | - AEF\_Security\_APISpecified in TS 29.222 [11]- Service APIs: not specified | - Authentication and authorization of MnS consumers is specified in TS 28.533 [12] clause 4.9 - Service APIs (MnS): faultMnS, fileDataReportingMnS, heartbeatNtf, perfMnS, provMnS, and streamingDataMnSSpecified in in TS 28.532 [1] |
| CAPIF 3 | - CAPIF\_Events\_API- CAPIF\_Security\_API - CAPIF\_Logging\_API\_Invocation\_API - CAPIF\_Access\_Control\_Policy\_API- CAPIF\_Routing\_Info\_API Specified in TS 29.222 [11]- Nchf\_ConvergedChargingSpecified in TS 32.254 [13] | - Access control for an MnS consumers by an MnS producer is not specified- Routing of an MnS consumers request by an MnS producer is not specified- Nchf\_ConvergedChargingSpecified in TS 28.201 [14] and TS 28.202 [15] |
| CAPIF 4 | - CAPIF\_Events\_API- CAPIF\_Publish\_Service\_API  Specified in TS 29.222 [11] | - Registration of MnS by an MnS producerSpecified in TS 28.622 [7] and TS 28.623 [4]  |
| CAPIF 5 | - CAPIF\_Events\_API- CAPIF\_Monitoring\_API - CAPIF\_Auditing\_API - CAPIF\_API\_Provider\_Management\_API Specified in TS 29.222 [11] | - Management of MnS consumers is not specified- Auditing of the MnS producer is not specified |

#### 4.3.2.3 Scenario C

Scenario C is depicted in figure 4.3.2.3.1



Figure 4.3.2.3.1: The API providers as MnS consumer

In this case the exposure would rely completely on CAPIF and the service APIs related to management services could be specified either inside or outside of 3GPP. This would mean that there could be a translation from the MnS to a service API that is more API invoker specific or specific to the type of enterprise the API invoker belongs to e.g., other operators, car manufacture, mining. The translation from the MnS to the service API could be seen as a separate function which then could be implemented as part of the API provider or as a specific MnF (for example the dashed box in Figure 4.3.2.3.1).

For example, there could be a service API dedicated for network slice allocation, modification, and deallocation called NetworkSliceManagement\_API or an API specific for setting QoS for a network slice called NetworkSliceQoS\_API both service APIs would be a translation of the provMnS.

## 4.4 Analysis

Scenario A would imply that the whole CAPIF would need to be specified as MnS(s), this would also make it more difficult for the API invokers that then often would need support two different ways of accessing 3GPP APIs i.e., the CAPIF way and the MnS way.

Scenario B could be seen as the same as figure 4.2.2, where the MnS C would correspond to CAPIF-3, 4, and 5. This means that the API invoker would use the same way of invoking all types of 3GPP APIs and the only difference would be the actual service API.

Scenario C is matching the figure 4.2.3 where MnF would correspond to the API provider, and the MnS A', MnS A", and MnS AB would be the API invoker specific APIs. This means that the API invoker would use the same way of invoking all types of 3GPP APIs and the only difference would be the actual service API, which in this case also would be more adapted to the API invokers need.

## 4.5 Conclusion

Scenarios B and C reuses the services provided by the CAPIF core function which would allow for an easier integration between the management and network provided services. The main difference between scenario B and C is that in B the MnS(s) are exposed as is while in C there may be an adaption made to the services to better match the API invoker requirements.

The recommendation is therefore to specify C while allowing B. For scenario C the specification of the service APIs should be left for forums that have better knowledge of the industries that will use the API (i.e. implement an API invoker).

Annex A:
Overview of 3GPP defined network provided services

Table A.1 lists the current yaml specifications with their corresponding network service listed as part of SCEF/NEF, to get a view of what type of services currently exposed by the network functions in 3GPP.

| **Service name** | **Description** | **Supported HTTP operations** | **Yaml definition file name (.yaml)** | **Reference** |
| --- | --- | --- | --- | --- |
| AsSessionWithQoS | Application Server (AS) Session with QoS API | GET, PUT, POST, PATCH, DELETE | TS29122\_AsSessionWithQoS | TS 29.122 [8] |
| ChargeableParty | Chargeable Party API | GET, POST, PATCH, DELETE | TS29122\_ChargeableParty | TS 29.122 [8] |
| - | - | No operations defined | TS29122\_CommonData | TS 29.122 [8] |
| CpProvisioning | Communication Patterns (CP) Parameters Provisioning API | GET, PUT, POST, DELETE | TS29122\_CpProvisioning | TS 29.122 [8] |
| DeviceTriggering | Device Triggering API | GET, PUT, POST, DELETE | TS29122\_DeviceTriggering | TS 29.122 [8] |
| GMDviaMBMSbyMB2 | Group Message Delivery via MBMS by MB2 API | GET, PUT, POST, PATCH, DELETE | TS29122\_GMDviaMBMSbyMB2 | TS 29.122 [8] |
| GMDviaMBMSbyxMB | Group Message Delivery via MBMS by xMB | GET, PUT, POST, PATCH, DELETE | TS29122\_GMDviaMBMSbyxMB | TS 29.122 [8] |
| MonitoringEvent | Event Monitoring API | GET, PUT, POST, PATCH, DELETE | TS29122\_MonitoringEvent | TS 29.122 [8] |
| MsisdnLessMoSms | MSISDN-less Mobile-Originated SMS API | POST | TS29122\_MsisdnLessMoSms | TS 29.122 [8] |
| NIDD | Non-IP Data Delivery (NIDD) API | GET, POST, PATCH, DELETE | TS29122\_NIDD | TS 29.122 [8] |
| NpConfiguration | Network Parameter Configuration API | GET, PUT, POST, PATCH, DELETE | TS29122\_NpConfiguration | TS 29.122 [8] |
| PfdManagement | Packet Flow Description (PFD) Management API | GET, PUT, POST, PATCH, DELETE | TS29122\_PfdManagement | TS 29.122 [8] |
| RacsParameterProvisioning | RACS (Radio Capability Signaling) Parameter Provisioning API | GET, PUT, POST, PATCH, DELETE | TS29122\_RacsParameterProvisioning | TS 29.122 [8] |
| ReportingNetworkStatus | Network Status Reporting API | GET, PUT, POST, DELETE | TS29122\_ReportingNetworkStatus | TS 29.122 [8] |
| ResourceManagementOfBdt | Resource Management of Background Data Transfer (BDT) API | GET, PUT, POST, PATCH, DELETE | TS29122\_ResourceManagementOfBdt | TS 29.122 [8] |
| 5GLANParameterProvision  | 5G LAN Parameter Provision API | GET, PUT, POST, PATCH, DELETE | TS29522\_5GLANParameterProvision | TS 29.522 [9] |
| ACSParameterProvision | ACS Parameter Provision API | GET, PUT, POST, DELETE | TS29522\_ACSParameterProvision | TS 29.522 [9] |
| AKMA | AKMA API | POST | TS29522\_AKMA | TS 29.522 [9] |
| AMInfluence | AM Influence API | GET, PUT, POST, PATCH, DELETE | TS29522\_AMInfluence | TS 29.522 [9] |
| AmPolicyAuthorization | AM Policy Authorization API | GET, PUT, POST, PATCH, DELETE | TS29522\_AmPolicyAuthorization | TS 29.522 [9] |
| AnalyticsExposure | Analytics Exposure API | GET, PUT, POST, PATCH, DELETE | TS29522\_AnalyticsExposure | TS 29.522 [9] |
| ApplyingBdtPolicy | Applying BDT Policy API | GET, POST, PATCH, DELETE | TS29522\_ApplyingBdtPolicy | TS 29.522 [9] |
| EcsAddressProvision | ECS Address Provision API | GET, PUT, POST, DELETE | TS29522\_EcsAddressProvision | TS 29.522 [9] |
| IPTVConfiguration | IPTV Configuration API | GET, PUT, POST, PATCH, DELETE | TS29522\_IPTVConfiguration | TS 29.522 [9] |
| LpiParameterProvision | LPI (Location Privacy Indicator) Parameter Provision API | GET, PUT, POST, DELETE | TS29522\_LpiParameterProvision | TS 29.522 [9] |
| MBSSession | <missing information> | GET, PUT, POST, PATCH, DELETE | TS29522\_MBSSession | TS 29.522 [9] |
| MBSTMGI | MBS TMGI API | POST | TS29522\_MBSTMGI | TS 29.522 [9] |
| MoLcsNotify | MO LCS Notify API | POST | TS29522\_MoLcsNotify | TS 29.522 [9] |
| NIDDConfigurationTrigger | NIDD (Non-IP Data Delivery) Configuration Trigger API | POST | TS29522\_NIDDConfigurationTrigger | TS 29.522 [9] |
| ServiceParameter | Service Parameter API | GET, PUT, POST, PATCH, DELETE | TS29522\_ServiceParameter | TS 29.522 [9] |
| TimeSyncExposure | Time Sync Exposure API | GET, PUT, POST, , DELETE | TS29522\_TimeSyncExposure | TS 29.522 [9] |
| TrafficInfluence | Traffic Influence API | GET, PUT, PATCH, DELETE | TS29522\_TrafficInfluence | TS 29.522 [9] |

Table A.1 Overview of 3GPP defined network provided services