

# SAPC 1 Network Impact Report

Ericsson Service-Aware Policy Controller

## NETWORK IMPACT REPORT

## **Copyright**

© Ericsson España, S.A. 2017. All rights reserved. No part of this document may be reproduced in any form without the written permission of the copyright owner.

## **Disclaimer**

The Network Impact Report is not to be used for working with real equipment. It is only meant as an informative document.

The contents of this document are subject to revision without notice due to continued progress in methodology, design, and manufacturing. Ericsson shall have no liability for any error or damage of any kind resulting from the use of this document.

## **Trademark List**

All trademarks mentioned herein are the property of their respective owners. These are shown in the document Trademark Information.

## **Abstract**

This Network Impact Report describes the new functions introduced in SAPC 1.0 and their impacts on the characteristics of the node.

Previous commercial release was SAPC 17A FD01.



# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Purpose	1
<b>2</b>	<b>General Impact</b>	<b>1</b>
2.1	Capacity and Performance	2
2.2	Upgrade Impact	6
2.3	Interface	6
2.4	Operation and Maintenance	9
2.5	Obsolete Functions	12
2.6	Other Impacts	12
2.7	Customer Product Information	13
2.8	Environment	13
<b>3</b>	<b>Additional Information</b>	<b>13</b>
3.1	Software Management	13
<b>4</b>	<b>Summary of Impacts per Value Package</b>	<b>13</b>
<b>5</b>	<b>Impact of New or Enhanced Value Packages</b>	<b>14</b>
5.1	Base Package	15
5.2	Convergence	16
5.3	Smart Personalized Broadband	16
5.4	Voice Optimization	16
5.5	Business Intelligence	16
5.6	High Availability and Pooling	17
5.7	Network Efficiency	17
5.8	Monetize OTT	17
5.9	Money Aware	17
<b>6</b>	<b>For Coming Releases</b>	<b>17</b>





# 1 Introduction

This Network Impact Report describes the new functions introduced in SAPC 1.0 and their impacts on the characteristics of the node compared with SAPC 17A FD01.

## 1.1 Purpose

The purpose of this document is to provide information about the changes between SAPC 17A FD01 and SAPC 1.0. It also provides enough information at an early stage to network operators, to help planning the introduction of new releases in customer networks.

This document is a living document that is subject to change during the development of the new release. Therefore, part of the information is subject to changes until General Availability (GA) of the SAPC 1.0 product release.

# 2 General Impact

The following is a summary of the changes related to interfaces and functional operation. Major changes in the SAPC 1.0 release include the following functions:

- Support of Presence Reporting Area
- Support of Dynamic Event Triggers selection
- Support of Emergency Services
- Support of PDN-GW and SPID selection for Mobility Based Policy Control for Overlay Deployments function (Smp Interface between the SAPC and the SGSN-MME)
- Support of External Database Geographical Redundancy (1+1+1)
- Support of Flexible Output Protocol to apply transformations of Gx protocol messages at command level and at service level (Charging-Rule).
- Support of deployment and scaling from ATLAS.
- Support of deployment and manual scaling from VMware vCloud Director.
- Support for AF restart detection and massive Rx session clean-up for invalid Rx sessions.



- Support of subscriber profile management in the Policy Studio.
- Modified criteria to detect a PCEF restart.
- Support for diameter race conditions and concurrent reauthorizations handling over Gx.
- Support of Performance Data Collection.
- Upgrade procedure enhancements.
- Support of Rx-Request-Type AVP in Rx AAR message.
- Support of CNOM.
- Support of NB-IoT RAT-Type (Gx)

#### SAPC 1.1

- Support of emergency services prioritization.

Next sections give information about the SAPC characteristics and describe the differences between SAPC 1.0 and the previous release SAPC 17A FD01 in subscriber capacity, network performance, and memory consumption. Figures given along this document are based on preliminary characteristics measurements on SAPC 1.0 in a VNF deployment.

## 2.1 Capacity and Performance

This section summarizes the performance of the SAPC in a standalone configuration, using internal repository, in the following network environments:

- **Scenario A**, where the SAPC uses Gx Rel 9 interface towards GGSN. Default Bearer QoS Control is activated.
- **Scenario B1**, where the SAPC uses Ericsson Gx+ Rel 8 interface towards GGSN. Default Bearer QoS Control and Usage Reporting for Mobile functions are activated.
- **Scenario F**, LTE/EPC solution, where the SAPC uses Gx Rel 8 interface towards Ericsson EPG or with any PDN Gateway.
- **Scenario F1**, IMS VoLTE solution

Performance data in this document are based on the Default Traffic Models.

The frequency of the messages received by the SAPC using the Default Traffic Model is as follows:

**Scenario A**

- 0.238 Default IPCAN bearer activations per subscriber during the Busy Hour.
- 0.238 Default IPCAN bearer deactivations per subscriber during the Busy Hour.
- 1 Gx Interim per session.
- 0.35 sessions per subscriber

**Scenario B1**

- 0.238 Default IPCAN bearer activations per subscriber during the Busy Hour.
- 0.238 Default IPCAN bearer deactivations per subscriber during the Busy Hour.
- 1 Gx interim per session.
- 0.3 Default IPCAN session modifications owing to Usage Reporting for Mobile per session.
- 100% of the subscribers use Usage Reporting for Mobile function.
- 0.35 IPCAN sessions per subscriber.

**Scenario F**

- 0.14 IPCAN session establishment per subscriber during the Busy Hour.
- 0.126 IPCAN session release per subscriber during the Busy Hour.
- 2.5 IPCAN session interim per IPCAN session during the Busy Hour.
- 0.7 IPCAN sessions per subscriber.

**Scenario F1**

- 0.14 IPCAN session establishment per subscriber during the Busy Hour.
- 0.126 IPCAN session release per subscriber during the Busy Hour.
- 2.5 IPCAN session interim per IPCAN session during the Busy Hour.
- 0.7 IPCAN sessions per subscriber.
- 1 AF session establishment per subscriber during the Busy Hour.
- 1 AF session modification per subscriber during the Busy Hour.
- 1 AF session release per subscriber during the Busy Hour.

- 100% of the subscribers use VoLTE services.
- The average duration per AF session is 1.5 minutes.

**Note:** Subscribers is the number of subscribers provisioned in the node.

### 2.1.1 Subscriber Capacity and Network Performance

The following data have been used for the characteristics measurements for each network scenario previously described.

- Subscriber Profile used for SACC scenarios: 14 authorized services in the Gx interface per IPCAN session. The number of services authorized has impact on the performance of the node.
- When Usage Reporting for Mobile function is used with SASN: two reporting groups (one limited for volume and other limited per time). The usage limits have been established per session.

The following tables show the maximum Subscriber Capacity and the maximum Transactions Per Second of SAPC 1.0 per each network scenario. The number of TPS supported for all releases of the Gx interface when executing similar functions is about the same.

The concept of Transaction in this document means a service request and the corresponding reply. The related capacity term is Transactions Per Second (TPS).

Table 1 Scenario A: Gx, QoS

Scenario A	2 TP	10 TP	20 TP	34 TP
Millions of Subscribers	8.2	59.6	113.3	184.5
Transactions Per Second	1,627	11,828	22,473	37,596
PDP Sessions (thousands)	2,871	20,873	39,659	64,581

Table 2 Scenario B1: Gx, QoS, Usage Reporting

Scenario B1	2 TP	10 TP	20 TP	34 TP
Millions of Subscribers	5.6	40.8	77.5	126.2
Transactions Per Second	1222	8,888	16,888	27,500
PDP Sessions (thousands)	1,965	14,285	27,141	44,197





Table 3 Scenario F: LTE/EPC Solution

Scenario F	2 TP	10 TP	20 TP	34TP
Millions of Subscribers	5.4	53.9	114.6	199.4
Transactions Per Second	938	9,236	19,610	34,132
Number of Gx sessions (thousands)	3,837	37,785	80,221	139,631

Table 4 Scenario F1: IMS VoLTE Solution

Scenario F1	2 TP	10 TP	20 TP	34 TP
Millions of Subscribers	1.1	8.3	15.7	25.6
Transactions Per Second	1,148	8,344	15,853	25,816
Number of Gx sessions (thousands)	799	5,810	11,039	17,976
AF Sessions (thousands)	28	207	394	642

### External Database Access

The impact of storing subscriber profiles in an external database is determined by the performance of the external database, the parts of the subscriber profile externally stored and the operator data model. According to estimations, the impact in performance using LDAP interface is as follows:

- 13% reduction in the number of TPS supported, when both subscriber profile and usage accumulators are stored in external database, which needs a write operation to external database.
- 10% reduction in the number of TPS supported, when no accumulators are stored in the external database.

### Mobility Based Policy Control for Overlay Deployments

This feature has no impact in the performance for those scenarios where the Smp interface is not used.

The performance of the Smp operations is similar to the performance of Gx operations with similar controls.

The impact on the performance of the feature mostly depends on:



- Subscribers that are using the Smp interface.
- Traffic model, that is actual frequencies of the Smp operations. The frequencies of some operations can become high depending on especially those related to location change.

## 2.2 Upgrade Impact

Upgrade procedure improved providing:

- Automatic update of configuration files.
- Automatic update of Diameter dictionary files.
- Automatic update of PM (counters and threshold alarms).
- Automatic update of preconfigured entities.
- Upgrade traces for troubleshooting purposes.
- Upgrade progress in console.

### Upgrade Impact in UDC

When the SAPC is deployed as part of the User Data Consolidation (UDC) solution, consider the following impacts:

- Application schema in CUDB:
  - Added `SevTrig`, `SspId`, `SpdnGwName`, and `SpresenceAreaName` attributes in SAPC object class.
- Application counters in CUDB: no impacts
- Notification files with CUDB: no impacts
- Notifications with the Provisioning Gateway: no impacts.
- Validations in Provisioning Gateway: no impacts.

## 2.3 Interface

This section contains the interface changes introduced between SAPC 17A FD01 and SAPC 1.0 releases.

### 2.3.1 Gx Interface

The following changes are done to support Dynamic Event Triggers:

- Added `Event-Trigger` AVP in CCA-Update and RAR messages.



- Added NO\_EVENT\_TRIGGERS (14) value in Event-Trigger AVP in CCA-Update and RAR messages.

The following changes are done to support Presence Reporting Area in Gx interface:

- Added bit value 23 in Supported-Features AVP.
- Added Presence-Reporting-Area-Information AVP in CCR and CCA messages.
- Added CHANGE\_OF\_UE\_PRESENCE\_IN\_PRESENCE\_REPORTING\_AREA\_REPORT (48) value in the Event-Trigger AVP in CCR, CCA and RAR messages.

The following changes are done to support emergency services:

- Added DIAMETER\_ERROR\_INITIAL\_PARAMETERS (5140) value in Experimental-Result-Code AVP.

The following changes are done to support diameter race conditions and concurrent reauthorizations handling:

- Added bit value 16 in the Supported-Features AVP.
- Added DIAMETER\_PENDING\_TRANSACTION (4144) value in Experimental-Result-Code AVP in RAA messages.
- Added DIAMETER\_OUT\_OF\_SPACE (4002) value in Result-Code AVP in RAA messages.

Related to the PCEF restart function:

- The SAPC does not reject CCR-Is with DIAMETER\_INVALID\_AVP\_VALUE (Result-Code value 5004) in case the CCR-I is received with an Origin-State-Id lower than locally stored one. Any different Origin-State-Id is considered for PCEF restart detection instead.

### SAPC 1.1

The following changes are done to support emergency services prioritization:

- Added DIAMETER\_TOO\_BUSY (3004) value in Result-Code AVP in CCA-Update and CCA-Termination messages.

## 2.3.2

### Rx Interface

The following changes are done to support emergency services:

- Added Service-URN AVP in AAR message.
- Added UNAUTHORIZED\_NON\_EMERGENCY\_SESSION (5066) value in Experimental-Result-Code AVP.



The following changes are done to support AVP Rx-Request-Type:

- When AAR message is received with this AVP, SAPC answers an AAA message whose AVP Result-Code is:
  - DIAMETER\_UNKNOWN\_SESSION\_ID (5002) if Rx-Request-Type is UPDATE\_REQUEST (1) and there is no Rx session.
  - DIAMETER\_INVALID\_AVP\_VALUE (5004) if Rx-Request-Type is PCSCF\_RESTORATION (2), given that this value is not supported yet.

### SAPC 1.1

The following changes are done to support emergency services prioritization:

- Added DIAMETER\_TOO\_BUSY (3004) value in Result-Code AVP in AAA-Update and STA messages.

## 2.3.3 Smp Interface

This is a new interface between the SGSN-MME and the SAPC to provide Mobility Based Policy Control for Overlay Deployments. For the details, refer to [Smp Interface Description](#).

This interface uses by default a non-standard port, different than rest of Diameter based interfaces, refer to [Security Hardening Guide](#).

## 2.3.4 Sy Interface

### SAPC 1.1

The following changes are done to support emergency services prioritization:

- Added DIAMETER\_TOO\_BUSY (3004) value in Result-Code AVP in SNA messages.

## 2.3.5 SOAP Notification Interface

### SAPC 1.1

The SAPC rejects the incoming notification request processing and returns an error to the SOAP client if the SAPC is overloaded.



### 2.3.6 Other Impact

#### SCTP

SCTP bundling is disabled by default.

## 2.4 Operation and Maintenance

### 2.4.1 Provisioning

Modifications in provisioning and configuration interfaces have been performed to adapt them to the new or enhanced functions.

#### Management of Policies

New policy type for Dynamic Event Triggers:

- `event-triggers`

New policy tags for Presence Reporting Area:

- `AccessData.subscriber.locationInfo.presenceReportingArea["presenceAreaName"].isInArea`
- `AccessData.host.isPraSupported`

New policy type for Presence Reporting Area:

- `presence-reporting-area`

New policy tag for Emergency Services:

- `AfData.serviceUrn`

Support of NB-IoT RAT-Type:

- New value for `AccessData.bearer.accessType` policy tag.

New policy types for Mobility Based Policy Control for Overlay Deployments:

- New policy for PDN-GW selection
- New policy for SPID selection
- New policy for Smp access control

For the details, refer to [Smp Interface Description](#)

## SAPC 1.1

The SAPC rejects any provisioning request via REST interface and returns 503 Service Unavailable http error message if the SAPC is overloaded.

### 2.4.2 Configuration

The differences in the Managed Object Model (MOM) since the previous release can be found as part of the MOM, see next Figure:

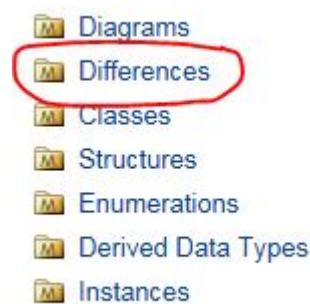


Figure 1 Location of the differences in the MOM

### 2.4.3 Fault Management

Related to load regulation for Mobility Based Policy Control for Overlay Deployments, the following alarm has been added:

- Policy Control, Number of Sx CCAs Initial Sent Indicating Too Busy Reached

Related to load regulation for Gx IP-CAN session establishment, the following alarm has been updated:

- Policy Control, Number of Gx CCAs Initial Sent Indicating Too Busy Reached

### 2.4.4 Logging Management

Related to the emergency services function, the following log events have been added:

- AF Emergency Session established
- AF Emergency Session terminated

New log file including only emergency services log events:

- emergencyCalls.log



Related to Mobility Based Policy Control for Overlay Deployments, the following log events have been modified or added:

- Error sending CCA
- Internal Error
- License Error
- Protocol Error

## 2.4.5 Performance Management

The following measurements related to Gx interface have been added:

- gxCcasInitEmergencySuccess
- gxCcasInitEmergencyFailed
- gxCcasErrorInitialParameters
- gXRaasPendingTransaction
- gXRaasOutOfSpace

The following measurements related to Rx interface have been added:

- rxAaasInitEmergencySuccess
- rxAaasInitEmergencyFailed
- rxAaasUnauthorizedNonEmergency
- rxAaasUnknownSessionId

The descriptions of the next measurements have been modified:

- rxAarsInit
- rxAarsUpdate

The following capacity measurements have been added:

- afEmergencyActiveSessions
- ipCanUnauthenticatedEmergencyActiveSessions
- ipCanAuthenticatedEmergencyActiveSessions
- ipCanUnknownEmergencyActiveSessions
- ipCanEmergencyActiveSessionsPerApn



The following External Database measurements have been added:

- ldapSearchRequests
- ldapModifyRequests
- ldapSearchResponsesFailed
- ldapModifyResponsesFailed
- soapExtDbNotificationsReceived
- soapExtDbNotificationsReceivedTooBusy
- soapExtDbNotificationResponsesFailed

New measurements related to Smp interface added, for the details, refer to [Measurements](#).

### SAPC 1.1

New measurements related to overload control (load regulation) in traffic updates, terminations, SOAP, REST and ToD added, for more details, refer to [Measurements](#).

## 2.4.6

### CNOM

The Core Network Operations Manager (CNOM) is an Ericsson separate product not directly provided with the SAPC.

The SAPC provides support to integrate the following applications of CNOM:

- Network monitor.
- Alarm monitor.
- Health check.

## 2.5

### Obsolete Functions

No changes.

## 2.6

### Other Impacts

No changes.





## 2.7 Customer Product Information

The online Customer Product Information (CPI) library is stored in the Active Library Explorer database.

The following documents have been added to the CPI library:

- Configuration Guide for Mobility Based Policy Control for Overlay Deployments (Smp)
- Smp Interface Description
- Mobility Based Policy Control for Overlay Deployments
- Configuration Guide for Emergency Services
- Emergency Services
- Flexible Output Protocol
- Performance Data Collection

## 2.8 Environment

SAPC 1 may take part of the following solutions: virtual Evolved Packet Core (vEPC), Service Aware Charging & Control (SACC), the Mobile Telephony Evolution with VoLTE, Ericsson SDN, and Ericsson Network Integrated Wi-Fi (ENIW).

# 3 Additional Information

## 3.1 Software Management

The SAPC version information is available through COM CLI. For the details, refer to [View Software Information](#).

# 4 Summary of Impacts per Value Package

This section summarizes the impact of each new or enhanced value package on the network.



Next table lists all the value packages in SAPC 1.0.

For details on impact, see the description of each value package in Section 5 on page 14.

Table 5 Value Packages

Value Package	Major Impact	Minor Impact	No Impact	Number
Base Package		X		FAJ 801 0091
Convergence			X	FAJ 801 0093
Smart Personalized Broadband		X		FAJ 801 0092
Voice Optimization		X		FAJ 801 0464
Business Intelligence			X	FAJ 801 0463
High Availability and Pooling		X		FAJ 801 0466
Network Efficiency		X		FAJ 801 0465
Monetize OTT		X		FAJ 801 0462
Money Aware			X	FAJ 801 0468

## 5 Impact of New or Enhanced Value Packages

This section describes the impact new or enhanced value packages have on an operator's network. If there is an enhanced value package, the network impact is described based on the value package enhancements relative to the prior release of the SAPC.

For detailed description about each particular value package, refer to Technical Product Description, 1/221 02-FGC 101 3390/1 Uen.



## 5.1 Base Package

### 5.1.1 Event Triggers Selection

Event Triggers can be set unconditionally at subscriber, subscriber group or node levels, and also dynamically using policies.

Event-Triggers can now be included on CCA-Update and RAR messages.

### 5.1.2 Flexible Output Protocol

Flexible Output Protocol allows transformations of the outgoing Gx protocol messages that do not affect the SAPC logic, but that are complementary to it. The SAPC supports transformation at command level (message) and at service level (Charging-Rule).

### 5.1.3 AF Restart

AF restart is detected when any Rx-AAR (initial or update) message is received with an Origin-State-Id AVP different than Origin-State-Id currently stored in SAPC. After the restart detection, the SAPC starts identifying all the invalid Rx sessions established from the restarted AF and removing them, without any additional delay.

The SAPC executes massive clean-up with low priority, and provides a mechanism to avoid load peaks due to the massive clean-up, so incoming messages are not affected.

### 5.1.4 PCEF Restart

PCEF restart is detected when any CCR-Initial message is received with an Origin-State-Id AVP different than Origin-State-Id currently stored in SAPC (in previous SAPC release it was detected only if the received Origin-State-Id was higher than the stored one).

#### 5.1.4.1 Removal of a Configured PCEF

When a `diameterNode` peer is removed from the configuration data, the SAPC removes all the sessions established by that peer as done during a PCEF restart, but without applying any delay before starting to delete.

### 5.1.5 Subscriber profile management in Policy Studio

The Policy Studio supports the view, creation, modification and deletion of subscriber profiles. It allows to associate profiles, dataplans, reporting groups, etc with subscribers. It also supports to visualize the usage accumulators.



### 5.1.6 Diameter Race Conditions and Concurrent Reauthorizations over Gx.

When a race condition is reported by the PCEF, the SAPC is able to reauthorize the session and send reattempting RARs to the PCEF with the latest policy information. The SAPC does not send a new Gx RAR message to the PCEF until the previous Gx RAR is acknowledged for the same Gx session.

Enabling diameter race conditions and concurrent reauthorization handling over Gx may imply a performance drop of up to 8% in TPS for traffic models with high rate of SAPC-initiated reauthorizations (Gx RAR messages), due to for example AF events or time of day conditions.

### 5.1.7 Performance Data Collection Support

The SAPC provides Performance Data Collection (PDC) support to regularly collect performance data and generate output information.

SAPC 1.0 also supports health check option containing information about general SAPC status (ports, interfaces and capacity licenses).

Refer to [Performance Data Collection](#) for details.

## 5.2 Convergence

No impact.

## 5.3 Smart Personalized Broadband

The Presence Reporting Area function enables the SAPC to select an area where presence of the subscriber is reported. Only changes of presence relative to the area (that is, whether the subscriber enters or leaves the PRA) are reported by the PCEF, which produces a decrease in signalling. The SAPC makes policy decisions based on the presence of the subscriber in the area and sends the corresponding enforcement actions to the PCEF.

## 5.4 Voice Optimization

Emergency Services functionality introduces support for emergency IP-CAN sessions and IMS emergency calls.

Rx interface is enhanced supporting Rx-Request-Type AVP in AAR messages from the AF.

## 5.5 Business Intelligence

No impact.



## 5.6 High Availability and Pooling

The SAPC allows to define up to three different points of access towards the External Database, each one towards different site. Each point of access is identified by a different VIP address.

## 5.7 Network Efficiency

The Mobility Based Policy Control for Overlay Deployments function introduces a new Smp interface between the SAPC and the SGSN-MME that enables the PDN-GW selection and SPID selection.

## 5.8 Monetize OTT

Rx interface is enhanced supporting Rx-Request-Type AVP in AAR messages from the AF.

## 5.9 Money Aware

No impact.

# 6 For Coming Releases

Some OAM elements (for example configuration objects, measure instances or alarm instances and data in the REST provisioning interface) are present in the SAPC data model, but have no effect until the corresponding functions are implemented in future deliveries:

- The measure `sxActiveGlobalSessions`.
- UE trace xml and pcap files configuration.