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| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Services and System Aspects;  Study on charging aspects of Common API Framework for Northbound APIs (CAPIF) phase2;  (Release 19) | |
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| ***3GPP***  Postal address  3GPP support office address  650 Route des Lucioles - Sophia Antipolis  Valbonne - FRANCE  Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  Internet  http://www.3gpp.org |
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# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document focus on how CAPIF can be supported by the current Converged charging Architecture.

The following items are studied:

- possible charging scenarios and requirements for supporting CAPIF.

- identify NEF functionalities which can implement CAPIF functionalities for charging scenarios

- potential charging solutions for supporting CAPIF.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.222: "Common API Framework for 3GPP Northbound APIs".

[3] 3GPP TS 32.254: "Telecommunication management; Charging management; Exposure function Northbound Application Program Interfaces (APIs) charging".

[4] 3GPP TS 32.290: "Telecommunication management; Charging management; 5G system; Services, operations and procedures of charging using Service Based Interface (SBI)".

[5] 3GPP TS 29.222: "Common API Framework for 3GPP Northbound APIs".

[6] 3GPP TS 32.255: "Telecommunication management; Charging management; 5G data connectivity domain charging; Stage 2".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

## 3.2 Symbols

Void.

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

3GPP 3rd Generation Partnership Project

5GS 5g System

AEF API Exposing Function

API Application Programming Interface

AS Application Server

BSS Business Support Systems

CAPIF Common API Framework

CCF CAPIF Core Function

CDR Charging Data Record

CHF Charging Function

CTF Charging Trigger Function

ECUR Event Charging with Unit Reservation

EPS Evolved Packet System

IEC Immediate Event Charging

NEF Network Exposure Function

NF Network Function

OCS Online Charging System

OSS Operational Support Systems

PEC Post Event Charging

RNAA Resource owner-aware Northbound API Access

SCEF Service Capabilities Exposure Function

SCS Service Capability Server

# 4 Void

# 5 Concepts and background

## 5.1 General Description

The Common API Framework (CAPIF) architecture is defined as service-based and interactions between the CAPIF functions are represented in two ways:

- A service-based representation, where CAPIF functions enable other authorized CAPIF functions to access their services.

- A reference point representation, where interactions between any two CAPIF functions (e.g. CCF, AEF) is shown by an appropriate point-to-point reference point (e.g. CAPIF-3).

The CAPIF functional architecture can be adopted by any 3GPP functionality providing 3GPP northbound service APIs.

Figure 5.1-1 shows the reference point based functional model for the CAPIF.



Figure 5.1-1: Functional model for the CAPIF

## 5.2 Background

### 5.2.1 API Exposure

According to the CAPIF relationship with network exposure aspects of 3GPP systems in the clause Annex B described in the TS 23.222 [2], the details of SCEF which is the role in exposing network capabilities of EPS to 3rd party applications and NEF which is the role in exposing network capabilities of EPS to 3rd party applications are present in the following clause:

- B.1 CAPIF relationship with 3GPP EPS network exposure

- B.2 CAPIF relationship with 3GPP 5GS network exposure

According to the CAPIF role in charging in the clause Annex C described in the TS 23.222 [2], the common architecture for charging, including the offline charging and online charging, which is the role of CAPIF in charging service API invocations, is introduced in the figure C.1-1 and following clauses in the TS 23.222 [2]:

- C.2 CAPIF role in online charging

- C.3 CAPIF role in offline charging

According to the high-level Service Exposure Function architecture described in the TS 32.254 [3], the offline, online and converged charging description for Northbound Application Program Interfaces (API), based on the transaction over T8 reference point between SCEF and SCS/AS and Network Exposure Function (NEF) are introduced:

- Clauses 4.2 and 4.3: the details of SCEF functioning as the CTF, may generate accounting metrics sets for Northbound Application Program Interfaces (APIs) CDRs in the figure 4.2.1, and the details of SCEF utilizing Ro interface and application towards the OCS in the figure 4.2.2 are described:

- Clause 4.4: the details of NEF functioning as the CTF, using Nchf to perform converged charging for the northbound API access.

## 5.3 Business Roles related to CAPIF charging

### 5.3.1 Basic CAPIF business relationships

As per the TS 23.222 [2] clause 5.1, the basic business roles related to CAPIF charging include:



Figure 5.3.1-1: Business relationships in CAPIF

- API invoker: typically provided by a 3rd party application provider, which is the charged party for CAPIF API invocation charging by CAPIF provider.

- CAPIF provider: the charging party, which embeds the CTF to perform the charging to API invoker.

### 5.3.2 CAPIF business relationships for RNAA

As per the TS 23.222 [2] clause 5.2, the business roles related CAPIF for RNAA charging include:



Figure 5.3.2-1: CAPIF business relationships for RNAA

- API invoker: see CAPIF business relationships in clause 5.2.1.

- CAPIF see CAPIF business relationships in clause 5.2.1.

NOTE: In the current release, both the CAPIF provider and the API provider belongs to the same enterprise (e.g. PLMN operator) and the service API arrangement is not required explicitly.

## 5.4 Charging aspect requirements by SA6

As per the charging aspect requirements specified in TS 23.222 [2], the requirement related CAPIF Charging are present as following:

- [AR-5.4.2-a] The CAPIF shall support charging for service APIs usage.

- [AR-5.4.2-b] The CAPIF shall provide mechanisms to record the usage (e.g. invocation count) of the service APIs for charging purpose, on a per API invoker basis.

- [AR-5.4.2-c] The CAPIF shall provide mechanisms to record timestamp of the service API invocation.

- [AR-5.4.2-d] The CAPIF shall provide mechanisms to record the service API related information, e.g. API location.

- [AR-5.4.3-a] The CAPIF shall support online and offline charging for 3rd party API providers' service APIs -usage.

- [AR-5.4.3-b] The CAPIF shall provide mechanisms to query charging related information of the 3rd party service APIs by the authorized users.

The above charging requirements are defined by SA6, which need to be studied from SA5 charging aspect.

# 6 CAPIF Charging Scenarios and Topics

## 6.1 Topic #1 CAPIF Converged Charging support of Service APIs Operation and Management

### 6.1.1 General description and assumptions

Informative Annex B.2.2 of 3GPP TS 23.222 [2] describes on how the NEF can implement the specific service aspect and how its aligned with the CAPIF Architecture. Therefore, it would be necessary to evaluate the possibility to support Converged charging in those deployment models.

### 6.1.2 Use Case

#### 6.1.2.1 Use Case #1.1: Service API Operation and management via CAPIF

The service API invokers (e.g. the 3rd party application provider) and the CAPIF providers (i.e. Operators) has the service agreement about the API invocations. The CAPIF providers and API providers has the Service API arrangement about the API publishing, API exposure and API management.

The API invoker can perform one or multiple service API invocation to CAPIF. The CAPIF Core Function acknowledges the API invocation request and provide the API invocation response to the API invoker. CAPIF can collect the charging information based on the following chargeable events, for example:

- the service API publish, as specified in the TS 23.222 [2] clause 8.3

- the service API unpublish, as specified in the TS 23.222 [2] clause 8.4

- the service API retrieve, as specified in the TS 23.222 [2] clause 8.5

- the service API update, as specified in the TS 23.222 [2] clause 8.6

The charging party: the CAPIF providers

The charged party: the API provider

The potential charging requirements for this UC are: REQ-3GPPCH-APIM-01.

#### 6.1.2.2 Use Case #1.2: API invoker management via CAPIF

The service API invokers (e.g. the 3rd party application provider) and the CAPIF providers (i.e. Operators) has the service agreement about the API invoker management. The CAPIF providers the Service API about API invoker management.

As part of onboarding an API Provider is provisioned to get access to the service APIs. From a high-level perspective, the corresponding process has implications on the provisioning on the Operator's BSS/OSS Systems that will also be responsible for triggering the chargeable events. CAPIF can collect the charging information based on the following chargeable events, for example:

- the service activation: Onboarding the API invoker to the CAPIF, as specified in TS 23.222 [2], clause 8.1;

- the service in-activation: Offboarding the API invoker from the CAPIF, as specified in TS 23.222 [2], clause 8.2.

The charging party: the CAPIF providers.

The charged party: the API invoker.

The potential charging requirements for this UC are: REQ-3GPPCH-IVKM-01.

#### 6.1.2.3 Use Case #1.3: Service API discovery via CAPIF

The service API invokers (e.g. the 3rd party application provider) and the CAPIF providers (i.e. Operators) has the service agreement about the service API discovery. The Discovery Service API could be used to find a specific service by API Invoker.

The CAPIF core function enables the API invoker to discover, subscribe to, unsubscribe from and receive notifications from the CAPIF events, such as availability events of service APIs, change in service API information, monitoring service API invocations, API invoker onboarding events, etc., over CAPIF-1 or CAPIF-1e, as listed below:

- discover service APIs, as specified in TS 23.222 [2] Clause 8.7.

- subscription, unsubscription and notifications for the CAPIF events, as specified in TS 23.222 [2] Clause 8.8.

Note: The subscribing entity (i.e. the API invoker, the API exposing function, the API publishing function, the API management function) can subscribe to and unsubscribe the CAPIF events. The use case #1.3 only cover the relationship between API invoker and CAPIF.

The charging party: the CAPIF providers.

The charged party: the API invoker.

The potential charging requirements for this UC are: REQ-3GPPCH-IVKO-01.

### 6.1.3 Potential charging requirements

The following are potential high-level charging requirements, derived from the requirements in TS 23.222 [2].

**REQ-3GPPCH-APIM-01:** The CAPIF should support converged charging for APIs service management per API provider.

**REQ-3GPPCH-IVKM-01:** The CAPIF should support converged charging for APIs invoker management.

**REQ-3GPPCH-IVKO-01:** The CAPIF should support converged charging for service API discovery.

### 6.1.4 Key issues

#### 6.1.4.1 Key issue#1.1: Charging events and charging information required

This key issue is for investigating how to support the charging considering REQ-3GPPCH-APIM -01. This investigation covers the following:

- identification and classification of the charging information for APIs service Operation and Management;

- identification and classification of the chargeable event for APIs service Operation and Management.

#### 6.1.4.2 Key issue#1.2: Charging events and charging information required

This key issue is for investigating how to support the charging considering REQ-3GPPCH-IVKM-01. This investigation covers the following:

- identification of the charging information for API invoker management;

- identification of the chargeable event for API invoker management;

#### 6.1.4.3 Key issue#1.3: Charging events and charging information required

This key issue is for investigating how to support the charging considering REQ-3GPPCH- IVKO-01. This investigation covers the following:

- identification of the charging information for API discovery;

- identification of the chargeable event for API discovery;

### 6.1.5 Possible Solutions

#### 6.1.5.1 Solution #1.1 API Service Management Charging

##### 6.1.5.1.0 General

A possible solution for key issue #1.1 covers the requirement REQ-3GPPCH-APIM-01.

The focus on this solution to provide the capability to charge the following service API in case required:

- service API publish, as specified in the TS 23.222 [2] clause 8.3

- service API unpublish, as specified in the TS 23.222 [2] clause 8.4

- service API retrieve, as specified in the TS 23.222 [2] clause 8.5

- service API update, as specified in the TS 23.222 [2] clause 8.6

NEF, currently, is able to perform converged charging by interacting with CHF using Nchf, as specified in TS 32.254 [3], clause 5.4.1.1. It already performs converged charging for the Northbound API access.

Additionally there is already a Service API Charging function which is responsible for reporting/generating the charging information based on API consumption by the external consumers through the CAPIF framework. To do this, this function subscribes to the CCF to receive the notifications related to the Service API lifecycle events (e.g. Service API publish, unpublish, update and invocation logs). The Service API invocation log has the following information that will be used by the CHF.

The following NEF charging scenarios (IEC; ECUR) can be extended to cover the CAPIF API Service. Therefore, when there are specific requests from or to NEF for those Service APIs, a charging event shall be triggered, so it can be charged. It is recommended to extend the Default Trigger conditions table 5.4.1.2.1.1 of TS 32.254 [3] as described below.

Table 6.1.5.1-1: CAPIF default trigger conditions in NEF

| Trigger Conditions | Trigger level | Default category | CHF allowed to change category | CHF allowed to enable and disable | Message when "immediate reporting" category |
| --- | --- | --- | --- | --- | --- |
| Service API Publish | - | Immediate | Not Applicable | Not Applicable | IEC: Charging Data Request [Event]  ECUR: Charging Data Request [Initial] |
| Service API Publish Notification | - | Immediate | Not Applicable | Not Applicable | IEC: Charging Data Request [Event]  ECUR: Charging Data Request [Initial] |
| Service API Publish Acknowledgement | - | Immediate | Not Applicable | Not Applicable | ECUR: Charging Data Request [Termination] |
| Service API Unpublish | - | Immediate | Not Applicable | Not Applicable | ECUR: Charging Data Request [Termination] |
| Service API Unpublish Acknowledgement | - | Immediate | Not Applicable | Not Applicable | ECUR: Charging Data Request [Termination] |
| Service API update | - | Immediate | Not Applicable | Not Applicable | IEC: Charging Data Request [Event]  ECUR: Charging Data Request [Initial] |
| Service API update Acknowledgement | - | Immediate | Not Applicable | Not Applicable | ECUR: Charging Data Request [Termination] |

The following scenarios have to be considered to cover the Service APIs. Therefore, these message flow focus on the different messages from/to NEF and its interaction with CHF as specified in TS 32.254 [3], clause 5.4.2.

##### 6.1.5.1.1 Service API Publish Invocation - IEC



Figure 6.1.5.1.1-1: Service Publish API invocation request to CAPIF CORE Function using IEC

1. NEF receives either a Service API Publish, or Service API Publish Notification from an AF.

1ch-a. The NEF sends Charging Data Request [Event] to CHF for the received Service API Invocation.

1ch-b. The CHF creates a CDR for this Service Publish API Invocation.

1ch-c. The CHF acknowledges and grants authorization by sending Charging Data Response [Event] to the NEF.

2. NEF performs the actions needed to fulfil the Service API invoked.

3. If authorized, the NEF continues the Service API invocation processing and sends the Service API Invocation Response.

##### 6.1.5.1.2 Service API Publish Invocation - ECUR



Figure 6.1.5.1.2-1: Service Publish API invocation request to CAPIF CORE Function using ECUR

1. NEF receives either a Service API Publish, or Service API Publish Notification from an AF.

1ch-a. The NEF sends Charging Data Request [Event] to CHF for the received Service API Invocation.

1ch-b. The CHF creates a CDR for this Service Publish API Invocation.

1ch-c. The CHF acknowledges and grants authorization by sending Charging Data Response [Event] to the NEF.

2. NEF performs the actions needed to fulfil the Service API invoked.

3. If authorized, the NEF continues the Service API invocation processing and sends the Service API Invocation Response.

3ch-a. The NEF sends Charging Data Request [Termination] to the CHF for terminating the charging associated with the Service API Invocation.

3ch-b. The CHF closes the CDR for this Service API Invocation.

3ch-c. The CHF acknowledges by sending Charging Data Response [Termination] to the NEF.

##### 6.1.5.1.3 Service API Notification Invocation - IEC



Figure 6.1.5.1.3-1: Service API Notification from CAPIF CORE Function using IEC

1. The NEF receives a notification from an NF.

1ch-a. The NEF sends Charging Data Request [Event] to CHF for the Notification.

1ch-b. The CHF creates a CDR for this Notification.

1ch-c. The CHF acknowledges and grant authorization by sending Charging Data Response [Event] to the NEF.

2. The NEF sends the notification to AF.

3. The NEF receives acknowledgement for the notification.

##### 6.1.5.1.4 Service API Notification Invocation - ECUR



Figure 6.1.5.1.4-1: Service API Notification from CAPIF CORE Function using ECUR

1. The NEF receives a notification from an NF.

1ch-a. The NEF sends Charging Data Request [Event] to CHF for the Notification.

1ch-b. The CHF creates a CDR for this Notification.

1ch-c. The CHF acknowledges and grant authorization by sending Charging Data Response [Event] to the NEF.

2. The NEF sends the notification to AF.

3. The NEF receives acknowledgement for the notification.

3ch-a. The NEF sends Charging Data Request [Termination] to the CHF for terminating the charging associated with the API event Notification.

3ch-b. The CHF closes the CDR for this API Notification.

3ch-c. The CHF acknowledges by sending Charging Data Response [Termination] to the NEF.

##### 6.1.5.1.5 Service API Update - IEC



Figure 6.1.5.1.5-1: Service API Update from CAPIF CORE Function using IEC

1. The NEF receives a notification from an NF.

1ch-a. The NEF sends Charging Data Request [Event] to CHF for the Notification.

1ch-b. The CHF creates a CDR for this Notification.

1ch-c. The CHF acknowledges and grant authorization by sending Charging Data Response [Event] to the NEF.

2. The NEF sends the notification to AF.

3. The NEF receives acknowledgement for the notification.

4. The NEF receives acknowledgement for another notification.

4ch-a. The NEF sends Charging Data Request [Event] to CHF for the Notification.

4ch-b. The CHF updates a CDR.

4ch-c. The CHF acknowledges and grant authorization by sending Charging Data Response [Event] to the NEF.

##### 6.1.5.1.6 Service API Update - ECUR



Figure 6.1.5.1.6-1: Service API Update from NEF using ECUR

1. The NEF receives a notification from an NF.

1ch-a. The NEF sends Charging Data Request [Event] to CHF for the Notification.

1ch-b. The CHF creates a CDR for this Notification.

1ch-c. The CHF acknowledges and grant authorization by sending Charging Data Response [Event] to the NEF.

2. The NEF sends the notification to AF.

3. The NEF receives acknowledgement for the notification.

3ch-a. The NEF sends Charging Data Request [Termination] to the CHF for terminating the charging associated with the API event Notification.

3ch-b. The CHF updates the CDR for this API Notification.

3ch-c. The CHF acknowledges by sending Charging Data Response [Event] to the NEF.

4. The NEF sends the notification to AF.

5. The NEF receives acknowledgement for the notification.

6ch-a. The NEF sends Charging Data Request [Termination] to the CHF for terminating the charging associated with the API event Notification.

6ch-b. The CHF closes the CDR for this API Notification.

6ch-c. The CHF acknowledges by sending Charging Data Response [Termination] to the NEF.

#### 6.1.5.2 Solution #1.2: Service API discovery via CAPIF

##### 6.1.5.2.1 General description

This solution #1.2 which relying on CHF/5G Converged Charging System for CAPIF Converged Charging, addresses the Key Issue #1.3.

##### 6.1.5.2.2 Architecture description

The architecture is the same with the Figure 6.1.5.2.2-1 for CAPIF Core Function (CCF) Charging.

##### 6.1.5.2.3 Procedures description

The Figure 6.1.5.2.3-1 describes the high-level charging procedure for CCF Converged charging for service API discovery over CAPIF-1 or CAPIF-1e, based on the procedure for API discover in Figure 8.7.3-1 and event subscription/unsubscription in Figures 8.8.3-1 and 8.8.5-1 in TS 23.222 [2]. The event-based charging, i.e. IEC, PEC and ECUR specified in 3GPP TS 32.290 [4] are supported.

Pre-conditions:

1. The API invoker is onboarded and has received an API invoker identity.

2. The CAPIF core function is configured with a discovery policy information.

3. The API invoker has the authorization to subscribe for the CAPIF events.



Figure 6.1.5.2.3-1: Event Charging Procedure for Service API discovery to the CAPIF   
(PEC as example)

1. The CAPIF supports service API discovery with CAPIF\_Discover\_Service\_API including operations, e.g. discover service API and subscribe/unsubscribe event, as defined in TS 23.222 [2] clause 10.2. The API invoker sends the service API discovery request, e.g. API discover request, event subscription request, to CAPIF core Function over CAPIF-1 or CAPIF-1e, including the API invoker identity.

2. CAPIF core function performs service API discovery handling procedure which includes applies the discovery policy and performs filtering of service APIs information retrieved from the CAPIF core function, stores the subscription information, updates the subscription information, removes the subscription information.

3. The CAPIF provides the successful service API discovery response.

3ch-a. CAPIF core function generates charging data related to the service API discovery and sends the request for the CHF to store related charging data for CDR generation purpose.

3ch-b. CHF stores received information and creates a CDR related to the API invokers.

3ch-c. CHF informs the CAPIF core function on the result of the request.

The figure 6.1.5.2.3-2 describes the high-level charging procedure for CCF Converged charging for service API discovery over CAPIF-1 or CAPIF-1e, based on the procedure for CAPIF event notifications in Figure 8.8.3-1 in TS 23.222 [2]. The event-based charging, i.e. IEC, PEC and ECUR specified in 3GPP TS 32.290 [4] are supported.

Pre-conditions:

1. The API invoker is onboarded and has received an API invoker identity.

2. The subscription procedure of API invoker has is performed.



Figure 6.1.5.2.3-2: Event Charging Procedure for CAPIF Event notifications (PEC as example)

1. CAPIF core function performs service API discovery handling procedure for retrieving application subscriptions based on the generated events to be consumed by the subscribing entity (API Invokers).

2. The CAPIF core function sends event notifications to API invokers.

3. API invokers sends the event notification acknowledgement to the CAPIF core function.

3ch-a to 3ch-c is the same with the Figure 6.1.5.2.3-1.

#### 6.1.5.3 Solution #1.3: API invoker management by via CAPIF

##### 6.1.5.3.1 General description

This solution #1.3 which relying on CHF/5G Converged Charging System for CAPIF Converged Charging, addresses the Key Issue #1.2.

##### 6.1.5.3.2 Architecture description

The architecture is the same with the Figure 6.1.5.3.2-1 for CAPIF Core Function (CCF) Charging.

##### 6.1.5.3.3 Procedures description

The Figure 6.1.5.3.3-1 describes the high-level charging procedure for CCF Converged charging for API invoker management over CAPIF-1 or CAPIF-1e, based on Figures 8.1.3-1 and 8.2.3-1 about the procedure for onboarding and offboarding API invoker in the TS 23.222 [2]. The event-based charging, i.e. IEC, PEC and ECUR specified in 3GPP TS 32.290 [4] are supported.



Figure 6.1.5.3.3-1: Event Charging Procedure for API invoker management to the CAPIF (PEC as example)

1. The CAPIF supports management of API invoker with CAPIF\_API\_invoker\_management API, including onboard/offboard API invoker, as defined in TS 23.222 [2] clause 10.5. The API invoker triggers onboard/offboard API invoker request to the CAPIF core function over CAPIF-1 or CAPIF-1e.

2. CAPIF core function performs API invoker management procedure which includes onboarding approval (enrolment of the API invoker to be a recognized as user of the CAPIF) and cancelling the API invoker enrolment from CAPIF.

3. The CAPIF provides the successful onboarding/offboarding API invoker management response.

3ch-a. CAPIF core function generates charging data related to the API invoker management and sends the request for the CHF to store related charging data for CDR generation purpose.

3ch-b. CHF stores received information and creates a CDR related to the API invokers.

3ch-c. CHF informs the CAPIF core function on the result of the request.

#### 6.1.5.4 Solution #1.4: Service API management via CAPIF

##### 6.1.5.4.1 General description

This solution #1.4 which relying on CHF/5G Converged Charging System for CAPIF Converged Charging, addresses the Key Issue #1.1.

##### 6.1.5.4.2 Architecture description

Figure 6.1.5.4.2-1 shows the 5G System high level charging architecture for CAPIF Core Function (CCF) Charging, in the reference point representation for non-roaming:



Figure 6.1.5.4.2-1: 5G CCF converged charging architecture non-roaming

##### 6.1.5.4.3 Procedures description

The Figure 6.1.5.4.3-1 describes the high-level charging procedure for CCF Converged charging for API management via CAPIF-4, based on Figures 8.3.3-1, 8.4.3-1, 8.5.3-1 and 8.6.3-1 about the procedure for publish/unpublish/retrieve/update service APIs in the TS 23.222 [2]. The event-based charging, i.e. IEC, PEC and ECUR specified in 3GPP TS 32.290 [4] are supported.



Figure 6.1.5.4.3-1: Event Charging Procedure for API management to the CAPIF (PEC as an example)

1. The CAPIF supports management of the service APIs by the API provider with the CAPIF\_Publish\_Service\_API, including publish/unpublish/get/update service API, as defined in clause 10.3 in TS 23.222 [2]. The API publishing function sent the service API management requests to CAPIF core function over CAPIF-4.

2. CAPIF core function performs service API management procedure which includes storing /removing /retrieving/ updating the API information.

3. The CAPIF sends the service API management response to the API publishing function.

3ch-a. CAPIF core function generates charging data related to the service API management and sends the request for the CHF to store related charging data for CDR generation purpose.

3ch-b. CHF stores received information and creates a CDR related to the service APIs.

3ch-c. CHF informs the CAPIF core function on the result of the request.

#### 6.1.5.5 Solution #1.5: Use of Exposure function Northbound Application Program Interfaces (APIs) charging

##### 6.1.5.5.1 General description

This solution #1.5 covers key issues #1.1 and #1.2, and requirements REQ-3GPPCH-APIM-01, REQ-3GPPCH-IVKM-01, and REQ-3GPPCH-IVKO-01. It reuses the current exposure function northbound APIs charging, TS 32.254 [3], with some adaptations and extensions.

##### 6.1.5.5.2 Architecture description

For architecture see TS 32.254 [3] clause 4.4 where CAPIF Core Function (CCF) is an alternative to NEF.

##### 6.1.5.5.3 Procedures description

For flows see TS 32.254 [3] clause 5.4.2 where CCF is an alternative to NEF.

For the API Provider charging the following is required:

- API Provider would be considered the tenant, i.e. the API Provider Id would be stored in the Tenant Identifier

- New triggers for service API publish, unpublish, retrieve, update

- The API Target Network Function would be CCF

For the API Invoker charging the following is required:

- API Invoker would be considered the tenant, i.e. the API Invoker id would be stored in the Tenant Identifier

- New triggers for onboarding and offboarding

- The API Target Network Function would be CCF

#### 6.1.5.6 Solution #1.6: Use of subscription based charging

##### 6.1.5.6.1 General description

This solution covers key issue #1.2, and requirements REQ-3GPPCH-APIM-01 and REQ-3GPPCH-IVKM-01. It uses a subscription model for the charging of operation management as well as for onboarding.

In most cases the onboarding of API Invoker or Provider is part of the onboarding of the enterprise that the API Invoker or Provider belongs to, i.e. the process where the enterprise that wants become an API Invoker or API Provider would get an agreement with the CAPIF provider. This means that the enterprise will get a limited number of API Invokers or API Providers that can be authorized and authenticated as part of its subscription. The control of the number of API Invokers or API Providers can be done outside the current scope of 3GPP SA5.

### 6.1.6 Evaluation

#### 6.1.6.1 Solutions evaluation for Key issue #1.1

Solution #1.1 provides the capability to support Charging of the CAPIF Service APIs, by using the current NEF Charging architecture.

Solution #1.4 provides the CAPIF Core Function (CCF) capability to support CAPIF Service APIs publish, unpublish, retrieve and update charging. In the solution #1.4, the new charging specification is requested focusing on the CAPIF charging or a new clause for CAPIF charging in the TS 32.254 [3].

Solution #1.5 provides the capability to support charging of API Invoker as well as APIs service Operation and Management, by using the current Exposure function northbound Application Program Interfaces (APIs) charging architecture and information. The new triggers and charging information are requested with the extension and adaptation specified in the TS 32.254 [3].

#### 6.1.6.2 Solutions evaluation for Key issue #1.2

Solution #1.3 provides the CAPIF Core Function (CCF) capability to support API invoker onboard/offboard charging via the CAPIF, which is supplement to solution #1.2. In the solution #1.3, the new charging specification is requested focusing on the CAPIF charging or a new clause for CAPIF charging in the TS 32.254 [3].

Solution #1.5 provides the capability to support charging of API invoker management, by using the current NEF charging architecture and information. The new triggers and charging information are requested with the extension and adaptation specified in the TS 32.254 [3].

Solution #1.6 suggest having the support charging of API invoker onboard/offboard outside of 3GPP SA5.

#### 6.1.6.3 Solutions evaluation for Key issue #1.3

Solution #1.2 provides the CAPIF Core Function (CCF) capability to support CAPIF Service APIs discovery request and notification charging via CAPIF. In the solution #1.2, the new charging specification is requested focusing on the CAPIF charging or a new clause for CAPIF charging in the TS 32.254 [3] for the CAPIF Service APIs discovery charging.

### 6.1.7 Conclusion

From solution #1.5 it is concluded that the current Exposure function northbound Application Program Interfaces (APIs) charging architecture and information can be reused with some extension. All solutions add CAPIF Core Function (CCF) as the CTF except #1.6, therefore having the CTF in CAPIF Core Function (CCF) seems to be the preferred solution and adding triggers and charging information according to solutions #1.3, and #1.4.

Following solutions are concluded as being taken for normative work as part of this study:

- Solutions #1.5 and #1.4 for Key Issue #1.1

- Solution #1.3 for Key Issue #1.2,

- Solution #1.3 cover solution #1.2 for Key Issue #1.3.

## 6.2 Topic #2 CAPIF Converged Charging of multiple API Providers

### 6.2.1 General description and assumptions

Informative Annex B.3.2 of 3GPP TS 23.222 [2] describes on how the NEF (and SCEF) can implement the specific service aspect and how its aligned with the CAPIF Architecture. Therefore, it would be necessary to evaluate the possibility to support Converged charging in those deployment models.

### 6.2.2 Use Case

#### 6.2.2.1 Use Case #2.1: API Provider Converged Charging

The service API provider (e.g. the 3rd party application provider) can access Service APIs (i.e. available from the API Provider) through NEF. CAPIF Provider is not only managing the Service APIs that are available to API invokers, but also able to support converged charging of one or more API Providers.

The charging party: CAPIF provider

The charged party: API providers

The potential charging requirements for this UC is: REQ-CH\_CAPIF\_NEF-01.

#### 6.2.2.2 Use Case #2.2: API Invoker Converged Charging

The service API invokers (e.g. the 3rd party application provider) can access Service APIs (i.e. available from the API Provider) through NEF. CAPIF Provider is not only managing the exposed APIs that are available to API invokers, but also able to support converged charging either one or more API Invokers.

The charging party: CAPIF provider.

The charged party: API Invokers.

The potential charging requirements for this UC is: REQ-CH\_CAPIF\_NEF-01.

### 6.2.3 Potential charging requirements

The following are potential high-level charging requirements, derived from the requirements in TS 23.222 [2].

**REQ-CH\_ CAPIF\_NEF-01**: The 5GS should be able to provide NEF Converged Charging support to CAPIF.

### 6.2.4 Key issues

#### 6.2.4.1 Key issue#2.1: Charging events and charging information required

This key issue is for investigating how Converged Charging can support CAPIF deployment models considering REQ-CH\_ CAPIF\_NEF-01. This investigation covers the following:

- identification of the CAPIF deployment models that should be supported taking in consideration NEF specific service aspects.

- identification of charging information required for CAPIF deployment models identified.

### 6.2.5 Possible Solutions

#### 6.2.5.1 Solution #2.1 Multiple API Provider Service Management Charging

A possible solution for key issue #2.1 covers the requirement REQ-CH\_ CAPIF\_NEF-01.

The focus on this solution to provide the capability to charge the following service API in case required from multiple Service Providers:

- service API publish, as specified in the TS 23.222 [2] clause 8.3

- service API unpublish, as specified in the TS 23.222 [2] clause 8.4

- service API retrieve, as specified in the TS 23.222 [2] clause 8.5

- service API update, as specified in the TS 23.222 [2] clause 8.6

The following deployment model already depicted in 3GPP TS 23.222 [2] clause B.3.2.2 provides a view on the possibility on having multiple API providers.



Figure 6.2.5.1-1: Integrated Deployment of the SCEF and the NEF with CAPIF

The solution is similar to the one already detailed in clause 6.1.5.1. Therefore, the following details can be considered to be on top of what is proposed in the solution. In order to charge multiple API Providers, the ‘Tenant Identifier' can be used to identify the correct API Provider. This will be in the Charging Data Request Message and CDR, which is already available according to TS 32.290 [4], clause 6.2a.

#### 6.2.5.2 Solution #2.2: Use of Exposure function Northbound Application Program Interfaces (APIs) charging

##### 6.2.5.2.1 General description

This solution covers key issue #2.1, and requirement REQ-CH\_CAPIF\_NEF-01. It reuses the current exposure function northbound APIs charging, TS 32.254 [3], with some adaptations and extensions.

##### 6.2.5.2.2 Architecture description

For architecture see TS 32.254 [3] clause 4.4 where NEF is replaced by CAPIF Core Function (CCF) and the NEF/SCEF are considered API Providers.

##### 6.2.5.2.3 Procedures description

For flows see TS 32.254 [3] clause 5.4.2 where NEF is replaced by CCF.

For the API Provider charging the following is required:

- API Provider would be considered the tenant, i.e. the API Provider Id would be stored in the Tenant Identifier

- New triggers for service API publish, unpublish, retrieve, update

- The API Target Network Function would be CCF

For the API Invoker charging the following is required:

- API Invoker would be considered the tenant, i.e. the API Invoker id would be stored in the Tenant Identifier

- New triggers for onboarding and offboarding

- The API Target Network Function would be CCF

### 6.2.6 Evaluation

#### 6.2.6.1 Solutions evaluation for Key issue #2.1

Solution #2.1 The solution evaluation is similar to the evaluation for solution #1.1, because the main difference between the two use cases is on the number of API Providers which can be used, and the possibility to have different charging scenarios which can be used for each of the API Providers identified by the tenant identifier.

Solution #2.2 This solution is using the CCF instead of the NEF, which will facilitate the charging by relying on the current CAPIF architecture. It will be required to enhance the current Charging architecture by having CTF in the CCF.

### 6.2.7 Conclusion

Following solutions are concluded as being taken for normative work as part of this study:

Solution 2.1 for Key Issue 2.1 is already covered by Solution #1.1 and reuses the NEF Charging

Solution 2.2 for Key Issue 2.1

## 6.3 Topic #3 API Service usage charging of CAPIF

### 6.3.1 General description and assumptions

Informative Annex B.3.2 of 3GPP TS 23.222 [2] describes on how the NEF (and SCEF) can implement the specific service aspect and how its aligned with the CAPIF Architecture. Additionally, it’s described in clause 8.8 of 3GPP TS 23.222 [2] on the flows for subscription, unsubscription and notifications for the CAPIF events. Therefore, it would be necessary to evaluate the possibility to support Converged charging in those deployment models and on how the API Service Invoker could be supported by Converged Charging.

### 6.3.2 Use Case

#### 6.3.2.1 Use Case #3.1: API Service Usage via CAPIF

The service API invokers (e.g. the 3rd party application provider) and the CAPIF providers (e.g. Operators) has the service agreement about the API invocations.

The API invoker can perform one or multiple service API invocation to CAPIF. The CAPIF Core Function acknowledges the API invocation request and provide the API invocation response to the API invoker. CCF can collect the charging information based on the following chargeable events, according to the service procedure specified in the TS 23.222 [2] Service API invocation, for example:

- the API invocation, e.g. API invoker identifier, timestamp of API invocations

- the result of the API invocation response, e.g. the success or failure of API invocation request.

- Subscription, un-subscription and notifications for the CAPIF events (e.g. API notification for the Monitoring service API invocation) as specified in the TS 23.222 [2] clause 8.8.

- Revoking subscription of the CAPIF events, as specified in the TS 23.222 [2] clause 8.9.

The charging party: the CAPIF providers.

The charged party: the API invoker or API Provider for the chargeable event of API invocations.

The potential charging requirements for this UC are: REQ-3GPPCH-APIInvo-01 and REQ-3GPPCH-APIInvo-02.

### 6.3.3 Potential charging requirements

**REQ-3GPPCH-APIInvo-01:** The CAPIF should support converged charging for service APIs invocations, on a per API invoker basis.

**REQ-3GPPCH-APIInvo-02:** The CAPIF should support the converged charging based on the resource usage (e.g. invocation count, invocation duration, invocation data volume) of the service APIs, on a per API invoker basis.

### 6.3.4 Key issues

#### 6.3.4.1 Key issue#3.1: Charging events and charging information required

This key issue is for investigating how to support the charging considering REQ-3GPPCH-APIInvo-01 and REQ-3GPPCH-APIInvo-02. This investigation covers the following:

- identification of the charging information for API invocation;

- identification of the chargeable event for API invocation.

### 6.3.5 Possible Solutions

#### 6.3.5.1 Solution #3.1: API invocation via CAPIF

##### 6.3.5.1.1 General description

This solution #3.1 covers key issue #3.1, and requirements REQ-3GPPCH-APIInvo-01and REQ-3GPPCH-APIInvo-02. It is relying on CHF/5G Converged Charging System for CAPIF Converged Charging.

##### 6.3.5.1.2 Architecture description

Figure 6.3.5.1.2-1 shows the 5G System high level charging architecture for CAPIF Core Function (CCF) Charging, in the reference point representation for non-roaming:



Figure 6.3.5.1.2-1: 5G CCF converged charging architecture non-roaming

##### 6.3.5.1.3 Procedures description

The figure 6.3.5.1.3-1 describes the high-level charging procedure for CCF Converged charging for API invocation via CAPIF-2/CAPIF-2e and CAPIF-3 or CAPIF-1 or CAPIF-1e, based on the figure 8.20.3.1 Procedure for charging the invocation of service APIs in the TS 23.222 [2]. The event-based charging. i.e. IEC, PEC and ECUR specified in 3GPP TS 32.290 [4] are supported.



Figure 6.3.5.1.3-1: Event Charging Procedure for API invocation to the CAPIF (PEC as example)

1. The CAPIF core function performs the API invocation handling procedure which includes storing the information for access by authorized API management after the API invoker send the invocation of service API request to AEF over CAPIF-2/CAPIF-2e or to CAPIF core function directly over CAPIF-1 or CAPIF-1e.

1ch-a, CAPIF sends the Charging Data Request [Event] to CHF for the service API(s) invocation(s) to be granted authorization, and to allow the number of units, if determined by CAPIF, to be rated and accounted.

1ch-b. The CHF creates a CDR related to the service API(s) invocation.

1ch-c. The CHF grants authorization to CAPIF for the service API(s) invocation to start, with a number of granted units.

#### 6.3.5.2 Solution #3.2: Use of Exposure function Northbound Application Program Interfaces (APIs) charging

##### 6.3.5.2.1 General description

This solution covers key issue #3.1, and requirements REQ-3GPPCH-APIInvo-01and REQ-3GPPCH-APIInvo-02. It reuses the current exposure function northbound APIs charging, TS 32.254 [3], with some adaptations.

##### 6.3.5.2.2 Architecture description

For architecture see TS 32.254 [3] clause 4.4 where NEF is replaced by CAPIF Core Function (CCF) Charging.

##### 6.3.5.2.3 Procedures description

For flows see TS 32.254 [3] clause 5.4.2 where NEF is replaced by CCF.

#### 6.3.5.3 Solution #3.3: CAPIF APIs charging

##### 6.3.5.3.1 General description

This solution #3.3 which relies on CHF/5G Converged Charging System for CAPIF Converged Charging, addresses the Key Issue #3.1.

##### 6.3.5.3.2 Architecture description

Figure 6.3.5.3.1-1 shows the 5G System high level charging architecture for CAPIF Core Function (CCF) Charging, in the reference point representation for non-roaming:



Figure 6.3.5.3.1-1: High level functional architecture for CAPIF (TS 23.222 [2], clause 6.2.0)

##### 6.3.5.3.3 Procedures description

The Figure 6.3.5.3.3-2 describes the high-level charging procedure for CCF Converged charging for API management via CAPIF-4, based on Figures 8.3.3-1, 8.4.3-1, 8.5.3-1 and 8.6.3-1 about the procedure for API Invocation in TS 23.222 [2]. The event-based charging, i.e. IEC, PEC and ECUR specified in 3GPP TS 32.290 [4] are supported.

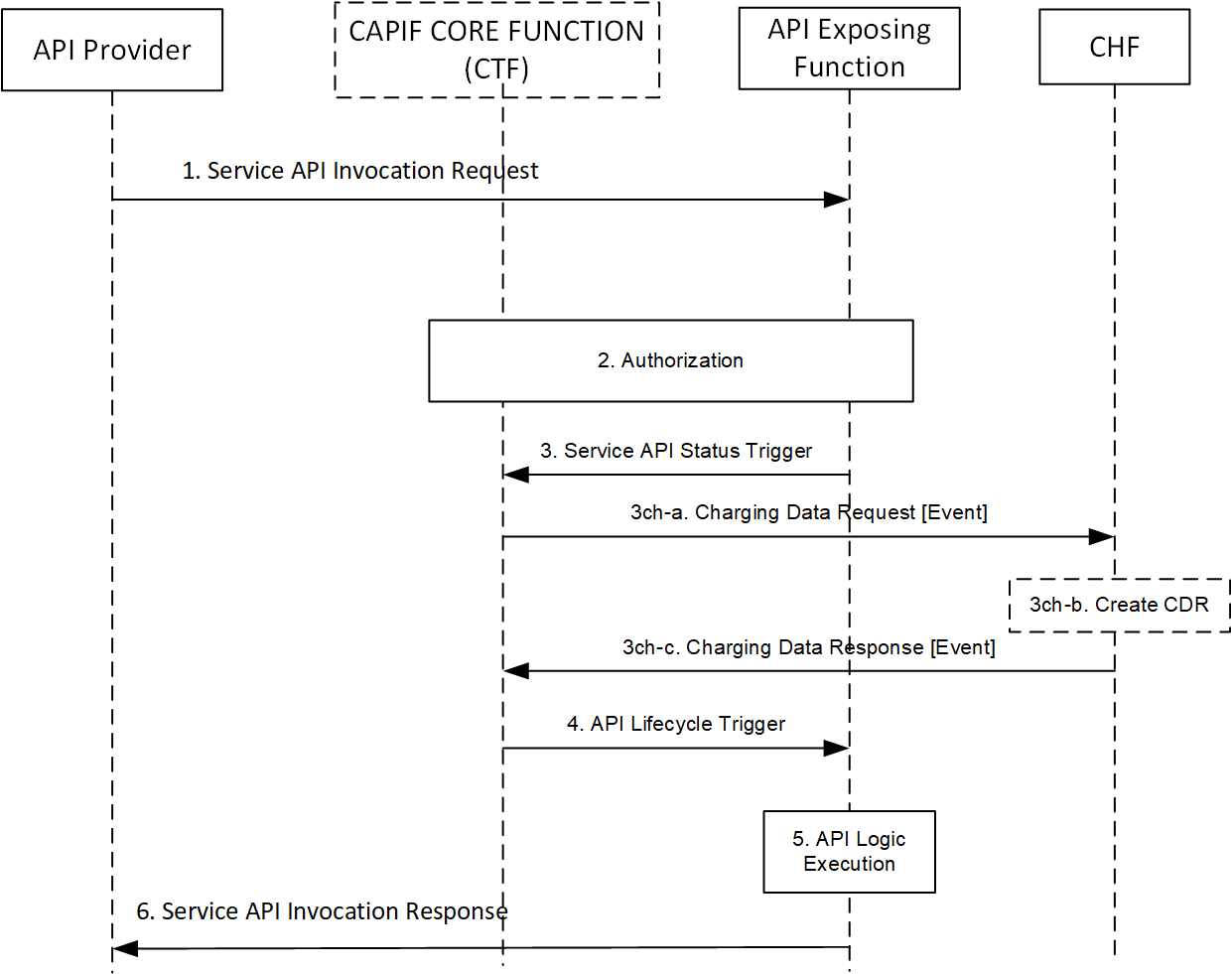


Figure 6.3.5.3.3-2: Event Charging Procedure for API object to the CAPIF (IEC)

1. The API Provider sends a service request that relates to an API object lifecycle change (creating/deleting) or API object access (reading/updating).

2. The AEF checks whether the API invoker is authorized.

3. Corresponding to the nature of the request in step 1, the AEF sends the Service API status trigger to CTF, via the CAPIF-3 interface.

3ch-a. The CTF sends Charging Data Request to CHF for the received API Invocation.

3ch-b. The CHF opens CDR for this API Invocation.

3ch-c. The CHF acknowledges by sending Charging Data Response.

4. The CCF notifies the AEF about the outcome of the charging procedure.

5. The AEF executes the API logic, fulfilling the API request.

6. The AEF returns the API response.

A diagram of a api

AI-generated content may be incorrect.

Figure 6.3.5.3.3-3: Event Charging Procedure for API object to the CAPIF (PEC)

1. The API Provider sends a service request that relates to an API object lifecycle change (creating/deleting) or API object access (reading/updating).

2. The API invoker is authorized.

3. Corresponding to the nature of the request in step 1, the AEF sends the Service API status trigger to CTF, via the CAPIF-3 interface.

4. The AEF returns the API response.

5. Corresponding to the nature of the request in step 1, the AEF sends the matching API object lifecycle trigger or API object access trigger to CaTF, via the CAPIF-3 interface.

5ch-a. The CTF sends Charging Data Request to CHF for the received API Invocation.

5ch-b. The CHF opens CDR for this API Invocation.

5ch-c. The CHF acknowledges by sending Charging Data Response.

6. The CCF notifies the AEF about the outcome of the charging procedure.

A diagram of a service api

AI-generated content may be incorrect.

Figure 6.3.5.3.3-4: Event Charging Procedure for API object to the CAPIF (ECUR)

1. The API invoker sends a service request that relates to an API object lifecycle change (creating/deleting) or API object access (reading/updating).

2. The AEF checks whether the API invoker is authorized to perform this operation.

3. Corresponding to the nature of the request in step 1, the AEF sends an Service API status trigger to CTF, via the CAPIF-3 interface, indicating initialization of the unit reservation.

3ch-a. The CTF sends Charging Data Request to CHF for the received API Invocation.

3ch-b. The CHF opens CDR for this API Invocation.

3ch-c. The CHF acknowledges by sending Charging Data Response whether the request is within the spending limit.

4. The CCF notifies the AEF about the outcome of the charging procedure, including an indication whether or not the processing can go ahead.

5. The AEF executes the API logic, fulfilling the API request, in case it has received permission in step 3ch-c.

6. Corresponding to the nature of the request in step 1, the AEF sends a Service API status trigger to CTF, via the CAPIF-3 interface, indicating termination of the unit reservation.

6ch-a. The CTF sends Charging Data Request to CHF for the received API Invocation.

6ch-b. The CHF opens CDR for this API Invocation.

6ch-c. The CHF acknowledges by sending Charging Data Response, closes the reservation and responds to the CCF.

7. The CCF notifies the AEF about the outcome of the charging procedure.

8. The AEF returns the API response.

### 6.3.6 Evaluation

#### 6.3.6.1 Solutions evaluation for Key issue #3.1

Solution #3.1 provides the CAPIF Core Function (CCF) capability to support CAPIF Service APIs invocation/notification charging. A new charging specification is required focusing on the CAPIF charging or a new clause for CAPIF charging in the TS 32.254 [3] for the CAPIF service API invocation/notification charging.

Solution #3.2 provides the capability to support charging of API invocation, by using the current Northbound Application Program Interfaces (APIs)charging architecture and information. The clarification about the relationship between CAPIF charging and NEF charging in the TS 32.254 [3] is required.

Solution #3.3 provides the capability to support charging of API Invocation Management Lifecycle (creation/deletion/access/reading) for the API Provider. A new charging specification is required focusing on the CAPIF charging or a new clause for CAPIF charging in the TS 32.254 [3].

### 6.3.7 Conclusion

From solution #3.2 it is concluded that the current Northbound Application Program Interfaces (APIs) charging architecture and information can be reused with some extension. All solutions add CAPIF Core Function (CCF) as the CTF, therefore having the CTF in CAPIF Core Function (CCF) seems to be the preferred solution and adding triggers and charging information according to solutions #3.1. It is concluded the solution #3.1 and solution #3.2 are selected to be normative work, by extending in the TS 32.254 [3].

## 6.4 Topic #4 CAPIF Converged Charging of NEF API

### 6.4.1 General description and assumptions

Either Informative Annex B.2.2.3, or Annex B.1.2.3 of 3GPP TS 23.222 [2] describes on how the NEF (and SCEF) can implement the functionalities of an API Provider Domain and how its aligned with the CAPIF Architecture.

### 6.4.2 Use Case

#### 6.4.2.1 Use Case #4.1: API Provider Converged Charging

The API provider (e.g. the 3rd party application provider) should access NEF APIs (i.e. available from the API Provider). CAPIF Provider is not only managing the Service APIs that are available to API invokers (e.g. AF), but also able to manage the NEF APIs.

There are two charged parties considered on this use case, one is API Provider and the other can be the API Invoker, which could be an AF.

The main difference considered is on how the NEF Charging can support this use case, by interfacing with the CCF.

The charging party: CAPIF provider.

The charged party: API providers, API Invokers.

The potential charging requirements for this UC is: REQ-CH\_CAPIF\_API-01.

### 6.4.3 Potential charging requirements

The following are potential high-level charging requirements, derived from the requirements in TS 23.222 [2].

**REQ-CH\_ CAPIF\_API-01**: The 5GS should be able to provide Converged Charging support to the API Provider, based on CAPIF Architecture.

### 6.4.4 Key issues

#### 6.4.4.1 Key issues#4.1: Charging events and charging information required

This key issue is for investigating how Converged Charging can support CAPIF deployment models considering REQ-CH\_ CAPIF\_API-01. This investigation covers the following:

- identification of the CAPIF deployment models that should be supported.

- identification of charging information required for CAPIF deployment models identified.

### 6.4.5 Possible Solutions

#### 6.4.5.1 Solution #4.1 CAPIF Converged Charging of NEF API

A possible solution for key issue #4.1 covers the requirement REQ-CH\_ CAPIF\_API-01.

The focus on this solution to provide the capability to the possibility of charging the NEF APIs.

The following deployment model already depicted in 3GPP TS 23.222 [2] clause B.2.2.2 provides a view on how the NEF can implement the CAPIF Architecture, so the CCF can trigger the charging support for the NEF lifecycle.



Figure 6.4.5.1-1: NEF implements CAPIF Architecture

On this solution, the focus would be to use NEF and its default triggers, as described in table 5.4.1.2.1.1 of TS 32.254 [3], so it can handle the respective charging event. The following solution provides an example on how a NEF API can be charged through CCF.



Figure 6.4.5.1-2: NEF Charging Scenario Example (ECUR)

1. CCF (CAPIF\_Event API)/NEF receives an API Event, from API Invoker.

1ch-a. The CCF/NEF sends Charging Data Request [Initial] to CHF for the received API Invocation.

1ch-b. The CHF creates a CDR for this API Invocation.

1ch-c. The CHF acknowledges and grants authorization by sending Charging Data Response [Event] to CCF/NEF.

2. If authorized CCF/NEF performs the actions needed to fulfil the API invoked.

3. The CCF/NEF continues the API invocation processing and sends the API Invocation Response to NEF (API Management Function).

3ch-a. The CCF sends Charging Data Request [Termination] to the CHF for terminating the charging associated with the API Invocation.

3ch-b. The CHF closes the CDR for this API Invocation.

3ch-c. The CHF acknowledges by sending Charging Data Response [Termination] to the CCF/NEF.

#### 6.4.5.2 Solution #4.Y CAPIF Converged Charging when NEF implement the API provider domain

##### 6.4.5.2.1 General description

A possible solution for key issue #4.1 covers the requirement REQ-CH\_ CAPIF\_API-01.

The focus on this solution to provide the capability to the possibility of charging when NEF implementing the API provider domain.

##### 6.4.5.2.2 Architecture description

The deployment model in Figure 6.4.5.2.2-1 depicted in 3GPP TS 23.222 [2] clause B.2.2.3 provides a view on how NEF implements the service specific aspect compliant with the CAPIF architecture.



Figure 6.4.5.2.2-1: NEF implements the service specific aspect compliant with the CAPIF architecture

The deployment model in Figure 6.4.5.2.2-1 already depicted in 3GPP TS 23.222 [2] clause B.2.2.4 provides a view on how distributed deployment of NEF implementing the service specific aspect compliant with the CAPIF architecture.



Figure 6.4.5.2.2-1: NEF implements the service specific aspect compliant with the CAPIF architecture

CCF can trigger the charging support for the NEF implementing API Provider. Figure 6.4.5.2.2-2 shows the 5G System high level charging architecture for CAPIF Core Function (CCF) Charging, in the reference point representation



Figure 6.4.5.2.2-2: 5G CCF converged charging architecture non-roaming

##### 6.4.5.2.3 Procedures description

The following message flow provides an example on how a NEF API invocation can be charged through CCF.



Figure 6.4.5.2.3-1: Event Charging Procedure for API invocation to the CAPIF (PEC as example)

1. The CAPIF core function performs the API invocation handling procedure request at CAPIF-1/CAPIF-1e or at the CAPIF-3. In that case of CAPIF-3, Nnef can implement the service specific aspects of CAPIF-2 and CAPIF-2 or CAPIF-2e can provide the service APIs exposed by the NEF-2 (AEF as a gateway) to the AF (API invoker).

The NEF-2 (AEF) can implement the CAPIF-3 reference point to the CAPIF core function for the API invocations charging.

1ch-a, CAPIF sends the Charging Data Request [Event] to CHF for the service API(s) invocation(s) to be granted authorization, and to allow the number of units, if determined by CAPIF, to be rated and accounted.

1ch-b. The CHF creates a CDR related to the service API(s) invocation.

1ch-c. The CHF grants authorization to CAPIF for the service API(s) invocation to start, with a number of granted units.

### 6.4.6 Evaluation

#### 6.4.6.1 Solutions evaluation for Key issue #4.1

Solution #4.1 enables the option of charging a NEF API through CCF. It uses the current Northbound Application Program Interfaces (APIs) Charging, though it needs to be enhanced to trigger a charging event (i.e. CTF) for each one of the Charging scenarios (PEC; IEC; ECUR)

Solution #4.Y enables the option of charging a NEF API through CCF. It uses the CCF embedded CTF for charging when NEF implementing with the API provider domain. The CCF can reuse the NEF charging mechanism with the chargeable event (i.e. Triggers) for each one of the Charging scenarios (PEC; IEC; ECUR). A new charging specification is requested focusing on the CAPIF charging or a new clause for CAPIF charging in the TS 32.254 [3].

### 6.4.7 Conclusion

It is concluded that the solution 4.1 and 4.Y is applicable for Key issue #4.1 by extending the TS 32.254 [3], which are applicable for different deployment options of CAPIF.

# 7 Evaluation

There are three possible ways to add this in the specifications:

- a new TS

- a new annex in the TS 32.254 [3]

- new architecture and information in the current TS 32.254 [3]

Adding a new TS could cause interoperability issues since in the case the NEF implements the CAPIF Core Function according to solution #4.1 it will be difficult to know which TS to use. The combination of new architecture and information together with informative annex on CAPIF architecture in TS 32.254 [3] provide the information needed without interoperability concerns.

# 8 Conclusion

The following solutions, for each one of the topics, are recommended to be included into normative work:

- CAPIF Converged Charging support of Service APIs Operation and Management: solutions as per clause 6.1.7 conclusion.

- CAPIF Converged Charging of multiple API Providers: solutions as per clause 6.2.7 conclusion.

- API Service usage charging of CAPIF: solutions as per clause 6.3.7 conclusion.

- CAPIF Converged Charging of NEF API: solutions as per clause 6.4.7 conclusion.

Annex A:  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2024-8 | SA5#156 | S5-243527  S5-243716  S5-244511  S5-244512  S5-243719  S5-244513  S5-244515  S5-244514  S5-244516  S5-244517  S5-244518 |  |  |  | Initial skeleton  Document Structure Update  Skeleton Update  Update of the Scope  Abbreviations Update  Introduce the background of CAPIF charging  CAPIF Charging Scenarios and KI  Addition of use cases for the API operation and management  Introduce the topic on API invoker management  Introduce the topic on API invocation charging  Introduce the solution for API invocation charging | 0.1.0 |
| 2024-10 | SA5#157 | S5-245885  S5-245886  S5-245887  S5-245888  S5-245889  S5-245890  S5-245891  S5-245892  S5-245893  S5-245658  S5-245894  S5-245895  S5-245898  S5-245760 |  |  |  | API Service Management Solution  API Service Management Evaluation  Multiple API Providers Solution  Multiple API Providers Evaluation  Update charging solution for API invocation  New charging scenario for service API discovery  New charging solution for service API discovery  New charging solution for API invoker management  New charging solution for service API management  Update of relationships for RNAA  Solution for topic 1 reusing NEF charging  Solution for topic 1 using subscription  Solution for topic 3 reusing NEF charging  Editorial Changes | 0.2.0 |
| 2024-11 | SA5#158 | S5-246839  S5-246957  S5-246958  S5-246959  S5-246960  S5-246961  S5-246962  S5-246963  S5-246964 |  |  |  | Correction of key issue for topic 3  Topic#4 CAPIF Charging Scenarios and KI  CAPIF Converged Charging of NEF API Solution  CAPIF Converged Charging of NEF API Evaluation  Missing requirement for topic 1  Evaluation and conclusion for CAPIF charging topic 1  Update of solution 1.  New solution for topic 2  Evaluation and conclusion for CAPIF charging topic 3 | 0.3.0 |
| 2024-12 |  |  |  |  |  | editHelp's review | 0.3.1 |
| 2024-12 | SA#106 | SP-241601 |  |  |  | Presentation to SA for Information | 1.0.0 |
| 2025-02 | SA5#159 | S5-250726  S5-250727  S5-250728  S5-250729  S5-250730  S5-250731  S5-250732  S5-250733  S5-250734  S5-250735  S5-250736 |  |  |  | Update of solution 1.6  Evaluation and conclusion for topic 1  Evaluation for Topic #2  Conclusion for Topic #2  Use Case for Topic #3  Solution for Topic #3  Update evaluation and conclusion for Topic 3  New solution for NEF implementing API Provider in Topic 4  Update evaluation and conclusion for Topic 4  Conclusion  EditHelp Editorial Changes | 1.1.0 |
| 2025-02 | SA5#159 |  |  |  |  | EditHelp cleanup | 1.1.1 |
| 2025-03 | SA#107 | SP-250145 |  |  |  | Presentation to SA for approval | 2.0.0 |
| 2025-03 | SA#107 |  |  |  |  | Upgrade to change control version | 19.0.0 |
| 2025-06 | SA#108 | SP-250532 | 0001 | 1 | D | Rel-19 CR 28.849 EditHelp Editorial Changes | 19.1.0 |