Southbound Interface Network Resources APIs

Version 2.0

29 March 2023

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1 Introduction

1.1 Overview

The Operator Platform’s (OP) Network Integration Support Application Programming Interfaces (APIs) are mainly related to the Telco network interfaces, e.g. the Southbound Interface-Network Resources (SBI-NR), but also aiming to provide the end-to-end fulfilment of the specific topic, hence including any other OP Interface as described in GSMA PRD OPG.02 [1].

The list of the topics and the associated APIs in the SBI-NR interface are presented in the Table 1 below. Grey items are still under analysis and will be available in a later release.

<table>
<thead>
<tr>
<th>No</th>
<th>OPAG APIs in SBI-NR Interface (Phase 1)</th>
<th>OP Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Network Events</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>2</td>
<td>QoS Management</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>3</td>
<td>Traffic Influence</td>
<td>SNI-NR</td>
</tr>
<tr>
<td>4</td>
<td>Application Relocation</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>5</td>
<td>Confirm User Location</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>6</td>
<td>Mobility Triggers</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>7</td>
<td>Mobility Control</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>8</td>
<td>Managing Service Availability in LADN</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>9</td>
<td>User Location Privacy Indicator</td>
<td>SBI-NR</td>
</tr>
<tr>
<td>10</td>
<td>User Authentication and Authorisation (defined in UNI)</td>
<td>SBI-NR</td>
</tr>
</tbody>
</table>

Table 1: List of APIs in SBI-NR Interface

The purpose of this document is to provide the API requirements and the Standards Developing Organisation (SDO) reference mapping for each API listed.

The structure to document each API consists of:

1. Descriptions: summary of the purpose and expected use of the API
2. Requirements and Service Aspects: References to requirements related to the API identified in GSMA PRD OPG.02 [1].
3. Procedures: References to procedures and flows from an SDO's specifications (e.g. 3GPP) that match with the OP's view for the API.
4. API: References to API (API parameters, HTTP implementation and YAML file) located in SDOs specifications.

The main reference source of the API Requirements is the GSMA PRD OPG.02 [1]. Other sources for the API Requirements are found in the relevant SDO's reference documents definitions.

1.2 Scope

The present document aims to define OP APIs that are related to SBI-NR Interface in the OP architecture. This set of APIs define the Network Integration Support APIs.
## 1.3 Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Events</td>
<td>The OP in the role of Application Function (AF) would need to manage network events and notifications over the SBI-NR interface (NEF APIs) and orchestrate edge Application Instances in target Cloudlets and synchronise the associated application states to provide application Session Continuity. [1]</td>
</tr>
<tr>
<td>Application Relocation</td>
<td>The Operator Platform shall be able to consider the application-specific requirements for managing mobility over different edge nodes. [1]</td>
</tr>
<tr>
<td>Mobility Triggers</td>
<td>Many different elements shall monitor and control the end-to-end service delivery for detecting any modification and trigger a change on the path. [1]</td>
</tr>
<tr>
<td>Mobility Control</td>
<td>Because of this User Equipment (UE) mobility, or because of the OP’s measurements or knowledge, or hints from the application about performance degradations, the OP may decide that a different edge compute resource can better host the Edge Application. An OP may be able to negotiate the UE data plane mobility process based on the application instance relocation process. An OP may be able to specify the request for routing, influencing network mobility and routing. [1]</td>
</tr>
<tr>
<td>Traffic Influence</td>
<td>Based on some of the events on the SBI-NR interface, e.g. location monitoring events, QoS status notification events etc., the OP may determine the level of QoS provided by the mobile network to application sessions against the Quality of Service (QoS) level requested by the application. In such cases, the OP may initiate the user plane relocation (e.g., by using Traffic Influence APIs) services on the SBI-NR interface. Possibly this may result in the triggering of session mobility procedures in the mobile network. [1]</td>
</tr>
</tbody>
</table>

## 1.4 Abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5QI</td>
<td>5G QoS Identifiers</td>
</tr>
<tr>
<td>AF</td>
<td>Application Function</td>
</tr>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>AS</td>
<td>Application Server</td>
</tr>
<tr>
<td>CGNAT</td>
<td>Carrier Grade NAT</td>
</tr>
<tr>
<td>EAC</td>
<td>Edge Application Client</td>
</tr>
<tr>
<td>EAS</td>
<td>Edge Application Server</td>
</tr>
<tr>
<td>EEC</td>
<td>Edge Enabled Client</td>
</tr>
<tr>
<td>EES</td>
<td>Edge Enabled Server</td>
</tr>
<tr>
<td>EWBI</td>
<td>East West Bound Interface</td>
</tr>
<tr>
<td>DDN</td>
<td>Downlink Data Notification</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
</tr>
<tr>
<td>IMEI</td>
<td>International Mobile Equipment Identity</td>
</tr>
<tr>
<td>IMEI(SV)</td>
<td>International Mobile Equipment Identity (Software Version)</td>
</tr>
<tr>
<td>IMSI</td>
<td>International Mobile Subscriber Identity</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>MSISDN</td>
<td>Mobile Subscriber Integrated Services Digital Network Number</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>NAT</td>
<td>Network Address Translation</td>
</tr>
<tr>
<td>NBI</td>
<td>Northbound Interface</td>
</tr>
<tr>
<td>NEF</td>
<td>Network Exposure Function</td>
</tr>
<tr>
<td>OP</td>
<td>Operator Platform</td>
</tr>
<tr>
<td>OPG</td>
<td>Operator Platform Group</td>
</tr>
<tr>
<td>PDN</td>
<td>Packet Data Network</td>
</tr>
<tr>
<td>PRD</td>
<td>Permanent Reference Document</td>
</tr>
<tr>
<td>QoE</td>
<td>Quality of Experience</td>
</tr>
<tr>
<td>QoS</td>
<td>Quality of Service</td>
</tr>
<tr>
<td>SBI-NR</td>
<td>Southbound Interface – Network Resources</td>
</tr>
<tr>
<td>SCEF</td>
<td>Service Capability Exposure Function</td>
</tr>
<tr>
<td>SDO</td>
<td>Standards Developing Organisation</td>
</tr>
<tr>
<td>UDM</td>
<td>Unified Data Management</td>
</tr>
<tr>
<td>UE</td>
<td>User Equipment</td>
</tr>
<tr>
<td>UNI</td>
<td>User Network Interface</td>
</tr>
<tr>
<td>YAML</td>
<td>YAML Ain't Markup Language. YAML is a human-readable data serialization</td>
</tr>
<tr>
<td></td>
<td>standard that can be used in conjunction with all programming languages</td>
</tr>
<tr>
<td>V2X</td>
<td>Vehicle to X (anything)</td>
</tr>
</tbody>
</table>

1.5 References

<table>
<thead>
<tr>
<th>Ref</th>
<th>Doc Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
<td>OP PRD</td>
<td>GSMA PRD OPG.02, 14 April 2022</td>
</tr>
<tr>
<td>[3]</td>
<td>3GPP TS 29.522</td>
<td>5GS, Network Exposure Function Northbound APIs, Stage 3, Release 17.6, June 2022</td>
</tr>
</tbody>
</table>

1.6 Conventions

The key words “must”, “must not”, “required”, “shall”, “shall not”, “should”, “should not”, “recommended”, “may”, and “optional” in this document are to be interpreted as described in RFC2119 [2].
1.7 Summary SDO Reference Mapping Table

The OP's SBI-NR Interface is linking with the 3GPP 5G Core Network Exposure Function (NEF). Table below summarises the SDO Reference mapping between the OP SBI-NR and 3GPP NEF in its Northbound Interface (NBI) and associated APIs.

<table>
<thead>
<tr>
<th>No</th>
<th>APIs in SBI-NR Interface</th>
<th>OP Interface</th>
<th>SDO Reference Mapping - 3GPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Network Events</td>
<td>SBI-NR</td>
<td>3GPP TS 29.522</td>
</tr>
<tr>
<td>2</td>
<td>QoS Management</td>
<td>SBI-NR</td>
<td>3GPP TS 29.522/29.122</td>
</tr>
<tr>
<td>3</td>
<td>Traffic Influence</td>
<td>SNI-NR</td>
<td>3GPP TS 29.522</td>
</tr>
<tr>
<td>4</td>
<td>Application Relocation</td>
<td>SBI-NR</td>
<td>3GPP TS 29.558</td>
</tr>
<tr>
<td>5</td>
<td>Confirm User Location</td>
<td>SBI-NR</td>
<td>3GPP TS 29.522/29.122</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3GPP TS 29.558</td>
</tr>
<tr>
<td>6</td>
<td>Mobility Triggers</td>
<td>SBI-NR</td>
<td>3GPP TS 29.522/29.122</td>
</tr>
<tr>
<td>7</td>
<td>Mobility Control</td>
<td>SBI-NR</td>
<td>3GPP TS 29.522</td>
</tr>
</tbody>
</table>

2 Network Integration Support APIs in SBI-NR Interface

2.1 Network Events API

2.1.1 Description

Goal of the OP's Network Events service is to provide interface for Operators and Application Providers to support enhanced application-aware exposure for 5G network events including federated topologies. Two interfaces between 5G System, Edge System and Application Client should be described:

- **Collecting Network Status Events SBI-NR** which supports User Plane related notifications (Session Establish, UE IP address allocation, Access and Mobility with Registration, Connection, Reachability and Mobility Management) and other events related to application traffic. Those events are mostly exposed by the 4G Service Capability Exposure Function (SCEF)/5G NEF.

- **Network Events NBI** exposed by an OP to an Application Provider allowing introducing context awareness regarding occurred network events and provide support for quality, performance and security to ensure the required Quality of Experience (QoE) of the OP's customers.

2.1.2 Requirements and Service Aspects

The requirements for the API are specified in the GSMA PRD OPG.02 [1]. in the following sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Document</th>
<th>Reference Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.1.7.3</td>
<td>OPG.02</td>
<td>Network Event Support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(*User Equipment (UE) location information and events; * UE network connection events; *Application to UE connection)</td>
</tr>
</tbody>
</table>
Section Document Reference Section Title
3.5.2.2.1 OPG.02 Network
(*Collecting radio network information, e.g. cell change
notification, measurement reports etc. for mobility decisions)

2.1.3 Procedures
The following procedures defined in 3GPP shall apply to the OP Network Events capabilities:

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>Procedure Name</th>
</tr>
</thead>
</table>
| NEF/SCEF | 4.11.6.3 | 3GPP 23.502 | Nnef_EventExposure_Subscribe
(*Configuration of monitoring events for common network exposure) |

2.1.4 API
The following API as defined in 3GPP shall be endorsed for Operator Platform

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
</table>
| SCEF | 4.4.2 | 29.122 | Procedures over T8 reference point / Monitoring Procedures
(*Loss of connectivity; UE reachability; Location Reporting; Change of IMSI-IMEI(SV) Association; Roaming Status; Communication Failure; PDN connectivity status; Availability after DDN Failure; API support capability.) |
| SCEF | Annex A (pp. 323) | 29.122 | Monitoring Event API - YAML |

The following API parameters have been identified as missing in 3GPP

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
</table>
| NEF | 4.4.2 | 29.522 | NEF Northbound Interface / Procedures for Monitoring
(*29.122 emphasizes SCEF-T8-Procedures can be applied in the NEF as well) |

2.2 QoS Management API

2.2.1 Description
The purpose of the Quality of Service (QoS) Management API is to enable an OP the ability to expose the network driven capabilities related to 5G QoS Identifiers (5QI). With this API, the OP provides to 3rd party consumer the capability to adapt the quality and capacity of the network based on its application requirements. This kind of customization can be applied to many Business-to-Business (V2X drone control, etc.) and Business-to-Consumer (immersive communications, gaming, etc.) use cases where the quality can be adapted and configured in the network to guarantee the best user experience.

For this API definition it makes sense to reuse existing 3GPP NEF/SCEF API for QoS management. The corresponding API in the NBI interface will be defined by the Linux
Foundation’s CAMARA project considering mapping to the references included in the following sections.

### 2.2.2 Requirement and Service Aspects

The requirements for the API are specified in the GSMA PRD OPG.02 \[1\]. in the following section(s).

<table>
<thead>
<tr>
<th>Section</th>
<th>Document</th>
<th>Reference Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.4</td>
<td>OPG.02</td>
<td>Southbound Interface to Network Resources</td>
</tr>
</tbody>
</table>

### 2.2.3 Procedures

The following procedures defined in 3GPP shall apply to the OP’s QoS Management capabilities:

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>Procedure Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>4.15.6.6/6a</td>
<td>23.502</td>
<td>Setting up an Application Function (AF) session with required QoS procedure</td>
</tr>
<tr>
<td>SCEF</td>
<td>4.4.13</td>
<td>29.122</td>
<td>Procedures for setting up an Application Server (AS) session with required QoS</td>
</tr>
<tr>
<td>NEF</td>
<td>4.4.9</td>
<td>29.522</td>
<td>Procedures for setting up an AF session with required QoS</td>
</tr>
</tbody>
</table>

**NOTE:** The AsSessionWithQoS API is define in the NEF 3GPP spec as a reused API (section 5.3 TS 29.522). It adapts the development and definition from the SCEF API (4G architecture) to the NEF (5G Architecture).

### 2.2.4 API

The following API as defined in 3GPP shall be endorsed for Operator Platform.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>5.3</td>
<td>29.522</td>
<td>AsSessionWithQoS (Reused APIs Table)</td>
</tr>
<tr>
<td>SCEF</td>
<td>5.14</td>
<td>29.122</td>
<td>AsSessionWithQoS</td>
</tr>
</tbody>
</table>

### 2.3 Traffic Influence API

#### 2.3.1 Description

The purpose of the Traffic Influence API is to enable OP the ability to expose the network driven capabilities to influence on the traffic transport paths between the UE and the Application Server hosted at the Cloud Resources. The selected API is based on 3GPP definitions. Some modifications the API would be required in the East-West Bound Interface (EWBI) interface to be usable in the federated environment. The corresponding API in the NBI interface will be defined by the Linux Foundation’s CAMARA project's specifications for the Service APIs in the NBI interface.
2.3.2 Requirement and Service Aspects
The requirements for the API are specified in the GSMA PRD OPG.02 [1] in the following section(s).

<table>
<thead>
<tr>
<th>Section</th>
<th>Document</th>
<th>Reference Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.4</td>
<td>OPG.02</td>
<td>Southbound Interface to Network Resources</td>
</tr>
</tbody>
</table>

2.3.3 Procedures
The following procedures defined in 3GPP shall apply to the OP Traffic Influence capabilities.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>Procedure Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>4.3.6</td>
<td>23.502 R 17</td>
<td>Application Function influence on traffic routing</td>
</tr>
<tr>
<td>NEF</td>
<td>5.2.6.7</td>
<td>23.502 R 17</td>
<td>Nnef_TrafficInfluence Service</td>
</tr>
<tr>
<td>NEF</td>
<td>5.4</td>
<td>23.502 R 17</td>
<td>TrafficInfluence</td>
</tr>
<tr>
<td>NEF</td>
<td>4.4.7</td>
<td>29.522 R 17</td>
<td>Procedures for Traffic Influence</td>
</tr>
</tbody>
</table>

2.3.4 API
The following API as defined in 3GPP shall be endorsed for Operator Platform.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>5.4</td>
<td>29.522 R 17</td>
<td>TrafficInfluence</td>
</tr>
</tbody>
</table>

2.4 Application Relocation API

2.4.1 Description
The purpose of the Application Relocation API is to enable the OP to manage and maintain inter- and intra-connectivity between applications as they move between different cloud and network resources. This concept is aligned with the architecture and definitions described in 3GPP TS 23.558 [4].

2.4.2 Requirement and Service Aspects
The requirements for the API are specified in the GSMA PRD OPG.02 [1] in the following section(s).

<table>
<thead>
<tr>
<th>Section</th>
<th>Document</th>
<th>Reference Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.7</td>
<td>OPG.02</td>
<td>Applications deployment in the Federated Operator Domain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Figure 15 and text)</td>
</tr>
<tr>
<td>5.1.6.2.6</td>
<td>OPG.02</td>
<td>Service Provisioning</td>
</tr>
<tr>
<td>5.2.2.3.6</td>
<td>OPG.02</td>
<td>Mobility Enforcements</td>
</tr>
<tr>
<td>5.2.2.6.3</td>
<td>OPG.02</td>
<td>Network and OP responsibilities for application session continuity</td>
</tr>
<tr>
<td>5.2.2.6.5</td>
<td>OPG.02</td>
<td>Edge Applications Role in Session Continuity Process</td>
</tr>
<tr>
<td>Annex F</td>
<td>OPG.02</td>
<td>5G Core Network Application Session Continuity Enabler Services</td>
</tr>
</tbody>
</table>
2.4.3 Procedures
The following procedures defined in 3GPP shall apply to the Application Relocation capabilities:

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>Procedure Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8.8</td>
<td>23.558</td>
<td>Service Continuity</td>
</tr>
<tr>
<td>EES</td>
<td>5.8</td>
<td>29.558</td>
<td>Eees_ACRManagementEvent Service</td>
</tr>
<tr>
<td>EES</td>
<td>5.9</td>
<td>29.558</td>
<td>Eees_AppContextRelocation Service</td>
</tr>
<tr>
<td>EES</td>
<td>5.11</td>
<td>29.558</td>
<td>Eees_EELManagedACR Service</td>
</tr>
<tr>
<td>EES</td>
<td>5.12</td>
<td>29.558</td>
<td>Eees_ACRStatusUpdate Service</td>
</tr>
<tr>
<td>EES</td>
<td>5.8.2.3</td>
<td>29.558</td>
<td>Eees_ACRManagementEvent_UpdateSubscription</td>
</tr>
<tr>
<td>EES</td>
<td>5.8.2.4</td>
<td>29.558</td>
<td>Eees_ACRManagementEvent_Unsubscribe</td>
</tr>
<tr>
<td>EES</td>
<td>5.8.2.5</td>
<td>29.558</td>
<td>Eees_ACRManagementEvent_Notify</td>
</tr>
<tr>
<td>EES</td>
<td>5.9.2.3</td>
<td>29.558</td>
<td>Eees_AppContextRelocation_ACRDetermination_Request</td>
</tr>
<tr>
<td>EES</td>
<td>5.11.2.2</td>
<td>29.558</td>
<td>Eees_EELManagedACR_Request</td>
</tr>
<tr>
<td>EES</td>
<td>5.11.2.3</td>
<td>29.558</td>
<td>Eees_EELManagedACR_Subscribe</td>
</tr>
<tr>
<td>EES</td>
<td>5.11.2.4</td>
<td>29.558</td>
<td>Eees_EELManagedACR_Notify</td>
</tr>
<tr>
<td>EES</td>
<td>5.12.2.2</td>
<td>29.558</td>
<td>Eees_ACRStatusUpdate_Request</td>
</tr>
</tbody>
</table>

2.4.4 API
The following API as defined in 3GPP shall be endorsed for Operator Platform.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
<tbody>
<tr>
<td>EES</td>
<td>8.7</td>
<td>29.558</td>
<td>Eees_ACRManagementEvent API</td>
</tr>
<tr>
<td>EES</td>
<td>8.9</td>
<td>29.558</td>
<td>Eees_EECContextRelocation API</td>
</tr>
<tr>
<td>EES</td>
<td>8.10</td>
<td>29.558</td>
<td>Eees_EELManagedACR API</td>
</tr>
<tr>
<td>EES</td>
<td>8.11</td>
<td>29.558</td>
<td>Eees_ACRStatusUpdate API</td>
</tr>
</tbody>
</table>

2.5 Confirm User Location API

2.5.1 Description
The purpose of the Confirm User Location API is to enable an OP with the ability to provide user location information to consumers. This can be used in combination with other network driven capabilities to trigger configurations within the network to provide services based on the location of the final users (e.g., to deploy resources and applications closer to the user so that latency can be reduced to the minimum and improve the user experience).

2.5.2 Requirement and Service Aspect
The requirements for the API are specified in the GSMA PRD OPG.02 [1]. in the following section(s).

<table>
<thead>
<tr>
<th>Section</th>
<th>Document</th>
<th>Reference Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.2.2.1</td>
<td>OPG.02</td>
<td>UC Location Retrieval</td>
</tr>
</tbody>
</table>
2.5.3 Procedures

The following procedures defined in 3GPP shall apply to the OP’s user location information capabilities.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>Procedure Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>4.4.2</td>
<td>29.522</td>
<td>Procedures for Monitoring</td>
</tr>
<tr>
<td>SCEF</td>
<td>4.4.2</td>
<td>29.122</td>
<td>Monitoring Procedures</td>
</tr>
<tr>
<td>EES</td>
<td>8.6.2</td>
<td>23.558</td>
<td>UE Location</td>
</tr>
</tbody>
</table>

2.5.4 API

The following API as defined in 3GPP shall be endorsed for Operator Platform.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCEF</td>
<td>5.3</td>
<td>29.122</td>
<td>MonitoringEvent</td>
</tr>
<tr>
<td>NEF</td>
<td>5.3</td>
<td>29.522</td>
<td>MonitoringEvent (Reused APIs Table)</td>
</tr>
<tr>
<td>EES</td>
<td>8.2</td>
<td>29.558</td>
<td>Eees_UELocation</td>
</tr>
</tbody>
</table>

2.6 Mobility Triggers API

2.6.1 Description

This API provides the required support from the network so that the OP can be informed about the need to move an application session to a different anchor point or of the actual move. A possible use case is when the user moves to a new location. By means of this API, the network alerts the OP about the change, so that the OP can perform the required new configurations for the user to access the applications in the new location.

2.6.2 Requirement and Service Aspects

The requirements for the API are specified in the GSMA PRD OPG.02 [1]. in the following section(s).

<table>
<thead>
<tr>
<th>Section</th>
<th>Document</th>
<th>Reference Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.7</td>
<td>OPG.02</td>
<td>Mobility Requirements (*5G Connectivity Models for Edge; *Roaming Requirements; *Geographic Conditions on Mobility)</td>
</tr>
<tr>
<td>5.2.2.3.2</td>
<td>OPG.02</td>
<td>Mobility Management</td>
</tr>
</tbody>
</table>

2.6.3 Procedures

The following procedures defined in 3GPP shall apply to the Mobility Management capabilities.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>Procedure Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>4.4.2</td>
<td>29.522</td>
<td>Procedures for Monitoring</td>
</tr>
<tr>
<td>SCEF</td>
<td>4.4.2</td>
<td>29.122</td>
<td>Monitoring Procedures</td>
</tr>
</tbody>
</table>
2.6.4 API

The following API as defined in 3GPP shall be endorsed for Operator platform.

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>5.3</td>
<td>29.522</td>
<td>MonitoringEvent API (Reused API Table)</td>
</tr>
<tr>
<td>SCEF</td>
<td>5.3</td>
<td>29.122</td>
<td>MonitoringEvent API</td>
</tr>
</tbody>
</table>

These APIs, defined in 3GPP, provides support to retrieve information related to different events related to the OP's Mobility Triggers concept. For instance:

- LOSS_OF_CONNECTIVITY
- UE_REACHABILITY
- LOCATION_REPORTING
- AREA_OF_INTEREST

2.7 Mobility Control API

2.7.1 Description

The Mobility Control API is responsible for controlling when an application session is to be moved to a different anchor point. For instance, due to a failure an application relocation occurs. After relocating an application, a change of anchor point may be required, if this is the case, the OP can use this API to adjust in the network the most appropriate configuration to access the application new endpoint.

2.7.2 Requirements and Service Aspects

The requirements for the API is specified in the GSMA PRD OPG.02 [1]. in the following sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Document</th>
<th>Reference Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.7.3</td>
<td>OPG.02</td>
<td>Requirements for Application Session Continuity</td>
</tr>
</tbody>
</table>

2.7.3 Procedures

The following procedures defined in 3GPP shall apply to the OP's traffic influence capabilities:

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>Procedure Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>4.3.6</td>
<td>23.502 R 17</td>
<td>Application Function influence on traffic routing</td>
</tr>
<tr>
<td>NEF</td>
<td>5.2.6.7</td>
<td>23.502 R 17</td>
<td>Nnfi_TrafficInfluence Service</td>
</tr>
<tr>
<td>NEF</td>
<td>5.4</td>
<td>23.502 R 17</td>
<td>TrafficInfluence</td>
</tr>
<tr>
<td>NEF</td>
<td>4.4.7</td>
<td>29.522 R 17</td>
<td>Procedures for Traffic Influence</td>
</tr>
</tbody>
</table>


2.7.4 API

The following API as defined in 3GPP shall be endorsed for Operator Platform

<table>
<thead>
<tr>
<th>NF</th>
<th>Section</th>
<th>TS</th>
<th>API name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>5.4</td>
<td>29.522 R 17</td>
<td>TrafficInfluence</td>
</tr>
</tbody>
</table>

3 Network key enabling capabilities

3.1 End user Public IP address to MSISDN mapping.

3.1.1 Introduction

Whilst the Mobile Subscriber Integrated Services Digital Network Number (MSISDN) is a valid personal identifier, the end user will unlikely consent this information to be shared with every Application Provider for privacy reasons. Therefore, other identifiers are required to refer to a subscriber in the Northbound API requests. The subscriber’s Public IP address and port as used to communicate with the Application Provider’s Application Backend could be one of those identifiers. If used, the OP should be able to map this Public IP address and port to an identifier that it can use to identify the subscriber on its Southbound Interfaces, e.g. the MSISDN. Because no standardised solutions exist to do this mapping, this section defines a new API that networks can provide for that purpose and suggest ways to realise the functionality exposed by that API based on enablers that are commonly used in networks.

As an illustration, the Service API for obtaining an Anonymised Subscriber Identifier as proposed in Linux Foundation’s CAMARA project enables an application to request an end user identity to the network by providing the end device’s public IP address. To realise that API with the Operator Platform, the OP should be able to interact with the network to map that end device’s public IP address into its MSISDN for the Operator Platform to return an anonymised user identity that could be used by the application.
3.1.2 Network setup

This section is meant to introduce mechanisms intended to support operators with implementations at the network level that will facilitate to obtain information related to users.

3.1.2.1 Deterministic NAT

Network Address Translation (NAT) is used in order to map the a UE’s Private IP address to a Public IP address for communication to services on the public internet. If deterministic NAT is used, each private UE IP is mapped to a specific port range of a public IP address of the Carrier Grade NAT (CGNAT). This allows to use this mapping also in the reverse direction and map a public IP address and port combination back to the Private IP address and thus to the UE for which it would then be possible to determine the MSISDN.

Deterministic NAT requires that the ratio between the range of private IP addresses and public IP addresses available is sufficient to ensure that the port range allocated for each UE Private IP address can satisfy the user’s needs in terms of concurrent connections.

NOTE: sourceNATP44 is described in RFC 7857 “Updates to Network Address Translation (NAT) Behavioral Requirements”.

Figure 1: Service flow for an API relying on IP address mapping (e.g. to obtain an anonymised subscriber identity)

Figure 2: Deterministic NAT Solution
3.1.2.2 End user directory

The network can provide a user directory where IP address (and port) mappings will be stored along with the corresponding user MSISDN. This directory could then be populated during the User Equipment’s connectivity to the network and consulted when a public IP address needs to be mapped to an MSISDN. Such directory is not available today within a standard 3GPP core network architecture but could be considered and supported in functions such as the Unified Data Management (UDM).

3.2 User Info API

This API allows to request the operator platform for an identifier for a subscriber based on their public IP address and port.

<table>
<thead>
<tr>
<th>Operation</th>
<th>HTTP Methods</th>
<th>Resource URI</th>
<th>Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>IdentifyUser</td>
<td>GET</td>
<td>/naas/networkresources/v1</td>
<td>M</td>
</tr>
</tbody>
</table>

Table 2: User Info API: Operations

3.2.1 GET Method: IdentifyUser

The GET method enables to retrieve user identifier information from the network, such as the MSISDN by providing a public IP and port.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>P</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>publicIPAddress</td>
<td>M</td>
<td>1</td>
<td>Origin public IP address from which the UE is connecting to an application backend.</td>
</tr>
<tr>
<td>port</td>
<td>M</td>
<td>1</td>
<td>Port from which the UE is connecting to an application backend.</td>
</tr>
<tr>
<td>protocol</td>
<td>O</td>
<td>1</td>
<td>Transport protocol (e.g UDP, TCP, SCTP)</td>
</tr>
<tr>
<td>identityType</td>
<td>O</td>
<td>1</td>
<td>Type of identifiers that need to be retrieve e.g MSISDN, Private IP</td>
</tr>
</tbody>
</table>

Table 3: Request Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>P</th>
<th>Response Codes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>identifier</td>
<td>M</td>
<td>200</td>
<td>User MSISDN, Private IP, other identifiers</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>400</td>
<td>Bad Request</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>401</td>
<td>Unauthorized</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>403</td>
<td>Permissions</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>404</td>
<td>Not Found</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>405</td>
<td>Method not allowed</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>406</td>
<td>Not Acceptable</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>429</td>
<td>Too many requests</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>500</td>
<td>Internal Server Error</td>
</tr>
</tbody>
</table>
Table 4: Response Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>P</th>
<th>Response Codes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>502</td>
<td>Bad Gateway</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>503</td>
<td>Service Unavailable.</td>
</tr>
<tr>
<td>errorResponse</td>
<td>C</td>
<td>504</td>
<td>Request time exceeded</td>
</tr>
</tbody>
</table>

Note: Responses are for immediate use only and their validity cannot be guaranteed over a longer time.

3.2.2 Data Model

3.2.2.1 Simple data types and enumerations

This subclause defines simple data types and enumerations that can be referenced from data structures defined in the previous subclauses.

Table 5: User Info API data types

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>publicIPAddress</td>
<td>String</td>
<td>Public IP address (IPv4 or IPv6).</td>
</tr>
<tr>
<td>port</td>
<td>Integer</td>
<td>A port number assigned to uniquely identify a connection endpoint and to direct data to a specific service.</td>
</tr>
<tr>
<td>protocol</td>
<td>String</td>
<td>Transport protocol (e.g UDP, TCP, SCTP)</td>
</tr>
<tr>
<td>identityType</td>
<td>String</td>
<td>Type of identifiers that need to be retrieve e.g MSISDN, Private IP</td>
</tr>
</tbody>
</table>
| identifier      | Object    | User identity information that contains: type: (e.g MSISDN, Private IP) id: Identifier value. In case of 'MSISDN' type, 'E164 with +' format must be used.

Annex A Open API definitions

A.1 User Info API

openapi: 3.0.3
info:
  version: ‘1.0.0’
  title: ‘User Info’
  description: |
  # Introduction
  ---
  RESTful API that allows an OP to map the UE origin Public IP address and port to an identifier that it can use to identify the subscriber on its Southbound Interfaces (e.g. the MSISDN, Private IP)
  ---
  # API Scope
  ---
APIs defined in this version of the specification can be categorized into the following areas:

* __UserInfo__ - To retrieve user identifier associated to some origin connection information such as public IP address and port.

---

# Definitions

---

- __publicIPAddress__ - Origin public IP address from which the UE is connecting an application backend.
- __port__ - Port from which the UE is connecting to an application backend.
- __protocol__ - Transport protocol (e.g. UDP, TCP, SCTP).
- __identityType__ - Type of identifiers that need to be retrieve e.g MSISDN, Private IP.
- __identifier__ - User MSISDN, Private IP or other possible identifiers.

---

# API Operations

---

__UserInfo__

* __IdentifyUser__ - Retrieve a user identifier associated to some origin connection information.

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externalDocs:

description: GSMA, SBI-Network Resources APIs
url: "https://www.gsma.com/futurenetworks/5g-operator-platform"
servers:
- url: '{apiRoot}/naas/networkresources/v1'
variables:
  apiRoot:
    default: https://operatorplatform.com

security:
- oAuth2ClientCredentials:
- net-resources

components:

securitySchemes:
oAuth2ClientCredentials:
type: oauth2
description: This API uses OAuth 2 with the client credentials grant flow.
flows:
clientCredentials:
tokenUrl: '/oauth2/token'
scopes:
  net-resources: Access to the Network Resources APIs

schemas:
IdentifierMSISDN:
type: object
required:
  - type
  - id
properties:
type:
type: string
description: Type of the user identifier retrieved (MSISDN).
example: "msisdn"
id:
  type: string
  description: MSISDN value. 'E164 with + format must be used [+][country code][subscriber number including area code] and can have a maximum of fifteen digits.'
  example: '+346667778889'
  format: ^\+[1-9]\d{1,14}$

IdentifierPrivateIP:
  type: object
  required:
    - type
    - id
  properties:
    type:
      type: string
      description: Type of the user identifier retrieved (Private IP address).
      example: "private IP address"
    id:
      type: string
      description: Private IP address of the UE.
      example: '192.168.0.20'
      format: ^\d{127}((\.(25[0-5]|2\d|3[01])\d{0,3})){3}$|\d{10}((\.(25[0-5]|2\d|3[01])\d{0,3})){3}$|\d{192}(\.(25[0-5]|2\d|3[01])\d{0,3})){2}$|\d{172}((?:\d{6-9}|\d{0,9})d\d{0,1})((\.(25[0-5]|2\d|3[01])\d{0,3})){2}$

errorResponse:
  type: object
  properties:
    code:
      type: string
      description: A short, human-readable summary of the problem type
    status:
      type: integer
      description: The HTTP status code
    message:
      type: string
      description: This parameter appears when there was an error. Human readable explanation specific to this occurrence of the problem

UserInfoMSISDNResponse:
  type: object
  required:
    - identifier
  properties:
    identifier:
      type: string
      $ref: '#/components/schemas/IdentifierMSISDN'

UserInfoPrivateIPResponse:
  type: object
  required:
    - identifier
  properties:
    identifier:
      type: string
      $ref: '#/components/schemas/IdentifierPrivateIP'

responses:
  400BadRequest:
    description: Bad Request
content:
application/json:
  schema:
    $ref: '#/components/schemas/errorResponse'
  examples:
    InvalidIP:
      value:
        {
          "code": "INVALID_ARGUMENT",
          "status": 400,
          "message": "Invalid or missing IP header"
        }
    InvalidPort:
      value:
        {
          "code": "INVALID_ARGUMENT",
          "status": 400,
          "message": "Invalid or missing Port header"
        }
    401Unauthorized:
      description: Unauthorized
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/errorResponse'
          examples:
            InvalidCredentials:
              value:
                {
                  "code": "UNAUTHENTICATED",
                  "status": 401,
                  "message": "Request not authenticated due to missing, invalid, or expired credentials"
                }
    403Forbidden:
      description: Forbidden
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/errorResponse'
          examples:
            InsufficientPermissions:
              value:
                {
                  "code": "PERMISSION_DENIED",
                  "status": 403,
                  "message": "Client does not have sufficient permissions to perform this action"
                }
    404NotFound:
      description: Subscriber Not Found
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/errorResponse'
          examples:
            SubscriberNotFound:
description: The specified IP address and port are not currently associated with any customers of this service
value:
{
  "code": "NOT_FOUND",
  "status": 404,
  "message": "No subscriber found with the specified IP address and port"
}

405MethodNotAllowed:
description: Method Not Allowed
content:
application/json:
schema:
$ref: '#/components/schemas/errorResponse'
examples:
MethodNotAllowed:
description: An HTTP verb other than GET has been used to try and access the resource
value:
{
  "code": "METHOD_NOT_ALLOWED",
  "status": 405,
  "message": "The request method is not supported by this resource"
}

406Unacceptable:
description: Not Acceptable
content:
application/json:
schema:
$ref: '#/components/schemas/errorResponse'
examples:
NotAcceptable:
description: A response format other than JSON has been requested
value:
{
  "code": "NOT_ACCEPTABLE",
  "status": 406,
  "message": "The server cannot produce a response matching the content requested by the client through Accept-* headers"
}

429TooManyRequests:
description: Too Many Requests
content:
application/json:
schema:
$ref: '#/components/schemas/errorResponse'
examples:
TooManyRequests:
description: Access to the API has been temporarily blocked due to quota or spike arrest limits being reached
value:
{
  "code": "TOO_MANY_REQUESTS",
  "status": 429,
  "message": "Either out of resource quota or reaching rate limiting"
}
500InternalServerError:

description: Internal Server Error

collection:

application/json:

  schema:
    $ref: '#/components/schemas/errorResponse'

example:

  
  "code": "INTERNAL",
  "status": 500,
  "message": "The service is currently not available"

502BadGateway:

description: Bad Gateway

content:

application/json:

  schema:
    $ref: '#/components/schemas/errorResponse'

example:

  
  "code": "BAD_GATEWAY",
  "status": 502,
  "message": "The service is currently not available"

503ServiceUnavailable:

description: Service Unavailable

content:

application/json:

  schema:
    $ref: '#/components/schemas/errorResponse'

example:

  
  "code": "UNAVAILABLE",
  "status": 503,
  "message": "The service is currently not available"

504GatewayTimeout:

description: Gateway Time-Out

content:

application/json:

  schema:
    $ref: '#/components/schemas/errorResponse'

example:

  
  "code": "TIMEOUT",
  "status": 504,
  "message": "The service is currently not available"

paths:

/identifyUser:

get:

  summary: Retrieve a user identifier given a public IP and Port
tags:
- UserInfo

parameters:
- in: header
  name: publicIPAddress
  description: Origin public IP address from which the UE is connecting to an application backend.
  required: true
  examples:
  
  `ipv4:
  value: "84.125.93.10"
  ipv6:
  `
  schema:
  type: string
  format: ipv4/ipv6
  oneOf:
  - pattern: "^((\[\0-9a-f]|1-9a-f\|[0-9a-f]|0-3))(/0-6)/((\[\0-9a-f]|1-9a-f\|[0-9a-f]|0-3))/$" 

- in: header
  name: port
  description: Port from which the UE is connecting to an application backend.
  required: true
  example: 20000
  schema:
  type: integer
  minimum: 1024
  maximum: 65535

- in: header
  name: protocol
  description: The transport protocol in use.
  required: false
  examples:
  TCP:
  value: "tcp"
  UDP:
  value: "udp"
  SCTP:
  value: "sctp"
  schema:
  type: string
  default: tcp

- in: header
  name: identityType
  description: Type of identifiers that need to be retrieve.
  required: false
  examples:
  MSISDN:
  value: "msisdn"
  Private IP address:
  value: "private ip"
  schema:
  type: string
  default: msisdn
responses:
  "200":
    description: User identified successfully
    content:
      application/json:
        schema:
          oneOf:
            - $ref: '#/components/schemas/UserInfoMSISDNResponse'
            - $ref: '#/components/schemas/UserInfoPrivateIPResponse'
  "400":
    $ref: '#/components/responses/400BadRequest'
  "401":
    $ref: '#/components/responses/401Unauthorized'
  "403":
    $ref: '#/components/responses/403Forbidden'
  "404":
    $ref: '#/components/responses/404NotFound'
  "405":
    $ref: '#/components/responses/405MethodNotAllowed'
  "406":
    $ref: '#/components/responses/406Unacceptable'
  "429":
    $ref: '#/components/responses/429TooManyRequests'
  "500":
    $ref: '#/components/responses/500InternalServerError'
  "502":
    $ref: '#/components/responses/502BadGateway'
  "503":
    $ref: '#/components/responses/503ServiceUnavailable'
  "504":
    $ref: '#/components/responses/504GatewayTimeout'
Annex B  Document Management

B.1  Document History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Brief Description of Change</th>
<th>Approval Authority</th>
<th>Editor / Company</th>
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<tr>
<td>1.0</td>
<td>03 Oct 2022</td>
<td>New PRD defining the Soutbound Interface of the Operator Platform to the network resources</td>
<td>ISAG</td>
<td>Milan Lalovic / British Telecom</td>
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<tr>
<td>2.0</td>
<td>29 Mar 2023</td>
<td>Update implementing OPG.03 CR1002 introducing Public IP address mapping</td>
<td>ISAG</td>
<td>Tom Van Pelt / GSMA</td>
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B.2  Other Information

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<th>Description</th>
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<td>Document Owner</td>
<td>Operator Platform Group</td>
</tr>
<tr>
<td>Editor / Company</td>
<td>Milan Lalovic / British Telecom</td>
</tr>
</tbody>
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Your comments or suggestions & questions are always welcome.