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Services, operations and procedures of charging using Service Based Interface (SBI)
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Contents

Foreword

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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.

1 Scope

The present document specifies service, operations and procedures of 5G charging for service based interface. This charging description includes the charging architecture and scenarios as well as the mapping of the common charging architecture specified in TS 32.240 [1]. The present document is related to other 3GPP charging TSs as follows:

- The common 3GPP charging architecture is specified in TS 32.240 [1].
- The protocol that are used for service based interface is specified in TS 32.291 [58].

The description is following the same methodology as used in TS 23.501 [201] and TS 23.502 [202] for the 5G system.

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 TS 32.240: "Telecommunication management; Charging management; Charging architecture and principles".

[2] - [49] Void.

[50] 3GPP TS 32.299: "Telecommunication management; Charging management; Diameter charging application".

[51] - [54] Void.

[55] - [57] Void.

[58] 3GPP TS 32.291: "Telecommunication management; Charging management; 5G system; Charging service, stage 3.

[59] - [99] Void.

[100] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[101] - [200] Void.

[201] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[202] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[203] - [206] Void.

[207] - [299] Void.

[300] 3GPP TS 29.510: " 5G System; Network function repository services; Stage 3".

[301] - [370] Void.

[371] - [399] Void.

[400] - [499] Void.

[500] - [599] Void.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [100], TS 32.240 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in either 3GPP TR 21.905 [100] or TS 32.240 [1].

5G Access Network: An access network comprising a NG-RAN and/or non-3GPP AN connecting to a 5G Core Network.

5G Core Network: The core network specified in the present document. It connects to a 5G Access Network.

NF service: a functionality exposed by a NF through a service based interface and consumed by other authorized NFs.

NF service operation: An elementary unit a NF service is composed of.

service based interface: It represents how a set of services is provided/exposed by a given NF.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

Nchf Service-based interface exhibited by Charging Function.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [100] 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 [100].

5GC	5G Core Network
5GS	5G System
CCS	Converged Charging System
CHF	Charging Function
NF	Network Function
PCF	Policy Control Function
SBI	Service based Interface
SMF	Session Management Function

4 Architecture reference model

4.1 General

The present document describes the service based architecture for 5G Charging.

4.2 Reference architecture

The NFs with CTF interact with CHF using Nchf interface for converged online and offline charging. The NF PCF interacts with CHF using Nchf interface for Spending Limit Control. The Nchf is a service based interface for NF and CHF.

Figure 4.2.1 depicts the reference architecture for the Nchf Interface.

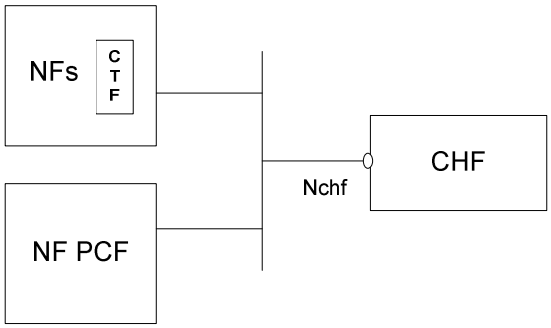

Figure 4.2.1: Reference Architecture for the Nchf Interface; SBI representation

Editor's note: The name and the role of the CTF is FFS.

5 Charging Function requirement

5.1 Offline charging scenario

5.1.1 Basic principles

Basic principles for offline charging are defined in TS 32.240 [1].

5.1.2 Charging scenarios

5.1.2.1 Introduction

Offline charging for both events and sessions based charging as defined in TS 32.240 [1].

Two basic scenarios are used:

- Event based charging;
- Session based charging.

Both these scenarios may generate CDR files, which may then be transferred to the network operator's BD for the purpose of subscriber billing and/or inter-operator accounting.

5.1.2.2 Scenarios

The scenarios described in TS 32.299 [50] clauses 5.1.1.1 and 5.1.1.2 apply with the CHF acting as a CDF.

5.2 Online charging scenario

5.2.1 Basic principles

Basic principles for online charging are defined in TS 32.240 [1].

5.2.2 Charging scenarios

5.2.2.1 Introduction

The following basic scenarios are used:

1 Immediate Event Charging

a) Decentralized Unit Determination and Centralized Rating

b) Centralized Unit Determination and Centralized Rating

c) Decentralized Unit Determination and Decentralized Rating

2 Event charging with Unit Reservation

a) Decentralized Unit Determination and Centralized Rating

b) Centralized Unit Determination and Centralized Rating

c) Decentralized Unit Determination and Decentralized Rating

3 Session charging with Unit Reservation

a) Decentralized Unit Determination and Centralized Rating

b) Centralized Unit Determination and Centralized Rating

c) Decentralized Unit Determination and Decentralized Rating

The combination of Centralized Unit Determination with Decentralized Rating is not possible.

5.2.2.2 Scenarios

The scenarios described in TS 32.299 [50], clauses 5.2.2.1, 5.2.2.2 and 5.2.2.3, apply with the CHF acting as an OCF.

5.2.3 Other requirements

5.2.3.1 Re-authorization

The NF Service Producer may trigger a re-authorization request which are defined in TS 32.299 [50].

5.2.3.2 Threshold based re-authorization triggers

The NF Service Producer may optionally include an indication to the NF Service Consumer of the remaining quota threshold that shall trigger a quota re-authorization.

5.2.3.3 Termination action

The NF Service Producer may specify to the NF Service Consumer the behaviour on consumption of the final granted units, or zero units granted in the first place; this is known as termination action.

5.3 Converged Charging scenario

5.3.1 Basic principles

When offline charging and online charging are both applicable to a service delivery, the charging information of both offline charging and online charging can be provided in a single command, upon any triggers of the offline charging or online charging is occur.

5.3.2 Charging scenarios

5.3.2.1 Introduction

Converged charging for both events and sessions between CTF and the CHF is performed as defined in TS 32.240 [1].

Two basic scenarios are used:

- Converged Event based charging;
- Converged Session based charging.

5.3.2.2 Event based charging

For Converged Event based Charging, the following cases are supported:

- Convergence of IEC for online charging and Event based charging for offline charging.
- Convergence of ECUR for online charging and Event based charging for offline charging.

Figure 5.3.2.2.1 shows a scenario for Event based charging in Decentralized and Centralized Unit Determination, Centralized Rating configuration, user's account balance deduction before service delivery, where the CTF invokes a converged charging service towards the CHF, prior to service delivery if needed.

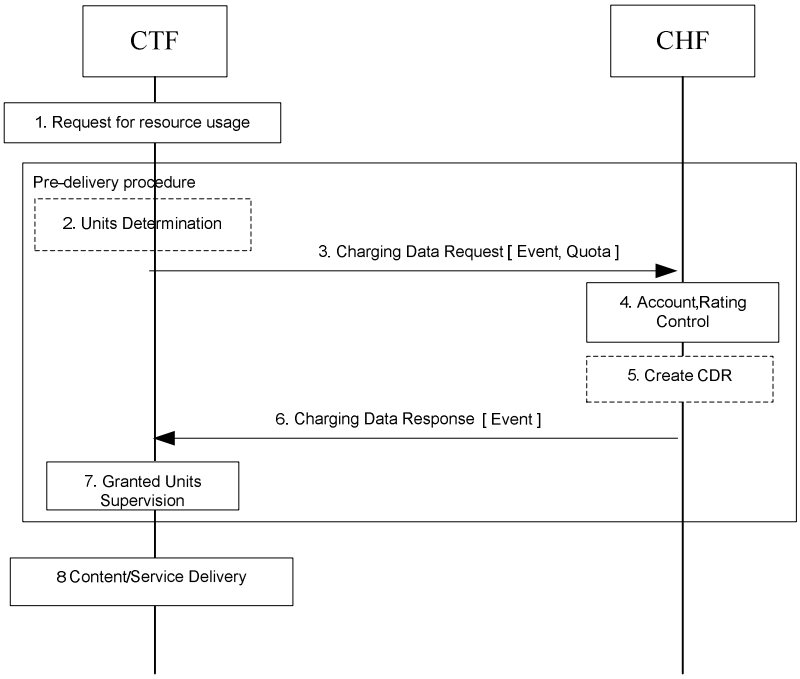

Figure 5.3.2.2.1: Event based charging - Decentralized and Centralized Unit Determination, Centralized Rating

1) **Request for resource usage:** A request for session establishment is received in the CTF. The service is configured to be authorized by the CHF to start.
2) **Units Determination:** the CTF determines the number of units depending on the service requested by the UE in "Decentralized Units determination" scenario.
3) **Charging Data Request [Event, Quota]:** The CTF sends the request to the CHF for the service to be granted authorization to start, and to make the number of units if determined in item 2 to be accounted and rating.
4) **Account, Rating Control:** The CHF calculates the number of monetary units that represents the price and makes deduction of the calculated amount from user's account balance based on the number of units requested or on internal unit determination, if the user's credit balance is sufficient
5) **Create CDR:** based on policies, the CHF creates a CDR related to the service.
6) **Charging Data Response [Event]:** The CHF grants authorization to CTF for the service to start, with a number of granted units.
7) **Granted Units Supervision:** The service starts and the CTF monitors the consumption of the granted units.
8) **Content/Service Delivery:** the CTF delivers the content/service based on the reserved number of units.

5.3.2.3 Session based charging

For Converged Session based Charging, the following cases are supported:

- Convergence of SCUR for online charging and Event based charging for offline charging
- Convergence of SCUR for online charging and Session based charging for offline charging

- Convergence of IEC for online charging and Session based charging for offline charging
- Convergence of ECUR for online charging and Session based charging for offline charging

Figure 5.3.2.3.1 shows a scenario for SCUR in Decentralized and Centralized Unit Determination, Centralized Rating configuration online charging and session based offline charging, where the CTF invokes a converged charging service towards the CHF.

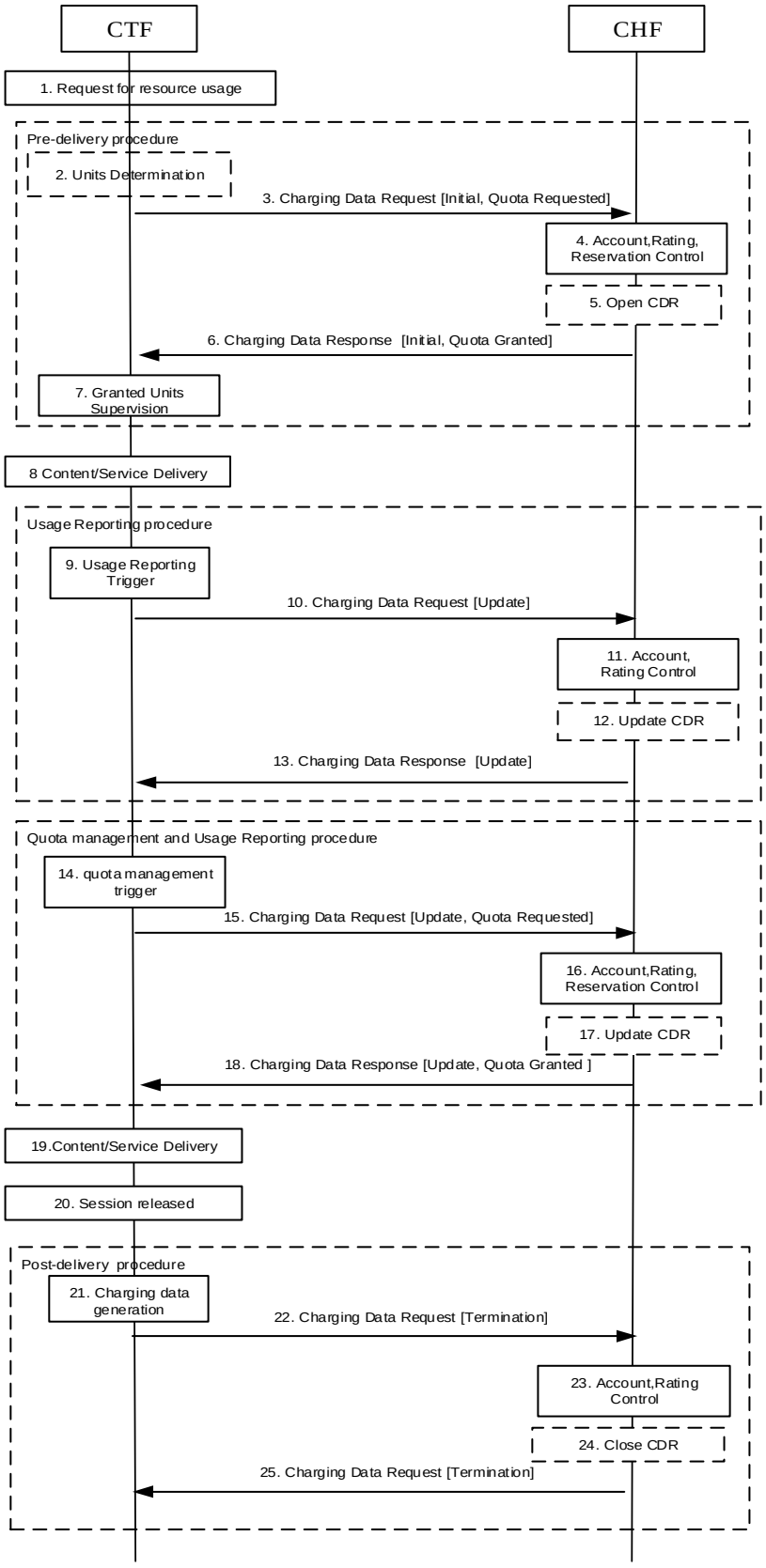

Figure 5.3.2.3.1: SCUR - Decentralized and Centralized Unit Determination, Centralized Rating with Session based

1) **Request for resource usage:** A request for session establishment is received in the CTF. The service is configured to be authorized by the CHF to start.

2) **Units Determination:** the CTF determines the number of units depending on the service requested by the UE in "Decentralized Units determination" scenario.

3) **Charging Data Request [Initial, Quota Requested]:** The CTF sends the request to the CHF for the service to be granted authorization to start, and to reserve the number of units if determined in item 2.

4) **Account, Rating, Reservation Control:** the CHF rates the requests either based on the number of units requested or on internal unit determination, checks if corresponding funds can be reserved on the user's account balance. If the account has sufficient funds, the CHF performs the corresponding reservations.

5) **Open CDR:** based on policies, the CHF opens a CDR related to the service.

6) **Charging Data Response [Initial, Quota Granted]:** The CHF grants authorization to CTF for the service to start, with the reserved number of units.

7) **Granted Units Supervision:** The service starts and the CTF monitors the consumption of the granted units.

8) **Content/Service Delivery:** the CTF delivers the content/service based on the reserved number of units.

9) **Usage Reporting Trigger:** the CTF generates charging data related to service delivered, based on a trigger for usage reporting is met.

10) **Charging Data Request [Update]:** the CTF sends the request for reporting the related charging data to the CHF.

11) **Account, Rating Control:** The CHF performs the reported usage process involving rating entity and user's account balance.

12) **Update CDR:** based on policies, the CHF updates the CDR with charging data related to the service.

13) **Charging Data Response [Update]:** The CHF informs the CTF on the result of the request.

14) **Quota management Trigger:** A Trigger associated to Quota management is met. Units determination is performed when applicable.

15) **Charging Data Request [Update, Quota Requested]:** the CTF sends the request to the CHF, to be granted with more unit for the service to continue, and also for reporting the used units.

16) **Account, Rating, Reservation Control:** The CHF performs the process related to the reported usage and the requested reservation, involving rating entity and user's account balance.

17) **Update CDR:** based on policies, the CHF updates the CDR with charging data related to the service.

18) **Charging Data Response [Update, Quota Granted]:** The CHF grants quota to CTF for the service to continue, with the reserved number of units.

19) **Content/Service Delivery:** the CTF delivers the content/service based on the granted quota.

20) **Session released:** the session is released.

21) **Charging Data Generation:** the CTF generates charging data related to service released.

22) **Charging Data Request [Termination]:** the CTF sends the request to the CHF, for charging data related to the service termination with the final consumed units.

23) **Account, Rating Control:** The CHF performs the service termination process involving rating entity and user's account balance.

24) **Close CDR:** based on policies, the CHF closes the CDR with charging data related to the service termination and the last reported units.

25) **Charging Data Response [Termination]:** The CHF informs the CTF on the result of the request.

Figure 5.3.2.3.2 shows a scenario for SCUR in Decentralized and Centralized Unit Determination, Centralized Rating configuration and session based charging, immediate start of service delivery, where the CTF invokes a converged charging service towards the CHF.

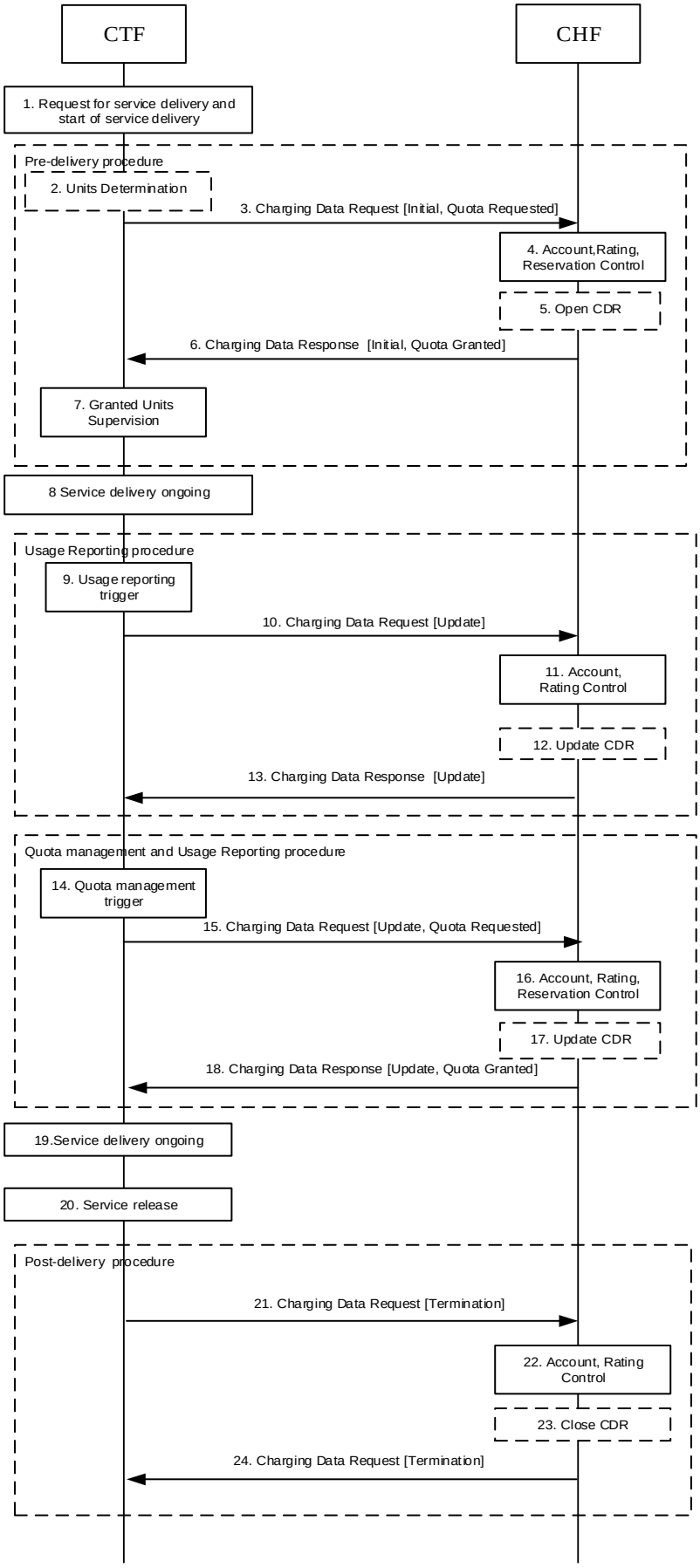

Figure 5.3.2.3.2: SCUR - Decentralized and Centralized Unit Determination, Centralized Rating with Session based charging, immediate start of service delivery

1) **Request for service delivery and start of service delivery:** A request for session establishment is received in the CTF. The CTF is configured to allow the service to be delivered.

2) **Units Determination:** the CTF determines the number of units depending on the service requested, in "Decentralized Units determination" scenario.

3) **Charging Data Request [Initial, Quota Requested]:** the CTF sends the request to the CHF to reserve the number of units if determined in step 2.

4) **Account, Rating, Reservation Control:** the CHF rates the requests either based on the number of units requested or on internal unit determination, checks if corresponding funds can be reserved on the user's account balance. If the account has sufficient funds, the CHF performs the corresponding reservation.

5) **Open CDR:** based on policies, the CHF opens a CDR related to the service.

6) **Charging Data Response [Initial, Quota Granted]:** the CHF grants the reserved number of units to CTF.

7) **Granted Units Supervision:** The CTF monitors the consumption of the granted units.

8) **Service delivery ongoing:** the CTF continues to deliver the service.

9) **Usage reporting trigger:** a trigger associated with service usage reporting is met.

10) **Charging Data Request [Update]:** the CTF reports the charging data related to service delivered to the CHF.

11) **Account, Rating Control:** the CHF uses the reported charging data to rate the usage and deduct the funds corresponding to the usage on the account balance.

12) **Update CDR:** based on policies, the CHF updates the CDR with charging data related to the service.

13) **Charging Data Response [Update]:** The CHF informs the CTF on the result of the request.

14) **Quota management Trigger:** A Trigger associated to Quota management is met. Units determination is performed when applicable.

15) **Charging Data Request [Update, Quota Requested]:** the CTF sends the request to the CHF, to be granted with more unit for the service to continue, and also for reporting the used units.

16) **Account, Rating, Reservation Control:** same as step 4, with the option to also deduct the funds corresponding to the usage on the account balance.

17) **Update CDR:** based on policies, the CHF updates the CDR with charging data related to the service.

18) **Charging Data Response [Update, Quota Granted]:** The CHF grants quota to CTF for the service, with the reserved number of units.

19) **Service delivery ongoing:** the CTF continues to deliver the service.

20) **Service release:** the CTF is requested to end the service delivery and does this.

21) **Charging Data Request [Termination]:** the CTF sends the request to the CHF, for charging data related to the service termination with the final consumed units.

22) **Account, Rating Control:** the CHF performs the service termination process which involve using the reported charging data to rate the usage and deduct the funds corresponding to the usage on the account balance.

23) **Close CDR:** based on policies, the CHF closes the CDR with charging data related to the service termination and the last reported units.

24) **Charging Data Response [Termination]:** The CHF informs the CTF on the result of the request.

6 Service Definition

6.1 NF Service Framework

5G Charging Function supports to interact with NRF, as defined in subclause 7.1 of 3GPP TS 23.501 [201] and 3GPP TS 29.510 [300] to enable following functionality:

- Service Register
- Service Deregister
- Service Discovery

6.2 Nchf_ConvergedCharging service

6.2.1 General

Service description: The ConvergedCharging service provides charging for session and event based NF services. This ConvergedCharging service offers charging with and without quota management, as well as charging information record generation.

6.2.2 Nchf_ConvergedCharging_Create service operation

Service operation name: Nchf_ConvergedCharging_Create

Description: Provides charging capabilities before service delivery, offers charging with and without quota management, as well as charging information record generation. Provides means for the NF Consumer to create the context of application session information. Makes an implicit subscribe to events that requires re-authorization from CHF.

The charging request initial, may be used to request quota authorisation for service delivery and may open a CDR in the CHF, based to the information provided by the NF Consumer.

Known NF Consumers: SMF.

Inputs, Required: served party, UE identity, either identification of the service or rating group.

Inputs, Optional: Requested service units, destination address, provider, location information, time and date.

Outputs, Required: Success or Failure.

Outputs, Optional: Granted service units, validity time, triggers

Editor's Note: The use of application session information, as well as input and outputs are for further study

6.2.3 Nchf_ConvergedCharging_Update service operation

Service operation name: Nchf_ConvergedCharging_Update

Description: Provides charging capabilities during service delivery, offers usage reporting and quota management, as well as charging information record generation.

The charging update request, is used to report usage and may request further quota authorisation, if the trigger conditions occurs, this operation may cause update of the CDR or production of an interim CDR in the CHF.

Known NF Consumers: SMF.

Inputs, Required: Subscriber Identifier, used service units, reporting reason.

Inputs, Optional: requested service units

Outputs, Required: Success or Failure.

Outputs, Optional: Granted service units, Validity Time, triggers

Editor's Note: The use of application session information, as well as input and outputs are for further study

6.2.4 Nchf_ConvergedCharging_Delete service operation

Service operation name: Nchf_ ConvergedCharging _Delete

Description: Provides charging capabilities after service delivery, offers usage reporting and charging information record generation. Provides means for the NF Consumer to delete the resource of application session information.

The charging delete request is used to report usage and close the CDR in the CHF if it has been opened.

Known NF Consumers: SMF.

Inputs, Required: Subscriber Identifier, reporting reason.

Inputs, Optional: Used service units.

Outputs, Required: Success or Failure.

Outputs, Optional: None.

Editor's Note: The use of the delete operation and application session information, as well as input and outputs are for further study

6.2.5 Nchf_ConvergedCharging_Notify service operation

Service operation name: Nchf_ConvergedCharging_Notify

Description: Provides notification to NF consumers of the subscribed events, i.e. any event that would lead to that the NF would need to send an Nchf_ConvergedCharging_Update reporting the current usage or to send an Nchf_ConvergedCharging_Delete to terminate the charging service.

Notify NF consumers of the subscribed events and requests an Update to be sent with the status of the service delivery.

Notify NF consumers of the subscribed events and requests a Delete to be sent to terminate the charging service.

Known NF Consumers: SMF.

Inputs, Required: Subscriber Identifier, notification type.

Inputs, Optional: rating group, service id.

Outputs, Required: Success or Failure.

Outputs, Optional: None

Editor's Note: The use of Notify and application session information, as well as input and outputs are for further study

6.3 Nchf_SpendingLimitControl service

6.3.1 Overview

The "Nchf_SpendingLimitControl" service is defined in 23.502 [202] clause 5.2.17.2.

6.4 Message contents

Converged charging is performed by CTF consuming service operations exposed by CHF, achieved using Charging Data Request and Charging Data Response.

The information structure used for these services operations is composed of two parts:

- Common structures specified in the present document.
- CTF NF consumer specific structures specified in the middle tier TSs.

Table 6.4.1 describes the data structure which is common to operations in request semantics.

Table 6.4.1: Common Data structure of Charging Data Request

Information Element	Category	Description
Subscriber Identifier	O_M	This field contains the identification of the subscriber that uses the requested service.
NF Consumer Identification		This is a grouped field which contains a set of information identifying the NF consumer of the charging service.
NF Name	M	This fields holds the name of the NF consumer
NF Address	M	This field holds the IP-address of NF consumer
NF PLMN ID	O_C	This field holds the PLMN ID of the network the NF consumer belongs to.
Invocation Timestamp	M	This field holds the timestamp of the charging service invocation by the NF consumer
Invocation Sequence Number	M	This field contains the sequence number of the charging service invocation by the NF consumer.
Termination Cause	O_C	This field contains the termination reason of the service.
Multiple Quota Usage	O_C	This field contains the parameters for the quota management request. It may have multiple occurrences.
Rating Group	M	The identifier of a rating group.
Requested Unit	O_C	This field holds the requested quota.
Time	O_C	This field holds the amount of requested time.
Total Volume	O_C	This field holds the amount of requested volume in both uplink and downlink directions.
Uplink Volume	O_C	This field holds the amount of requested volume in uplink direction.
Downlink Volume	O_C	This field holds the amount of requested volume in downlink direction.
Service Specific Units	O_C	This field holds the amount of requested service specific units.
Used Unit	O_C	This field holds used quota.
Service Identifier	O_C	This field holds the Service Identifier.
Reporting Reason	O_C	This field holds reason for charging information reporting.
Tariff Time Change Usage	O_C	This field identifies the reporting period for the used service unit, i.e. before, after or during tariff change.
Time	O_C	This field holds the amount of used time.
Total Volume	O_C	This field holds the amount of used volume in both uplink and downlink directions.
Uplink Volume	O_C	This field holds the amount of used volume in uplink direction.
Downlink Volume	O_C	This field holds the amount of used volume in downlink direction.
Event Charging Time Stamp	O_C	This field holds the timestamp of the event reported in the Service Specific Units when event based charging applies.

Table 6.4.2 describes the data structure which is common to operations in response semantics.

Table 6.4.2: Common Data structure of Charging Data Response

Information Element	Category	Description
Session Identifier	M	This field identifies the operation session.
Invocation Timestamp	M	This field holds the timestamp of the charging service response from the CHF.
Invocation Result	M	This field holds the result of the charging service invocation by the NF consumer
Result code	M	This field contains the result code: success or failure code.
Failed parameter	OC	This field holds missing and/or unsupported parameter that caused the failure.
Failure Handling	OC	This field holds the failure handling to be performed by the NF consumer, which is associated to the result code: Terminate, Continue, Retry and Terminate. In case of failure, it indicates which action to be performed by the SMF for the provided result code. In case of success, it indicates which action to be performed by the SMF in case subsequent charging service invocation are temporarily prevented.
Invocation Sequence Number	M	This field holds the sequence number of the charging service invocation by the NF consumer.
Session Failover	OC	This field indicates whether alternative CHF is supported for ongoing charging service failover handling by NF consumer.
Multiple Quota Information	OC	This field holds the parameters for the quota management information. It may have multiple occurrences.
Rating Group	M	The identifier of a rating group.
Granted Unit	OC	This field holds the granted quota.
Tariff Time Change	OC	This field contains the switch time when the tariff will be changed.
Time	OC	This field holds the amount of granted time.
Total Volume	OC	This field holds the amount of granted volume in both uplink and downlink directions.
Uplink Volume	OC	This field holds the amount of granted volume in uplink direction.
Downlink Volume	OC	This field holds the amount of granted volume in downlink direction.
Service Specific Units	OC	This field holds the amount of granted requested service specific units.
Trigger	OC	This field holds triggers for usage reporting associated to the rating group.
Validity Time	OC	This field defines the time in order to limit the validity of the granted quota for a given category instance.
Quota Holding Time	OC	This field holds the quota holding time in seconds.
Final Unit Indication	OC	This field indicates the granted final units for the service.
Trigger	OC	This field holds the triggers supplied from the CHF

Editor's Note: these parameters need to be adapted to reflect the use of HTTP/2 for service-based: e.g. session Id, session failover.

Editor's Note: the name and description for trigger at the main level is ffs.

The CTF NF consumer specific structures which are specified in the middle tier TSs, are defined as extensions of:

- common part structure of Charging Data Request and Charging Data Response.
- structure of Multiple Quota Usage.
- structure of Multiple Quota Information.

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2018-01						First creation of skeleton.	0.0.0
2018-02	SA5 #117	S5-181410 S5-181330 S5-181331 S5-181409 S5-181412 S5-181411				Introduce the architecture Update of the skeleton Scope and Reference Definitions, Symbols and Abbreviations Addition of section on NF service framework Addition of section 5 for TS 32.290	0.1.0
2018-04	SA5 #118	S5-182351 S5-182240 S5-182350 S5-182347 S5-182348 S5-182357 S5-182358 S5-182360 S5-182349				Introduce a new consumer Introduce Spending Limit Control Service Introduction of offline and online charging scenario Introduction of event based convergent charging scenarios Introduction of session based convergent charging scenarios Introduction of logical basic operations for SBI Adding Record requirements New Converged Charging Service Introduction of combined session based convergent charging scenarios	0.2.0
2018-05	SA5 #119	S5-183483 S5-183484 S5-183485 S5-183486 S5-183487 S5-183488				Correction of Nchf_ConvergedCharging_Notify service operation Clarification of Update and Delete service operation definition Update Charging Information Addition of Event based Charging Procedure Change server to Service Provider Quota Handling clarifications	0.3.0
2018-06	SA#80	SP-180408				Presented for information and approval	1.0.0
2018-06	SA#80					Upgrade to change control version	15.0.0

History

Document history		
V15.0.0	September 2018	Publication