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| 3rd Generation Partnership Project;Technical Specification Group Services and System Aspects;Study on CHF Segmentation;(Release 18) |
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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

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x the first digit:

1 presented to TSG for information;

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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 studies the CHF discovery and selection in order to support the discovery of a CHF by the NF consumers like SMF, AMF, SMSF and PCF based on information about network segments that the CHF belongs to.

The following are studied:

- possible charging scenarios and requirements which makes use of CHF Segmentation.

- potential charging solutions which make use of CHF Segmentation.

# 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 29.510: "Network Function Repository Services".

[3] 3GPP TS 32.290: " Services, operations and procedures of charging using Service Based Interface (SBI) ".

[4] 3GPP TS 32.255: "5G data connectivity domain charging; Stage 2".

[5] 3GPP TS 23.501: "System architecture for the 5G System (5GS);Stage 2".

[6] 3GPP TS 29.503: "Unified Data Management Services; Stage 3".

[7] 3GPP TS 29.505: "Usage of the Unified Data Repository services for Subscription Data; Stage 3".

[8] 3GPP TS 29.525: "Network Data Analytics Services; Stage 3".

[9] 3GPP TS 32.240: "Charging architecture and principles".

[10] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[11] 3GPP TS 32.291: "Telecommunication management; Charging management; 5G system, charging service; Stage 3".

[12] 3GPP TS 28.202: "Telecommunication management; Charging management; Network slice management charging in the 5G System (5GS); Stage 2".

[13] 3GPP TS 32.254: "Telecommunication management; Charging management; Exposure function Northbound Application Program Interfaces (APIs) charging.

[14] 3GPP TS 32.256: "Charging management; 5G connection and mobility domain charging; Stage 2".

[15] 3GPP TS 32.270: "Telecommunication management; Charging management; Multimedia Messaging Service (MMS) charging".

[16] 3GPP TS 32.274: "Telecommunication management; Charging management; Short Message Service (SMS) charging".

[17] 3GPP TS 32.260: "Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging".

[18] 3GPP TS 32.277: "Telecommunication management; Charging management; Proximity-based Services (ProSe) charging".

[19] 3GPP TS 32.273: "Telecommunication management; Charging management; Multimedia Broadcast and Multicast Service (MBMS) charging".

[20] 3GPP TS 28.201: "Charging management; Network slice performance and analytics charging in the 5G System (5GS); Stage 2".

[21] 3GPP TS 28.203: "Charging management; Network slice admission control charging in the 5G System (5GS)".

[22] 3GPP TS 28.204: "Charging management; Network slice-specific authentication and authorization charging in the 5G System (5GS)".

[23] 3GPP TS 32.257: "Telecommunication management; Charging management; Edge computing domain charging".

[24] 3GPP TS 32.282: "Charging management; Time-Sensitive Networking (TSN) charging".

[25| 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

 [26] 3GPP TS 32.275: “Charging management; MultiMedia Telephony (MMTel) charging”.

# 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].

5GS 5G System

AMF Access and Mobility management Function

API Application Program Interface

CCS Converged Charging System

CHF Charging Function

GPSI Generic Public Subscription Identifier

HPLMN Home PLMN

MMTel MultiMedia Telephony

IMS IP Multimedia System

IP Internet Protocol

NF Network Function

NRF Network Repository Function

PCF Policy Control Function

PDU Protocol Data Unit

PLMN Public Land Mobile Network

NRF Network Repository Function

SCP Service Communication Proxy

SMF Session Management Function

SMSF Short Message Service Function

SUPI Subscription Permanent Identifier

TAI Tracking Area Identity

UDM Unified Data Management

UDR Unified Data Repository

UE User Equipment

VPLMN Visited PLMN

VSMF Visited SMF

# 4 Overview

The current NRF Based Discovery can use the SUPI, GPSI PLMN and CHF Group ID for CHF Discovery and Selection according to TS 29.510 [2], clause 6.1.6.2.32, and TS 32.290 [3], clause 6.1. The CHF(s) can be selected taking in account the business model in use by a Customer, for instance its possible to group the CHF instance(s) for enterprises customers and another one for non-enterprise customers, and taking in account the deployment model in place (e.g. central or local/edge).

The present document aims to study on how to enhance HF Discovery and selection by the NF Consumers like SMF, AMF, SMSF, PCF and other NFs, as specified in various 3GPP Charging Specifications.

# 5 CHF Selection Scenarios and Key Issues

## 5.1 Topic #1: CHF Selection by NF Consumers Information

### 5.1.1 General description and assumptions

The CHF Selection, in a non-roaming scenario can be done by the SMF at the PDU Session establishment through the following priority (according to 3GPP TS 32.255 [4] clause 5.1.8):

- CHF address(es) with possible associated CHF instance ID(s) and/or CHF set ID(s) provided by the PCF for the PDU session.

- UDM provided charging characteristics.

- NRF based discovery.

- SMF locally provisioned charging characteristics.

On a roaming scenario the CHF Selection is supported taking in consideration the above point. The following exceptions apply (according to 3GPP TS 32.255 [4] clause 5.1.9.2) – Edge emphasize:

In local breakout scenario, at PDU session establishment, the CHF selection mechanism specified in clause 5.1.8 applies to:

The V-SMF for CHF selection in VPLMN, is the same as in the home routed scenario.

The V-SMF for CHF selection in HPLMN, with the following differences:

- CHF address(es) selection mechanisms based on PCF, UDM, and local configuration are not applicable.

- NRF based discovery, the H-CHF can be selected based on the H-PLMN of the UE.

Therefore, the CHF Instance should be also selected upon the NF Consumer derived information.

### 5.1.2 Potential charging requirements

The following are potential high-level charging requirements, derived from the requirements in TS 32.255 [4].

**REQ-CH\_ SELCHF\_LO -01**: The 5GS should be able to provide a CHF Instance based on the NF Consumer Location.

### 5.1.3 Key issues#1.1: Charging events and charging information required

This key issue is for investigating how to support the selection of a CHF Instance based on the Location considering REQ-CH\_ SELCHF\_LO -01. This investigation covers the following:

- identification of the CHF Instance based on NF Consumer derived information.

### 5.1.4 Possible Solutions

#### 5.1.4.1 Solution #1.1 CHF Selection and Discovery for NF Service Consumers Solution based on UDM

A possible solution for key issue #1.1 covers the requirement REQ-CH\_ SELCHF\_LO -01.

SUPI is the parameter for CHF discovery through NRF is not efficient in such network deployments and a Group ID based CHF discovery is needed. Although in 3GPP Rel-17 the CHF can register with the NRF using CHF-Group-ID (along other parameters such as CHF-Hostname, IP Address etc.) and an NF consumer can use CHF-Group-ID during CHF discovery process through the NRF:

- The NF consumers like the SMF, the AMF, the SMSF and the PCF does not have CHF-Group-ID information associated with UE.

- Group ID Mapping stored in UDR is not accessible to all NF consumers (e.g. AMF, SMF etc.). This also requires the UDR to store/maintain the mapping of all the subscribers in the network to the CHF-Group-ID

Therefore, it is proposed to have ChfSubsriptionData maintained at UDM which enables the current services of UDM and UDR to fetch the ChfSubscriptionData which would consist of the CHF Group ID.

This is new in 3GPP TS 29.503 [6] and 3GPP TS 29.505 [7].

This ChfSubscriptionData can be for a group or per individual UE, in the same way other SubscriptionData are maintained in the UDM / UDR.

Table 5.1.4.1-1: Definition of type ChfSubscriptionData

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| ChfGroupID | NfGroupId | C | 0..1 | CHF instances that belong to the CHF Group Id that would serve the specific UE or a group of UEs defined by the group |

Next, Nudr interface has to be extended, in 3GPP TS 29.505 [7] with CHF, and CHF has to be able to fetch the ChfSubscriptoinData for each of the UE's.



Figure 5.1.4.1-1: Message Flow for CHF Selection based on UDM

1. Any NF Service Consumer that would like to access the Nchf service has to discover the CHF. SUPI is one of the parameter that is include as part of the query parameters amongst others.

2. As part of the discovery response, NRF has to provide the list of CHFs that match the discovery criteria, and it shall also include the CHF Group ID for each of the CHF.

3. The NF Service Consumer has to invoke the Nchf Service API towards the selected CHF instance Id.

3a. The NF Service Producer (CHF) has to query UDM / UDR requesting the ChfSubsrciptionData for the corresponding SUPI.

3b. UDM / UDR has to provide the CHF Group ID along as part of the ChfSubscriptionData.

3c. CHF has to verify if it is the defined instance, as part of CCS, to handle the request for that particular SUPI.

3d. If the CHF identifies that it is the defined instance, as part of CCS, than it shall process the request and respond to the NF Service Consumer.

3e. If the CHF identifies that the CHF Group ID of self and the SUPI are different, it has to respond to the NF Service Consumer with an error code 307 including the CHF Group ID of the SUPI as part of the header.

4. NF Service Consumer based on the discovery result in step 2 and also the CHF Group ID received in step 3b, has to carry out the reselection of CHF.

5. NF Service Consumer has to invoke the Nchf Service API towards the CHF selected as part of the reselection logic. NF Service Consumer has then to use the selected CHF for the forthcoming requests.

Table 5.1.4.1-2: Extend to Charging Data Request Message
(3GPP TS 32.255 [4] – Table 6.1.1.2.1)

| Information Element | Category for converged charging | Category for offline only charging | **Description** |
| --- | --- | --- | --- |
| CHF Group | OC | - | CHF instances that belong to the CHF Group Id that would serve the specific UE or a group of UEs defined by the group  |

Editor's Note: Trigger and CHF Group Priority Information Elements availability is for FFS

Table 5.1.4.1-3: Extend to Charging Data Response Message
(3GPP TS 32.255 [4] – Table 6.1.1.2.2)

| Information Element | Category for converged charging | Category for offline only charging | **Description** |
| --- | --- | --- | --- |
| Multiple Unit Information | OC | OC | Described in TS 32.290 [57]This field is not applicable to QBC. |
| Result Code | OC | OC | Described in 1 32.290 [57] |
| Rating Group | M | M | Described in TS 32.290 [57] |
| UPF ID | OC | OC | This field holds the UPF identifier used for quota granted per UPF by CHF  |
| Granted Unit | OC | - | Described in TS 32.290 [57] |
| Validity Time | OC | - | Described in TS 32.290 [57] |
| Final Unit Indication | OC | - | Described in TS 32.290 [57] |
| Time Quota Threshold  | OC | - | Described in TS 32.290 [57] |
| Volume Quota Threshold  | OC | - | Described in TS 32.290 [57] |
| Unit Quota Threshold  | OC | - | Described in TS 32.290 [57] |
| Quota Holding Time | OC | - | Described in TS 32.290 [57] |
| Triggers | OC | OC | This field is described in TS 32.290 [57] and holds the 5G data connectivity specific triggers described in clause 5.2.1. |
| CHF Subscription Data | OC | - | CHF Instance to be used for a UE / Subscriber |

This solution would bring the following advantages for CHF Selection:

- Enable the possibility to for CHF Selection and Discovery by NF Consumers like SMF, AMF, SMSF and PCF.

- The solution proposes a more accurate CHF selection taking in account the details provided.

#### 5.1.4.2 Solution #1.2 CHF Selection by using CHF Default Instance Solution

A possible solution for key issue #1.1 covers the requirement REQ-CH\_ SELCHF\_LO -01.

The solution proposed is following what is described in detail in NF Service Consumers Selection and Discovery Solution based on UDM (clause 5.1.4.1). The following points differentiate the solution from the one described there. The goal is to avoid using NRF Lookup for Selection and initiate the CHF Selection and Discovery from the NF Service Consumer to the CHF.

Therefore, it is proposed to have ChfSubsriptionData maintained at UDM which enables the current services of UDM and UDR to fetch the ChfSubscriptionData which would consists of the CHF Group ID. It is proposed that a CHF Instance is used by default once Nchf service is called, avoiding CHF discovery and selection operations with NRF.

This is new in 3GPP TS 29.503 [6] (Unified Data Management Services; Stage 3) and 3GPP TS 29.505 [7] (Usage of the Unified Data Repository services for Subscription Data; Stage 3).

This ChfSubscriptionData can be for a group or per individual UE, in the same way other SubscriptionData are maintained in the UDM / UDR.

Table 5.1.4.2-1: Definition of type ChfSubscriptionData

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| ChfGroupID | NfGroupId | C | 0..1 | CHF instances that belong to the CHF Group Id that would serve the specific UE or a group of UEs defined by the group |

Next, Nudr interface has to be extended (3GPP TS 29.505 [7]) to the CHF, and CHF has to be able to fetch the ChfSubscriptoinData for each one of the UE's. Additionally, Nchf interface has to be extended, in 3GPP TS 32.290 [3], to accommodate a default CHF instance that is used in the first step once called by a NF Consumer (e.g. SMF).



Figure 5.1.4.2-1: Message Flow for CHF Selection based on CHF Default Instance

1. The NF Service Consumer has to invoke the Nchf Service API towards the selected CHF instance Id.

1a. The NF Service Producer (CHF) has to query UDM / UDR requesting the ChfSubsrciptionData for the corresponding SUPI.

1b. UDM / UDR has to provide the CHF Group ID along as part of the ChfSubscriptionData.

1c. CHF has to verify if it is the defined instance, as part of CCS, to handle the request for that particular SUPI.

1d. If the CHF identifies that it is the defined instance, as part of CCS, to handle the request, than it has to process the request as is currently and respond to the NF Service Consumer.

1e. If the CHF identifies that the CHF Group ID of self and the SUPI are different, it has to respond to the NF Service Consumer with an error code 307 including the CHF Group ID of the SUPI as part of the header.

2. NF Service Consumer based on the discovery result in step 2 and also the CHF Group ID received in step 3b, it has to carry out the reselection of CHF.

3. NF Service Consumer has to accordingly invoke the Nchf Service API towards the CHF selected as part of the reselection logic. NF Service Consumer has then to use the selected CHF for the forthcoming requests.

Table 5.1.4.2-2: Extend to Charging Data Request Message (3GPP TS 32.255 [4] – Table 6.1.1.2.1)

| Information Element | Category for converged charging | Category for offline only charging | Description |
| --- | --- | --- | --- |
| CHF Group | OC | - | CHF instances that belong to the CHF Group Id that would serve the specific UE or a group of UEs defined by the group  |

Editor's Note: Trigger and CHF Group Priority Information Elements availability is for FFS

This solution would bring the following advantages for CHF Selection:

- Enable the possibility for CHF Selection and Discovery by NF Consumers like SMF, AMF, SMSF and PCF

- CHF Selection Time is reduced by enabling the selection to be done directly between the NF Service Consumer and the CHF.

#### 5.1.4.3 Solution #1.3 CHF selection based on location

The solution addresses key issue #1.1 of topic #1 on CHF selection by NF Consumers Information.

NF(CTF) may discover and select the CHF instance(s) that is deployed geographically close to the UE(s), e.g. in edge computing scenario. To support the CHF discovery and selection based on location, CHF can provide the location information during NRF registration, i.e. the scope of geographical areas that can be served by the CHF instance.

The registration for the scope of geographical areas may re-use the existing common attribute in NF profile, e.g. "servingScope" specified in clause 6.1.6.2.2 TS 29.510 [2].

The attribute "servingScope" refers to the served area(s) of the NF instance. As specified in TS 29.510 [2], the servingScope may indicate geographical areas, it may be used e.g. to discover and select NFs in centralized Data Centers that are expected to serve users located in specific region(s) or province(s).

During the NFDiscovery procedure, the NF consumer may re-use the "serving-scope" query parameter to indicate the list of areas that can be served by the NF instances to be discovered, specified in clause 6.2.3.2.3 TS 29.510 [2]. The NRF has to return CHF instance(s) which can serve the areas requested in this query parameter.

#### 5.1.4.4 Solution #1.4: CHF selection based on NF instance

The solution addresses key issue #1.1 of topic #1 on CHF selection by NF Consumers Information.

NF(CTF) may discover and select the CHF instance(s) based on the serving NF instances. To support the CHF discovery and selection based on NF instance, CHF can provide the information of NFinstances during NRF registration, i.e. the list of NF instance(s) that can be served by the CHF instance.

The CHF attributes registered with NRF per Chfinfo specified in TS 29.510 [2] Table 6.1.6.2.32-1 should be enhanced by including the identifiers of NF instance(s), for instance, a list of "nfInstanceId".

The attribute "nfInstanceId" uniquely identifies an NF instance as specified in TS 29.571 [10].

An example of the extension to Chfinfo is shown in table 5.1.4.4-1. To support multiple occurrence of NF instances that can be supported by one CHF instance, the registered attribute in chfinfo can be "nfInstanceIdList".

Table 5.1.4.4-1: Extended attribute to the Chfinfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfInstanceIdList | Array(NfInstanceId) | O | 1..N | The list of NF instances that can be served by the CHF instance. |

By having the new attribute added to NRF, the NF consumer may then use Nnrf\_NFManagement and Nnrf\_NFDiscovery Service API, specified in clauses 5.2.2.2 and 5.3.2.2 TS 29.510 [2], to assist the selection of CHF instance based on NF instance.

In specific, during NFRegister, CHF may register with NRF the "nfInstanceIdList". The list of NF instance(s) may be obtained based on operator's configuration, e.g. a list of SMF instances that is locally configured to be served by a CHF instance.

During NFDiscover, the NF consumer may query the candidate CHF instances by including the "requester-nf-instance-id" query parameter, which is currently available in Table 6.2.3.2.3.1-1 of TS 29.510 [2]. The NRF may return the CHF instance(s) that could serve the specific NF instance.

#### 5.1.4.5 Solution #1.5: Using NRF locality information

A possible solution for key issue #1.1 covering requirements REQ-CH\_SELCHF\_LO-01, CHF instance based on NF Service Consumer (CTF) location.

The CHF can today register in the NRF using the NFRegister service operation in the Nnrf\_NFManagement Service. The NFRegister service operation will include the NFProfile. In the NFProfile there are CHF specific attributes defined in the ChfInfo, 3GPP TS 29.510 [2], clause 6.1.6.2.32, currently it contains: supiRangeList, gpsiRangeList, plmnRangeList, groupId, primaryChfInstance, and secondaryChfInstance. The NFProfile also contain attributes common for all NFs that register. For locating an NF there are several attributes, but there are two that allows operator defined information of the NF instance location of these are locality and extLocality. The extLocality can be used to describe location of different granularity, 3GPP TS 29.510 [2], clause 6.1.6.2.2.

An NF Service Consumer can today use the Nnrf\_NFDiscovery to find the CHF, this can be based on several query parameters. Two of these matches the locality and extLocality in the NFProfile these are preferred-locality and the ext-preferred-locality, where the last can set a priority on the locations listed.

For an NF using the subscription to subscribe to events there are also two attributes in the SubscriptionData that can be used LocalityDescriptionItem 3GPP TS 29.510 [2], clause 6.1.6.2.111 and LocalityDescription 3GPP TS 29.510 [2], clause 6.1.6.2.112.

The above allows an NF Service Consumer to find an NF instance close to it or at a specific location.

#### 5.1.4.6 Solution 1.6: NRF inferred CHF Group Id

A possible solution for key issue #1.1 covers the requirement REQ-CH\_ SELCHF\_LO-01.

According to TS 23.501 [5] clause 3.1 the CHF group id refers to one or more CHF instances managing a specific set of SUPIs. TS 23.501 [5] clause 6.3.11 states that optionally the NF Consumer can infer the CHF Group ID the UE's SUPI belongs to, based on the results of CHF discovery procedures with NRF. This means that the NF Consumer can use the CHF Group Id, using the NRF received information or a discovery procedures with NRF, to further select CHF instances that can handle the request.

#### 5.1.4.7 Solution 1.7: SCP retrieved CHF Group Id

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

According to TS 23.501 [5] clause 3.1 the CHF group id refers to one or more CHF instances managing a specific set of SUPIs. The SCP can optionally, TS 23.501 [5] clause 6.2.19, interact with UDR, to resolve the CHF Group ID based on UE identity e.g., SUPI or IMPI/IMPU. This means that by using an SCP the CHF Group Id can be used for further selecting CHF instances that can handle the request.

### 5.1.5 Evaluation

#### 5.1.5.1 Solutions evaluation for Key issue #1.1

Solution #1.1 provides the capability for identifying the CHF instance by any of the NF Consumers. There are new parameters required and a new interface between CHF and UDM/UDR is required.

Solution #1.2 is similar to solution #1.1. The main improvement is using a default CHF Instance once Nchf service is invoked.

Solution #1.3 and #1.5 allows the selection of the CHF Instance based of the NF Service Consumer Location (e.g. geographical area). Both solutions re-use existing attributes and mechanisms in the NRF.

Solution #1.4 allows the selection of CHF instance based on the serving NF instance list. It requires to add new attribute in NRF.

Solution #1.6 provides the capability for inferring the CHF Group Id, a SUPI can be served by for an NF Consumer. This information can then be used to find all CHF that can serve a specific CHF Group Id. The solution recuses current capabilities of the NRF, which means that there are no new parameters interface required. How the NRF determines the CHG Group Id is outside the scope of 3GPP SA5.

### 5.1.6 Conclusion

It is concluded that solutions #1.3 and #1.5 and are feasible solutions and can be considered for normative work.

## 5.2 Topic #2: CHF Selection based on SUPI or Group ID

### 5.2.1 General description and assumptions

In TS 23.501 [5], clause 6.3.11 it states that discovered using NRF as described in in clause 6.1 of TS 32.290 [3]. It further states that the CHF selection functionality in NF consumer or in SCP should consider one of the following factors:

- -CHF Group ID of the UE's SUPI.

 SUPI; the NF consumer selects a CHF instance based on the SUPI range the UE's SUPI belongs to or based on the results of a discovery procedure with NRF using the UE's SUPI as input for CHF discovery.

In the case of delegated discovery and selection in SCP, the NF consumer has to include all available factors in the request towards SCP.

Therefore, it should be improved the time required for such operation, for use cases which make use of latency as one the main requirements.

### 5.2.2 Potential charging requirements

The following are potential high-level charging requirements, derived from the requirements in TS 32.255 [4].

**REQ-CH\_ SELCHF\_LA -01**: The 5GS should be able to optimize the CHF Selection during the PDU Session Establishment.

### 5.2.3 Key issues#2.1: CHF Instance Selection optimization

This key issue is for investigating how to support the selection of a CHF Instance based on SUPI or Group ID considering REQ-CH\_ SELCHF\_LA-01. This investigation covers the following:

- CHF Instance Selection optimization.

- identification and classification of the information required to reduce the time of CHF Instance Selection.

### 5.2.4 Possible Solutions

#### 5.2.4.1 Solution #2.1 Location Optimization Solution

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

Currently, SUPI/Group ID is used for NRF-based discovery of CHF. The CHF discovery mechanism needs to support the discovery of a CHF by SMF, or AMF, or SMSF or PCF based on information about network segments that the CHF belongs to.

By using CHF selection based on location information, it enables supporting the most suitable CHF for efficient processing based on the location . Potentially selecting most suitable CHF based on the location, may reduce also latency for NF that are running PDU sessions with the Charging, such as SMF and PCF.

Network Integration before the suggested change for a service operation discovers the set of CHF Instances (and its associated CHF Service Instances), that is currently registered in NRF and is selected based on the SUPI or group ID.

This operation using NF type of CHF, retrieves a list of CHF Instances, and their offered services, currently registered in the NRF, satisfying a filter criteria of SUPI or group ID. Since the CHF selection is based on SUPI or Group ID only, the selected CHF may be distant from the consumer NF.

Network Integration after CHF selection based on location, will be able to get a CHF Instance based on a location. There are two options to implement the location information:

1) UE serving area, as received from AMF (TAI).

2) NF consumer location that is set during NF deployment.

The following procedure has to be followed for CHF Registration (with Location Data), which has to be used for CHF Selection:

1) CHF registers to NRF with served location area (such as TAI or list of TAI). The registration will be using a new data type CHFCond (to be included in Nnrf\_NFManagement service-based interface protocol as described in 3GPP TS 29.510).

2) CHF discovery by the NF consumers (like the SMF, the AMF, the SMSF and the PCF) will retrieve relevant CHF per the location information (UE serving area or NF consumer deployment location).

3) CHF sends a response to the consumer. CHF discovery by the NF consumers (like the SMF, the AMF, the SMSF and the PCF) will retrieve relevant CHF per the location information (UE serving area or NF consumer deployment location). This operation using NF type of CHF, retrieves a list of CHF Instances, and their offered services, currently registered in the NRF, satisfying a filter criteria of UE serving area or NF consumer location.

This solution would bring the following advantages for CHF Selection:

- Extend the criteria that can be used with SUPI to optimize time for CHF Selection.

#### 5.2.4.2 Solution #2.2 CHF selection based on user group

The solution addresses key issue #2.1 of topic #2 on CHF selection by SUPI or Group ID.

NF(CTF) can discover and selectthe CHF instance(s) based on the UE's group information, e.g. for enterprise customers. To support the CHF discovery and selection based on group, CHF can provide the UE group information during NRF registration, i.e. the group of individual UE(s) that can be served by the CHF instance.

The CHF attributes registered with NRF per Chfinfo specified in TS 29.510 [2] Table 6.1.6.2.32-1 should be enhanced by including group information, e.g. reuse the "externalGroupIdentifiersRanges" attribute defined in NEFinfo in TS 29.510 [2], table 6.1.6.2.48-1.

The "externalGroupIdentifiersRanges" is made up of a list of "externalGroupIdentifier" with data type "externalGroupId". According to the definition in TS 29.571 [10], the data type "externalGroupId" refers to string identifying External Group Identifier that identifies a group made up of one or more subscriptions associated to a group of IMSIs.

An example of the extension to Chfinfo is shown in table 5.2.4.2-1.

Table 5.2.4.2-1: Extended attribute to the Chfinfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| externalGroupIdentifiersRanges | array(IdentityRange) | C | 1..N | The range of external group identifier representing a group of individual UE(s) that can be served by the CHF instance.  |

#### 5.2.4.3 Solution #2.3: Use full set of NRF discovery

A possible solution for key issue #2.1 covering requirements REQ-CH\_SELCHF\_LA-01, optimize CHF selection.

The CHF can today register in the NRF using the NFRegister service operation in the Nnrf\_NFManagement Service. The NFRegister service operation will include the NFProfile. In the NFProfile there are CHF specific attributes defined in the ChfInfo, 3GPP TS 29.510 [2], clause 6.1.6.2.32. The NFProfile also contain attributes common for all NFs that register.

An NF Service Consumer can today use the Nnrf\_NFDiscovery to find the CHF, this can be based on several query parameters, 3GPP TS 29.510 [2], clause A.2. These query parameters can be dynamically set based on internal configuration of the NF Service Consumer.

#### 5.2.4.4 Solution #2.4 CHF selection based on internal group identifier

The solution addresses key issue #2.1 of topic #2 on CHF selection by SUPI or Group ID.

In the Exposure function Northbound Application Program Interfaces (APIs) charging the NF consumer can use internalGroupIdentifiers. If CHF instances are dedicated to specific internal groups, it could be useful to be able to discover CHF instances based on the internal group identifier.

The CHF attributes registered with NRF per Chfinfo specified in TS 29.510 [2], Table 6.1.6.2.32-1 could be enhanced by including internal group identifier, e.g., reuse the "internalGroupIdentifiersRanges".

An example of the extension to Chfinfo is shown in table 5.2.4.4-1.

Table 5.2.4.4-1: Extension of type ChfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| internalGroupIdentifiersRanges | array(InternalGroupIdRange) | O | 1..N | Ranges of Internal Group Identifiers that can be served by the CHF instance.The absence of this IE indicates that the CHF instance can serve any internal group. |

### 5.2.5 Evaluation

#### 5.2.5.1 Solutions evaluation for Key issue #2.1

Solution #2.1 allows the selection of the CHF Instance based either on UE Serving Area or the NF Consumer Location. The served location area (TAI or a list of TAI) for a CHF instance will be new for the NRF.

Solution #2.2 provides the capability for identifying the CHF instance by using an externalGroupIdentifier which is used for associating the Application Function ID. Therefore, it would facilitate linking the application functions to the CHF. New parameter is required in the NRF.

Solution #2.3 provides the capability for an NF consumer to infer the CHF Group Id, a SUPI can be served by CHF, and then selecting a CHF based on the CHF Group Id, S-NSSAI, SUPI ranges, etc.

Solution #2.4 provides the capability for identifying the CHF instance by using an internalGroupIdentifier which could be used by the NEF to find the CHF. New parameter is required in the NRF.

### 5.2.6 Conclusion

It is concluded that solutions #2.2 and #2.4 are feasible solutions which needs to clarified with 3GPP CT WG4.

## 5.3 Topic #3 CHF Selection by a Tenant or Application

### 5.3.1 General description and assumptions

In TS 23.501 [5], clause 6.3.11 it states that discovered using NRF as described in in clause 6.1 of TS 32.290 [3]. It further states that the CHF selection functionality in NF consumer or in SCP should consider one of the following factors:

- CHF Group ID of the UE's SUPI.

- SUPI; the NF consumer selects a CHF instance based on the SUPI range the UE's SUPI belongs to or based on the results of a discovery procedure with NRF using the UE's SUPI as input for CHF discovery.

There is currently no support for performing a CHF Selection based either on a Tenant, or a Application or a Group application. It would bring additional flexibility to Charging Domain.

### 5.3.2 Potential charging requirements

The following are potential high-level charging requirements, derived from the requirements in TS 32.255 [4].

**REQ-CH\_ SELCHF\_TEN -01**: The 5GS should be able to allow a CHF Selection per Tenant.

### 5.3.3 Key issues#3.1: CHF Instance Selection

This key issue is for investigating how to support the selection of a CHF Instance based on a Tenant considering REQ-CH\_ SELCHF\_TEN-01. This investigation covers the following:

- CHF Instance Selection per Tenant.

### 5.3.4 Possible Solutions

#### 5.3.4.1 Solution #3.1 Tenant Identifier Solution

A possible solution for key issue #3.1 is to support the CHF selection based on the Tenant Identifier, which is available, and being used for the other functionalities (e.g. network slicing in 3GPP 28.202 [12]). This solution is only applicable for the case when there is CEF or CHF as NF Consumer.

The CHF attributes registered with NRF per Chfinfo specified in TS 29.510 [2], table 6.1.6.2.32-1 should be enhanced by including Tenant Identifier which can identify an external system and can be served by the CHF instance.

An example of the extension to Chfinfo is shown in table 5.3.4.1-1.

Table 5.3.4.1-1: Extended attribute to the Chfinfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| tenantidentifier | string | C | 0..1 | Tenant Identifier for CHF instance Selection  |

#### 5.3.4.2 Solution #3.2 Generic Identifier Solution

A possible solution for key issue #3.1 is to support the CHF selection based on different criteria that may be identified (e.g. Application Identifier), which can be available as mentioned in TS 32.255 [4], clause 5.1.17. This can bring further flexibility to the CHF Selection procedure, which does not limit the addition of new attributes to CHF Selection and Discovery criteria.

The CHF attributes registered with NRF per Chfinfo specified in TS 29.510 [2], table 6.1.6.2.32-1 can be enhanced by including this attribute, which would be generic, bringing flexibility on how the CHF Selection and Discovery process is done.

#### 5.3.4.3 Solution #3.3: CHF selection based on S-NSSAI

The solution addresses key issue #3.1 of topic #3 on CHF selection by a Tenant or Application.

A possible solution is to use S-NSSAI as a proxy of the identification of a tenant.

NF consumer may use Nnrf\_NFManagement and Nnrf\_NFDiscovery Service API, specified in clauses 5.2.2.2 and 5.3.2.2 of TS 29.510 [2], to assist the selection of CHF instance based on the S-NSSAI.

During NFRegister, CHF may register with NRF the "allowedNssais", defined in clause 6.1.6.2.2 of TS 29.510 [2].

During NFDiscover, the NF consumer may query the candidate CHF instances by including the identification of network slice, i.e. "requester-snssais" query parameter, in the HTTP headers, specified in clause 6.2.3.2.3 of TS 29.510 [2]. The NRF may return CHF instance(s) that contain the at least one of the S-NSSAI in its "allowedNssais".

#### 5.3.4.4 Solution #3.4: CHF selection based on S-NSSAI and SUPI

The solution addresses key issue #3.1 of topic #3 on CHF selection by a Tenant or Application.

A possible solution is to use the combination of S-NSSAI and SUPI as a proxy of the identification of a tenant.

NF consumer may use Nnrf\_NFManagement and Nnrf\_NFDiscovery Service API, specified in clauses 5.2.2.2 and 5.3.2.2 of TS 29.510 [2], to assist the selection of CHF instance based on combination of S-NSSAI and SUPI.

During NFRegister, CHF may register with NRF the "allowedNssais" and "supiRangeList", defined in clauses 6.1.6.2.2 and 6.1.6.2.32 of TS 29.510 [2].

During NFDiscover, the NF consumer may query the candidate CHF instances by including both the S-NSSAI and the SUPI of the requester UE, i.e. "requester-snssais" and "supi" query parameter, in the HTTP headers, specified in clause 6.2.3.2.3 of TS 29.510 [2]. The NRF may return the CHF instance(s) that contain the SUPI in its "supiRangeList" and also contain at least one of the S-NSSAI in its "allowedNssais".

### 5.3.5 Evaluation

#### 5.3.5.1 Solutions evaluation for Key issue #3.1

Solution #3.1 allows the selection of the CHF Instance based on the Tenant Identifier. The Tenant Identifier for a CHF instance will be new for the NRF. Tenant Identifier is used by CHF or CEF as NF Consumer.

Solution #3.2 allows the selection of the CHF Instance based on the Application Identifier.

Solution #3.3 allows the CHF be selected by the network slice. It applies to scenario where per network slice only serves one tenant at a given time. The solution can reuse existing attributes and mechanisms in the NRF.

Solution #3.4 allows the CHF be selected by a combination of network slice identification and subscriber identification. It applies to scenario where per network slice may serve multiple tenants at the same time, with the assumption that each SUPI belong to only one tenant per network slice.

### 5.3.6 Conclusion

It is concluded that solutions #3.3 and #3.4 are feasible solutions and can be recommended into normative work. Solution #3.2 can be further evaluated in the normative work.

## 5.4 Topic #4 CHF Discovery by Charging Domains

### 5.4.1 General description and assumptions

This topic is for investigating how to support the discovery of a Charging Function segregated by one or more charging domains or subsystems. For example, there can be separate CHF NFs deployed:

- 5G connection and mobility domain charging.

- IP Multimedia System (IMS) domain charging.

- Edge Computing domain charging.

- Proximity-based Services (ProSe) charging.

- Exposure function Northbound Application Program Interfaces (APIs) charging.

Sometimes a CHF NF instance could support a set of related domains: e.g.:

- IMS and MMTel domains.

- Network Slice Management, Network Slice Admission Control, and Network Slice Performance and Analytics domains.

Therefore, it should be possible to discover and select a CHF instance based on the charging domain(s) or subsystem(s) that the charging is required for.

### 5.4.2 Potential charging requirements

The following are potential high-level charging requirements, derived from the requirements in TS 32.255 [4].

**REQ-CH\_SELCHF\_CD -01**: The 5GS should be able to provide a CHF instance based on the functional domain or subsystem that requires charging.

### 5.4.3 Key Issues

The following key issues are identified:

**- Key Issue #4a:** Definition of charging domain(s) or subsystem(s) for distributed charging deployments

**- Key Issue #4b:** Determination of methods and procedures by which a NF Service Producer (CHF) can indicate the supported charging domain(s) or subsystem(s)

**- Key Issue #4c:** Determination of methods and procedures by which an NF consumer can indicate the charging domain(s) or subsystem(s) for which it requests charging

**- Key Issue #4d:** Determination of methods and procedures by which an NF consumer can discover and select a NF Service Producer (CHF) providing charging service for one or more charging domain(s) or subsystem(s)

### 5.4.4 Possible Solutions

#### 5.4.4.1 Solution #4.1: Use NF type and Inter-CHF communication

A possible solution for key issue #4.1, discovery by charging domains.

Reuse the NF type (TS 29.510 [2], clause 6.1.6.3.3) to cover the requirements on domain based discovery and charging. In most cases one NF type is connected to a domain the service specific charging information is also connected to the NF type rather than the domain. This means that in most cases the domain and required support of service specific charging information can be inferred by using the NF type.

If there is a need to have an NF type belonging to more than one domain, it could be solved by using inter-CHF connection. The first CHF would check if it can complete the request and if cannot complete the request it can select a new CHF based on internal configuration and NRF discovery. The first CHF would then forward the request to the new CHF, and the new CHF would respond to the first CHF which would forward the response.

#### 5.4.4.2 Solution #4.2: Update Priority for CHF Selection

A possible solution for key issue #4d is to update the priority order for CHF selection, as defined in TS 32.255, clause 5.1.8, to include any additional methods and procedures that can be utilized for discovering a NF Service Producer (CHF) by charging domain or subsystems.

#### 5.4.4.3 Solution #4.3: Use enumeration to identify charging domain or subsystem

The solution addresses key issue #4a (Definition of charging domain(s) or subsystem(s) for distributed charging deployments) of topic #4 on CHF Discovery by Charging Domains.

TS 32.240 defines a 'domain' as a part of communication network that provides resources using a certain bearer technology.

The TR 21.905 defines a '3GPP System' as 'A telecommunication system conforming to 3GPP specifications, consisting of one or more 3GPP core networks, one or more 3GPP access networks (providing GSM/EDGE, UTRA, E-UTRA, or NR radio access), and/or non-3GPP access networks (such as WLAN), and User Equipment.'

Furthermore, TS 32.240 defines the list of Charging TS that specify the charging functionality for a domain (CS, PS, 5GS), subsystem (IMS) and service levels (e.g. MMS, LCS, PoC, MBMS, SMS, MMTel etc). These are in number ranges TS 32.25x, TS 32.26x and TS 32.27x. Network Slicing is covered under TS 28.201 and TS 28.202.

The TS 32.240 clause 1 also specifies that the set of TSs in the TS 32.28x range covers common services, such as the Advice of Charge service, and the set of in the TS 32.29x range covers common aspects, such as CDR parameter and syntax descriptions etc.

Therefore, it follows that the set of middle tier TS in range 32.25x. 32.26x, 32.27x as well as TS 28.20x are sufficient to identify a list of charging domains and subsystems, that could be supported by a CHF instance in a distributed charging deployment.

TS 32.240, clause 1 shows the list of charging domains, subsystems and services and their document structure as follows:



Figure 5.4.4.3-1: Charging specifications structure

A few subsystems do not have converged charging defined at present. Therefore, the list of charging domains and subsystems, that can be supported by a CHF instance in a distributed charging deployment, can be defined in an enumerated list as per the table 5.4.4.3-1.

The list can be extended in future as new subsystems are defined or converged charging specifications are added for more subsystems.

Table 5.4.4.3-1: Enumeration Values for Charging Domain/Subsystems

| Charging Domain or Subsystem Identification Enumeration | Middle Tier Specification | Examples of NF Consumer |
| --- | --- | --- |
| NEF\_NB\_API | TS 32.254 | NEF for CHF converged charging |
| Data\_Connectivity | TS 32.255 | SMF |
| 5G\_Connection\_And\_Mobility | TS 32.256 | AMF |
| Short\_Message\_Service | TS 32.274 | SMSF |
| IP\_Multimedia\_Subsystem | TS 32.260 | IMS Node e.g. MRFC, IMS-GWF (connected to S-CSCF using ISC) and SIP AS for converged charging |
| Multimedia\_Messaging\_Service | TS 32.270 | MMS Node |
| MultiMedia\_Telephony | TS 32.275 | MMTel AS for converged charging |
| Proximity\_Based\_Services | TS 32.277 | CEF or5G-DDNMF (5G Direct Discovery Name Management Function) for CHF converged charging |
| Multimedia\_Broadcast\_And\_Multicast\_Service  | TS 32.273 | BM-SC (Broadcast Multicast - Service Centre)  |
| Network\_Slice\_Performance\_And\_Analytics | TS 28.201 | CEF (MnS producer or NWDAF) |
| Network\_Slice\_Management | TS 28.202 | MnS producer or CEF |
| Network\_Slice\_Admission\_Control | TS 28.203 | NSACF (Network Slice Admission Control Function) |
| Network\_Slice\_AA | TS 28.204 | NSAAF (Network Slice Authorization and Authentication) |
| Edge\_Computing | TS 32.257 | CEF (MnS producer) andEES (Edge Enabler Server) |

#### 5.4.4.4 Solution #4.4: Use NRF to discover CHF by charging domain

A possible solution for key issue #4b and key issue #4d is to register and discover a CHF instance that supports a specific charging domain or a set of charging domains using the NRF and/or SCP. This is analogous to the concept of an NWDAF registering its supportedanalytics reportsin the NRF, or an NEF registering its supportedproceduresin the NRF.

A consumer NF or the SCP can discover the required producer CHF NF instance by querying the NRF with its relevant set of parameters, which may include charging domain(s).

#### 5.4.4.5 Solution #4.5: Specify Charging Domain in Nchf Converged Charging SBI

A possible solution for key issue #4c is to enhance the Nchf\_ConvergedCharging SBI so that a consumer NF indicates the intended domain(s) or subsystem(s) in a charging request to the CHF producer.

A list of 'requested' charging domain(s) and subsystem(s) could be added to Nchf\_ConvergedCharging SBI, analogous to NodeFunctionality (i.e. as an enumerated list). This is necessary because the charging container (e.g., PDUSessionInformation) in a service request could be applicable to two or more charging domains or subsystems supported by a single CHF.

Table 5.4.4.5-1: New Attribute in Charging Data Request

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description | Applicability |
| requestedChargingDomain | ChargingDomain | OC | 0..1 | A charging domain or a subsystem for which charging is requested by NF consumer |  |

The data type 'ChargingDomain' could be defined as an enumerated list. A sample enumeration is shown below.

Table 5.4.4.5-2: Sample Enumeration Values for Requested Charging Domain

|  |  |
| --- | --- |
| Enumeration value | Description |
| NEF\_NB\_API | Network Exposure Function Northbound API Domain Charging |
| Data\_Connectivity | Data Connectivity Domain Charging |
| 5G\_Connection\_And\_Mobility | 5G Connection and Mobility Domain Charging |
| SMS | SMS Domain Charging |
| IMS | IP Multimedia System Domain Charging |
| MMS | Multimedia Messaging Service Domain Charging |
| MultiMedia\_Telephony | Multimedia Telephony Domain Charging |
| Proximity\_Based\_Services | Proximity Based Services Domain Charging |
| MBMS | Multimedia Broadcast and Multicast Service Domain Charging |
| NSPA | Network Slice Performance and Analytics Domain Charging |
| NSM | Network Slice Management Domain Charging |
| NSAC | Network Slice Admission Control Domain Charging |
| NSAA | Network Slice Authorization and Authentication Domain Charging |
| Edge\_Computing | Edge Computing Domain Charging |

The use of 'requested charging domain' could be negotiated between consumer and producer via SupportedFeatures. A new 'SupportedFeature' can be added, as defined below.

Table 5.4.4.5-3: Supported Feature for Charging By Domain

|  |  |  |
| --- | --- | --- |
| Feature number | Feature Name | Description |
| X | ChargingDomain | This feature indicates support for charging for one or more charging domains or subsystems |

#### 5.4.4.6 Solution #4.6: Custom HTTP2 Header For Charging

A possible solution for key issue #4c is to enhance the Nchf\_ConvergedCharging SBI to allow routing of Nchf\_ConvergedCharging requests and responses based on HTTP2 headers that include charging domain(s). This means that the charging data request can be routed without decoding the message payload.

Charging Specification TS 32.291 [11] clause 6.1.2.3 allows the use of optional HTTP custom headers from clause 5.2.3.3 of TS 29.500 [25], which can be used by both direct and indirect communication methods.

This solution proposal is to add a new optional HTTP custom header in accordance with TS 29.500 [25]

Table 5.4.4.6-1: Custom HTTP2 Header for Charging

|  |  |  |
| --- | --- | --- |
| Name | Reference | Description |
| 3gpp-Sbi-Charging-Domain | Clause 5.2.3.3.x | This header is used to specify the charging domain or subsystem for a charging data request. This header be included when the charging service is requested for a specific charging domain or a subsystem e.g. edge charging, IMS charging etc. |

Note: The definition of the new optional custom header will need to be added in an SA2 document. The list of domains to be allowed as part of custom header has to be determined as per solution for Key Issue #4a.

#### 5.4.4.7 Solution #4.7: Use NF type and SCP

A possible solution for key issue #4.1, discovery by charging domains.

Reuse the NF type (TS 29.510 [2], clause 6.1.6.3.3) to cover the requirements on domain based discovery and charging. In most cases one NF type is connected to a domain the service specific charging information is also connected to the NF type rather than the domain. This means that in most cases the domain and required support of service specific charging information can be inferred by using the NF type.

If there is a need to have an NF type belonging to more than one domain, it could be solved by using an SCP with NRF interaction. The SCP could do an initial selection based on NRF discovery using internal configuration and header information.

#### 5.4.4.8 Solution #4.8: Use NF type and CHF redirect

A possible solution for key issue #4.1, discovery by charging domains.

Reuse the NF type (TS 29.510 [2], clause 6.1.6.3.3) to cover the requirements on domain based discovery and charging. In most cases one NF type is connected to a domain the service specific charging information is also connected to the NF type rather than the domain. This means that in most cases the domain and required support of service specific charging information can be inferred by using the NF type.

If there is a need to have an NF type belonging to more than one domain, it could be solved by using a CHF redirect (HTTP status code 308). The first CHF would check if it can complete the request and if cannot complete the request it can select a new CHF based on internal configuration and NRF discovery. The first CHF would then redirect the request to the new CHF, and any further requests could be going to the new CHF.

#### 5.4.4.9 Solution #4.9: A logical separation of charging domains

A possible solution for Key Issue 4a is to define charging domains based on a list of chargeable 5G services that are not too broad and not too fine-grained.

Here is a list that could be used:

|  |  |  |
| --- | --- | --- |
| Charging Domain Name | Middle Tier Specification | Examples of NF Consumer |
| API Exposure | TS 32.254 | NEF, Trusted NF |
| 5G Data | TS 32.255 | SMF |
| 5G Connection & Mobility | TS 32.256 | AMF |
| Messaging Services (SMS & MMS) | TS 32.270, TS 32.274 | SMS, MMS Node |
| IMS Services | TS 32.260 | IMS Node, MMTel AS |
| Proximity Based Services | TS 32.277 | CEF, 5G-DDNMF |
| MBMS  | TS 32.273 | BM-SC |
| Network Slice Performance & Analytics  | TS 28.201 | CEF (MnS Producer or NWDAF) |
| Network Slice Management | TS 28.202 | MnS producer or CEF |
| NS Admission Control  | TS 28.203 | NSACF |
| NS Authorization & Authentication | TS 28.204 | NSSAAF |
| EAS Infrastructure Usage | TS 32.257 clause 4.2.1 | CEF (MnS Producer) |
| EAS Deployment & Lifecycle Mgmt | TS 32.257 clause 4.2.2 | CEF (MnS Producer) |
| Edge Enabling Services Charging | TS 32.257 clause 4.2.3 | EES |
| TSN Charging | TS 32.282 | TSN |

The list of domains could be defined as an enumeration for NRF based discovery or defined as a list of Supported Features.

#### 5.4.4.10 Solution #4.10: Use Supported Features

One possible solution for Key Issue #4b, #4c and #4d is to use the list of Supported Features and the feature negotiation mechanism described in TS 32.291 and TS 29.500.

The supportedFeatures is a string of hexadecimal characters (TS 29.571 [10], table 5.2.2-1), this means that there is not a real limit to the number of features that can be indicated. The current list of features is a mix of domains like IMS and edge computing, together with small additions like support of SMF charging id as a string (TS 32.291 [11], clause 6.1.8). Adding the domains as feature would make it possible to also describe the attributes that are connected to that domain.

This solution proposal is to extend the list of supported features to include additional charging domains, as indicated by solution for Key Issue #4a.

The NF Consumer can use this list of features during NRF Lookup to identify the required NF Producer (CHF).

The NF Consumer and NF Producer (CHF) can also use the feature negotiation mechanism described in TS 29.500 clause 6.6.2 to request and indicate support for a specific Charging domain.

#### 5.4.4.11 Solution #4.11: Use 3gpp-Sbi-Consumer-Info for indicating domain support

A possible solution for key issue #4.1, discovery by charging domains.

The 3gpp-Sbi-Consumer-Info contains the supportedFeatures (TS 29.500 [25], clause 5.2.3.3.7) to cover the requirements on domain based discovery and charging. The supportedFeaures is a string of hexadecimal characters (TS 29.571 [10], table 5.2.2-1), this means that there is not a real limit to the number of features that can be indicated. The current list of features is a mix of domains like IMS and edge computing together with small additions like support of SMF charging id as a string ((TS 32.291 [11], clause 6.1.8). Adding the domains as feature would make it possible to also describe which attributes that is connected to that domain.

### 5.4.5 Evaluation

#### 5.4.5.1 Solutions evaluation for Topic #4

Solution 4.1 solves the key issue #4a and 4d with performance constraints. It also requires internal configuration and NRF discovery. Forwarding of requests and responses between CHFs will impact performance of the end-to-end communication involving CHF, especially when using indirect communication, which can include multiple hops between one or more SCPs. The use of internal configuration prevents dynamic discovery of applicable CHF instances.

Solution 4.2 solves the key issue #4d, but applies only for data charging, and is already supported in specifications.

Solution 4.3 solves the key issue #4a and #4b. The domains identified via this method are a combination of fine-grained and coarse-grained.

Solution 4.4 solves the key issue #4b, #4c and #4d and requires enhancing NRF interface to support CHF discovery based on charging domains.

Solution 4.5 solves the key issue #4c and requires enhancement to Nchf Converged Charging interface. The CHF producer needs to parse the service request payload before determining whether it can handle the request. The consumer may need to send the request to multiple producer instances before the required one is discovered, impacting performance of end-to-end communication.

Solution 4.6 solves the key issue #4c and requires a new optional custom HTTP header needs to be added in TS 29.500.

Solution 4.7 is similar to Solution 4.1, except that it uses SCP for discovering a CHF instance. Forwarding of requests and responses between NF Consumer, SCP, NF Producer (CHF) and NF Producer (CHF supporting a domain) will impact the performance of end-to-end communication. The SCP also needs local configuration, which prevents dynamic discovery of newly instantiated CHF instances.

Solution 4.8 is similar to Solution 4.1 and solves the key issues #4a and #4d. In this solution, the first CHF "redirects" the transaction to 2nd CHF, instead of "forwarding". The use of internal configuration prevents dynamic discovery of newly instantiated CHF instance.

Solution 4.9 for Key Issue #4a does not provide an objective criteria to define domains, specially those that might be added in future.

Solution 4.10 uses SupportedFeatures and provides a mix of domains and small features, but has the advantage of defining charging domains and their related attributes in a single place.

Solution 4.11 uses optional HTTP custom header 3gpp-Sbi-Consumer-Info, together with SupportedFeatures to discover a CHF and solves Key Issues #4b, #4c and #4d. It is unclear whether SCP is able to use this header to lookup NRF for an NF producer supporting the required features - this may need to be clarified with SA2.

### 5.4.6 Conclusion

#### 5.4.6.1 Conclusion for Topic 4

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

Solution 4.3 for Key Issue 4a

Solution 4.10 (Supported Features) for solving Key Issues 4b, 4c and 4d with direct communication.

Optional HTTP custom header for solving Key Issues 4b, 4c and 4d with indirect communication. This means solution 4.11 if an existing header can be re-used, else a new header can be added. This should be clarified with 3GPP CT WG4.

# 7 Conclusion

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

- CHF Selection by NF Consumers Information: solutions as per clause 5.1.6 conclusions

- CHF Selection based on SUPI or Group ID: solutions as per clause 5.2.6 conclusions

- CHF Selection by a Tenant or Application: solutions as per clause 5.3.6 conclusions

- CHF Discovery by Charging Domains: solutions as per clause 5.4.6 conclusions.

Annex <A>:
Change history

|  |
| --- |
| **Change history** |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2023-02 | SA5#147 | S5-232095S5-232096S5-232918 |  |  |  | Add the skeleton to TR 28.844Add scope and reference to TR 28.844Some editorial changes including aligning TR front page title with SA5 official title are made as well | 0.1.0 |
| 2023-04 | SA5#148e | S5-233668S5-233678 |  |  |  | Document StructureAbbreviations Chapter Update | 0.2.0 |
| 2023-04 | SA5#149 | S5-234010S5-234632 |  |  |  | Abbreviations Chapter UpdateUpdate of the Overview | 0.3.0 |
| 2023-08 | SA5#150 | S5-235884S5-235885S5-235887 |  |  |  | CHF Selection by NF Consumers InformationCHF Selection based on SUPI ID or Group IDCHF Selection per Charging Domain | 0.4.0 |
| 2023-10 | SA5#151 | S5-236386S5-236985S5-236388S5-236998S5-236986S5-236987S5-236988S5-236989S5-236990S5-236991S5-236992S5-236993 |  |  |  | Abbreviations Chapter UpdateReferences Chapter UpdateCHF Selection and Discovery for NF Service Consumers Solution based on UDMCHF Selection by using CHF Default Instance SolutionLocation Optimization SolutionCHF Selection by Charging DomainsCHF Selection by LocationCHF Selection by NF InstanceCHF Selection by User GroupCHF Selection by NF Instance LocationCHF SelectionCHF Selection for domain based discovery | 0.5.0 |
| 2023-11 | SA5#152 | S5-237567S5-238046S5-237877S5-238047S5-237792S5-238048S5-238049S5-238050S5-238051S5-238052S5-238053S5-238054S5-238055S5-238056S5-237794S5-237795 |  |  |  | Abbreviations Chapter UpdateEditorial UpdatesCHF Selection by NF Instance refinementCHF Selection by NF Consumers InformationCHF Selection by SUPI or Group IDSolution Evaluation for Topic #1Solution Evaluation for Topic #2New Topic for CHF Selection (by Tenant)New Key Issue for CHF Selection per Charging DomainsCHF Selection by using Charging Domains tableCHF Selection by using NRF (with Charging Domain)CHF Selection by including Charging Domain in NchfCHF Selection by Header Based RoutingCHF Selection by NF Type (refinement)CHF Selection by SCPCHF Selection by CHF Redirect | 0.6.0 |
| 2024-02 | SA5#153 | S5-240742S5-240201S5-240202S5-240743S5-240744S5-240745S5-240322S5-240323S5-240746S5-240592S5-240594S5-240748S5-240749S5-240750S5-240751S5-240753S5-240747S5-240754S5-240755S5-240752 S5-241018S5-241019 |  |  |  | Topic#3 Possible SolutionTopic#3 Section Number CorrectionReferences UpdateSolution for Topic 4 Key Issue 4aUpdate Solution 4.6Use Supported FeaturesUpdate solution #1.4Update solution #1.3Add solution for CHF selection by TenantNew solution for CHF selection based on internal group identifierNew solution 3gpp-Sbi-Consumer-Info for indicating domain supportEvaluation of solution 1.5Evaluation of solution 1.6Evaluation of solution 2.3Add Evaluation for Topic 4Add Conclusion for Topic 4Topic#3 Possible Solution 2Topic#1 ConclusionTopic#2 ConclusionTopic#3 EvaluationTopic#3 ConclusionFinal Conclusion | 0.9.0 |
| 2024-03 | SA#103 | SP-240257 |  |  |  | Draft after editHelp review and submitted to SA plenary for information and approval | 1.0.0 |
| 2024-03 | SA#103 |  |  |  |  | Upgrade to change control version | 18.0.0 |
| 2024-06 | SA#104 | SP-240810 | 0001 | - | D | Rel-18 CR 28.840 Editorial Changes | 18.1.0 |