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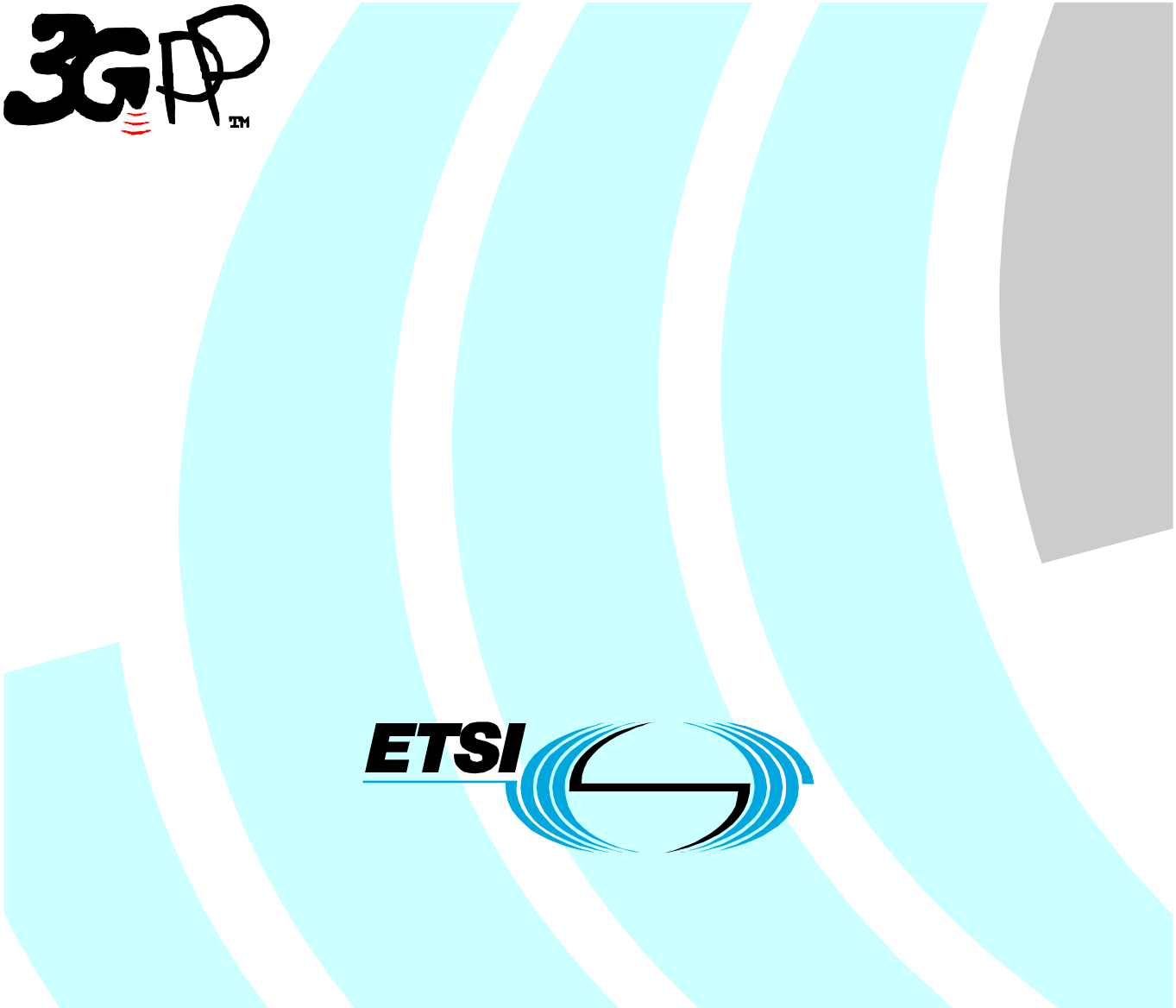
Technical Specification

Universal Mobile Telecommunications System (UMTS);
Telecommunication management;
Charging management;
Diameter charging applications
(3GPP TS 32.299 version 7.0.0 Release 7)



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Foreword

This Technical Specification (TS) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp .

Contents

Foreword

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

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

Version x.y.z

where:

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  - 1 presented to TSG for information;
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- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document is part of a series of documents that specify charging functionality and charging management in GSM/UMTS networks. The GSM/UMTS core network-charging architecture and principles are specified in 3GPP TS 32.240 [1], which provides an umbrella for other charging management documents that specify.

- The content of the CDRs' per domain and subsystem (offline charging);
- The content of real-time charging messages per domain / subsystem (online charging);
- The functionality of online and offline charging for those domains and subsystems;
- The interfaces that are used in the charging framework to transfer the charging information (i.e. CDRs or charging events).

The complete document structure for these TSs is defined in 3GPP TS 32.240 [1].

The present document specifies in detail the Diameter based offline and online charging applications for 3GPP networks. It includes all charging parameters, scenarios and message flows..

All terms, definitions and, abbreviations used in the present document, that are common across 3GPP TSs, are defined in 3GPP TR 21.905 [50]. Those that are common across charging management in GSM/UMTS domains, services or subsystems are provided in the umbrella document 3GPP TS 32.240 [1] and are copied into clause 3 of the present document for ease of reading. Finally, those items that are specific to the present document are defined exclusively in the present document.

Furthermore, requirements that govern the charging work are specified in 3GPP TS 22.115 [102].

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 TR 21.905: 'Vocabulary for 3GPP Specifications'

[51]-[199] Void.

[200] 3GPP TS 23.207: "End to end quality of service concept and architecture".

[201] 3GPP TS 23.228: "IP Multimedia Subsystem (IMS); Stage 2".

[202] 3GPP TS 24.229: "IP Multimedia Call Control Protocol based on SIP and SDP; Stage 3."

[203] 3GPP TS 29.207: "Policy control over Go interface".

[204] 3GPP TS 29.229: "Cx and Dx Interfaces based on the Diameter protocol; Protocol Details".

[205] 3GPP TS 29.210: "Charging rule provisioning over Gx interface".

[206] 3GPP TS 29.230: "3GPP specific codes and identifiers".

[207] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)".

[208] 3GPP TS 23.140: " Multimedia Messaging Service (MMS); Functional description; Stage 2".

[209] OMA "Multimedia Messaging Service; Encapsulation Protocol".

[210] OMNA WSP Content Type Codes database.
http://www.openmobilealliance.org/tech/omna/omna-wsp-content-type.htm

[211]-[400] Void.

[401] IETF RFC 3588: "Diameter Base Protocol".

[402] IETF RFC 4006: "Diameter Credit Control Application"

[403] Void.

[404] IETF RFC 3455 , "Private Extensions to the Session Initiation Protocol (SIP) for the 3rd Generation Partnership Projects (3GPP)".

[405] IETF RFC 3261: "SIP: Session Initiation Protocol".

[406] IETF Internet-Draft, "SDP: Session Description Protocol".
http://www.ietf.org/internet-drafts/draft-ietf-mmusic-sdp-new-24.txt

NOTE: The above reference will need to be updated to reference the assigned RFC number, once the draft achieves RFC status within the IETF.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

offline charging: charging mechanism where charging information **does not** affect, in real-time, the service rendered

online charging: charging mechanism where charging information can affect, in real-time, the service rendered and therefore a direct interaction of the charging mechanism with session/service control is required

Editor"s note: Include middle tier TS…

3.2 Symbols

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

Rf Offline Charging Reference Point between a 3G network element and the CDF.
Ro Online Charging Reference Point between a 3G network element and the OCS.

3.3 Abbreviations

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

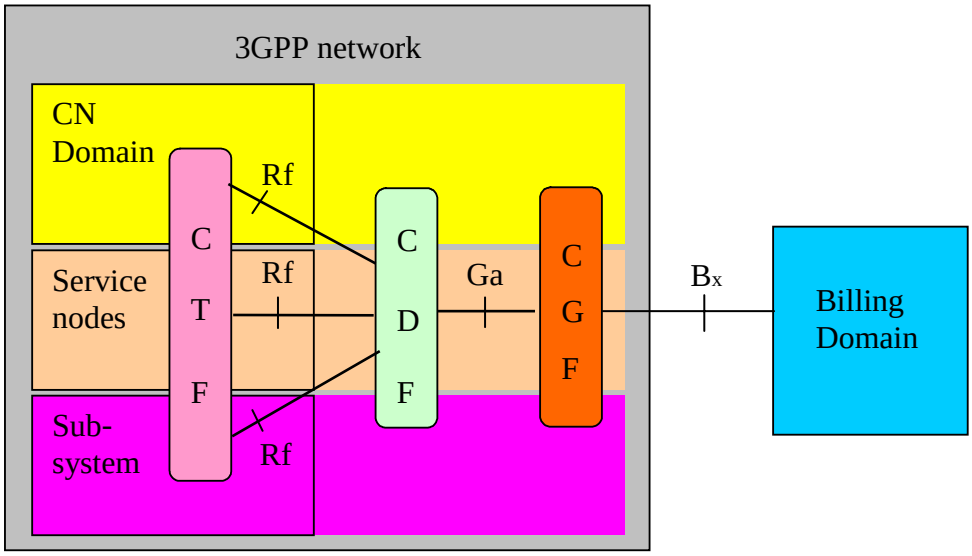
ACA ACcounting Answer
ACR ACcounting Request
AS Application Server
AVP Attribute Value Pair
CCA Credit Control Answer
CCR Credit Control Request

CDF	Charging Data Function
CDR	Charging Data Record
CI	Cost-Information
ECUR	Event Charging with Unit Reservation
FUI	Final-Unit-Indication
GSU	Granted-Service-Unit
IEC	Immediate Event Charging
IMS	IP Multimedia Subsystem
OCS	Online Charging System
SDP	Session Description Protocol

4 Architecture Considerations

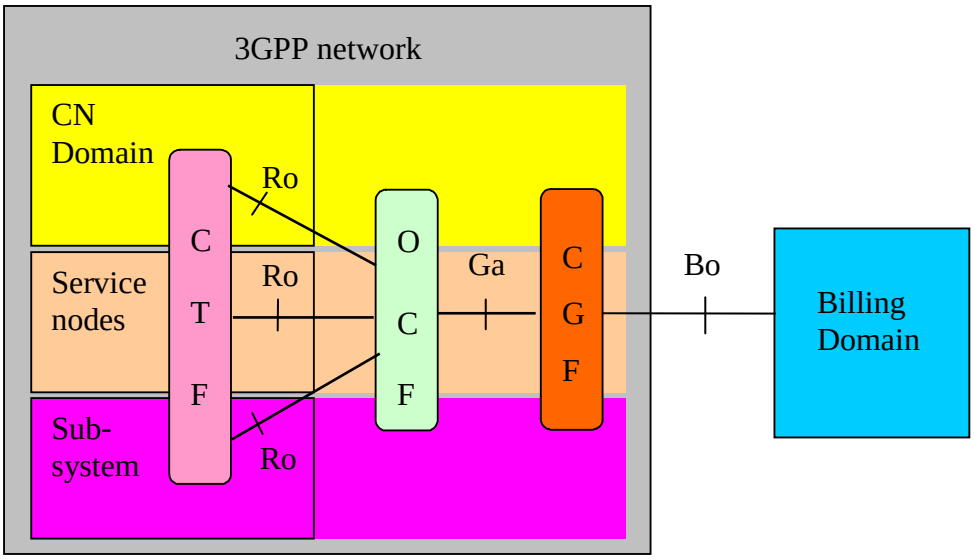
4.1 High level architecture

The Rf and the Ro are reference points from the Charging Trigger Function (CTF) to the Charging Data Function (CDF) and the Online Charging Function (OCF) respectively, and are intended for the transport of charging events. Rf is used for offline charging whereas Ro is used for online charging. The following figures depict the position of the Rf and Ro reference points within the overall 3GPP online and offline charging architecture.



CTF: **C**harging **T**rigger **F**unction
CDF: **C**harging **D**ata **F**unction
CGF: **C**harging **G**ateway **F**unction
BD: **B**illing **D**omain. This may also be a billing mediation device / post-processing system.

Figure 4.1.1 : Logical ubiquitous offline charging architecture



CTF: **C**harging **T**rigger **F**unction
OCF: **O**nline **C**harging **F**unction
CGF: **C**harging **G**ateway **F**unction
BD: **B**illing **D**omain. This may also be a billing mediation device / post-processing system.

Figure 4.1.2 : Logical ubiquitous online charging architecture

Different mappings of the ubiquitous offline charging functions, CTF, CDF and CGF, onto physical implementations are possible. Further details of the configuration refer to 3GPP TS 32.240 [1]. Details of the implementation options per domain / subsystem / service (usually a subset of the overall possible variants described above) are specified in the respective middle tier TS.

4.1.1 Charging related transfer requirements

Each CTF would have CDF and OCF address list to which it can send its charging events and/or charging requests. The list will be organized in address priority order. If the primary charging function is not available (e.g., out of service) then the CTF shall send the charging information to the secondary charging function and so on.

Within the scope of this release, each network element that generates charging information will send the information only to the charging entities of the same PLMN, and not to charging entities in other PLMNs.

Each CDF in the PLMN may know of other CDFs' network addresses (e.g., for redundancy reasons, to be able to recommend another CDF address with the Redirection Request message). This is achieved by OAM&P configuration facilities that will enable each CDF to have a configurable list of peer CDF addresses.

5 3GPP charging applications requirements

5.1 Offline Charging Scenarios

5.1.1 Basic Principles

Offline charging for both events and sessions between CTF and the CDF is performed using the Rf reference point as defined in TS 32.240[1].

Two basic scenarios are used:

- Event based Charging;

- Session based Charging.

5.1.1.1 Event based charging

In the following scenario, CTF asks the CDF to store event related charging data.

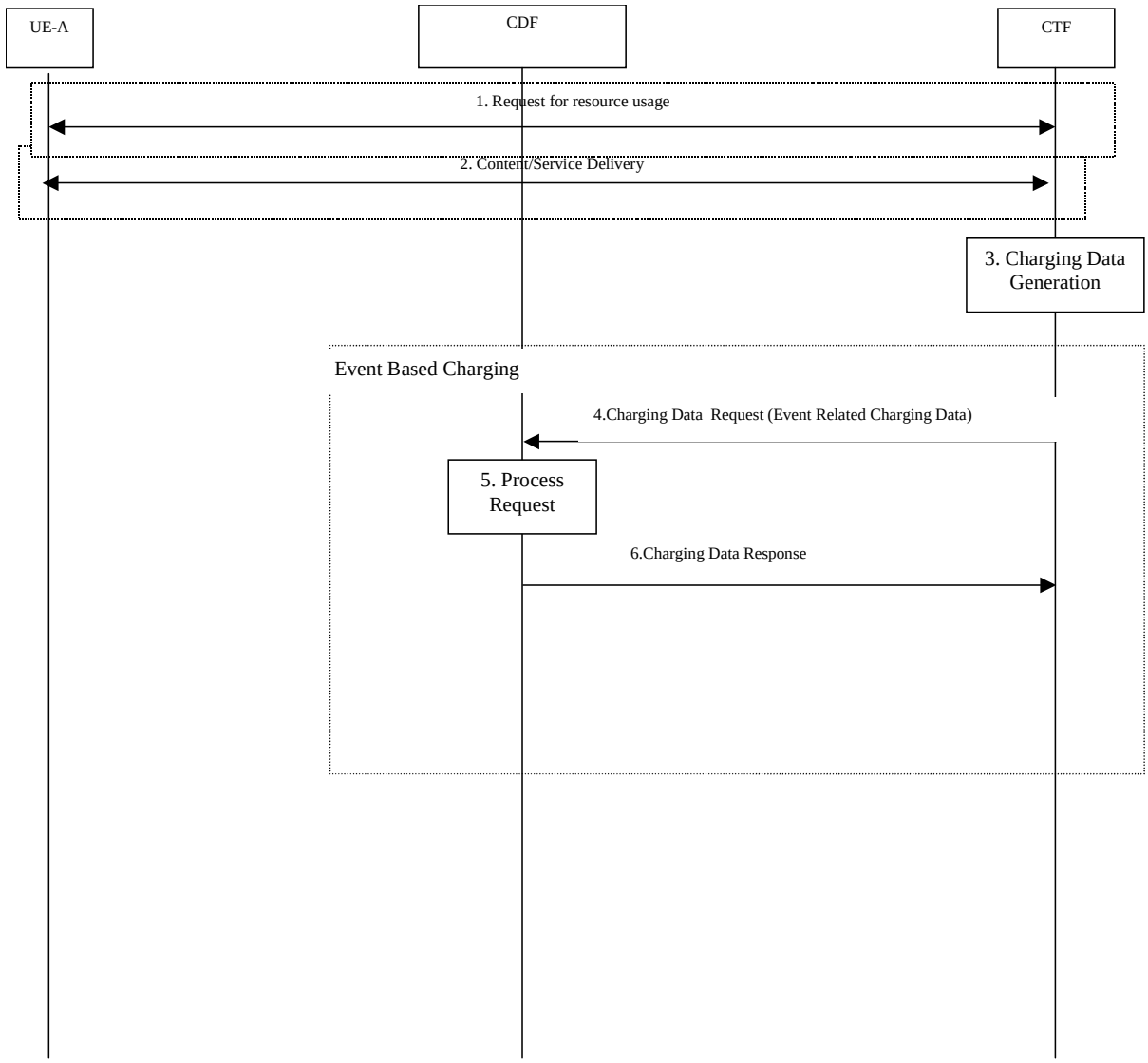


Figure 5.1.1.1 : Event Based Charging

1. **Request for resource usage:** UE-A requests the desired resource from the network element.
2. **Content/Service Delivery:** the network element delivers the content/service.
3. **Charging Data Generation:** the CTF generates charging data related to service delivery
4. **Record Charging Data Request:** the CTF requests the CDF to store event related charging data for CDR generation purposes.
5. **Process Request:** CDF stores received information. Whether the CDR is generated or not depends on CDR generation configuration.
6. **Record Charging Data Response:** the CDF informs the CTF that charging data was stored.

5.1.1.2 Session based charging

In the following scenario, CTF asks the CDF to store session related charging data.

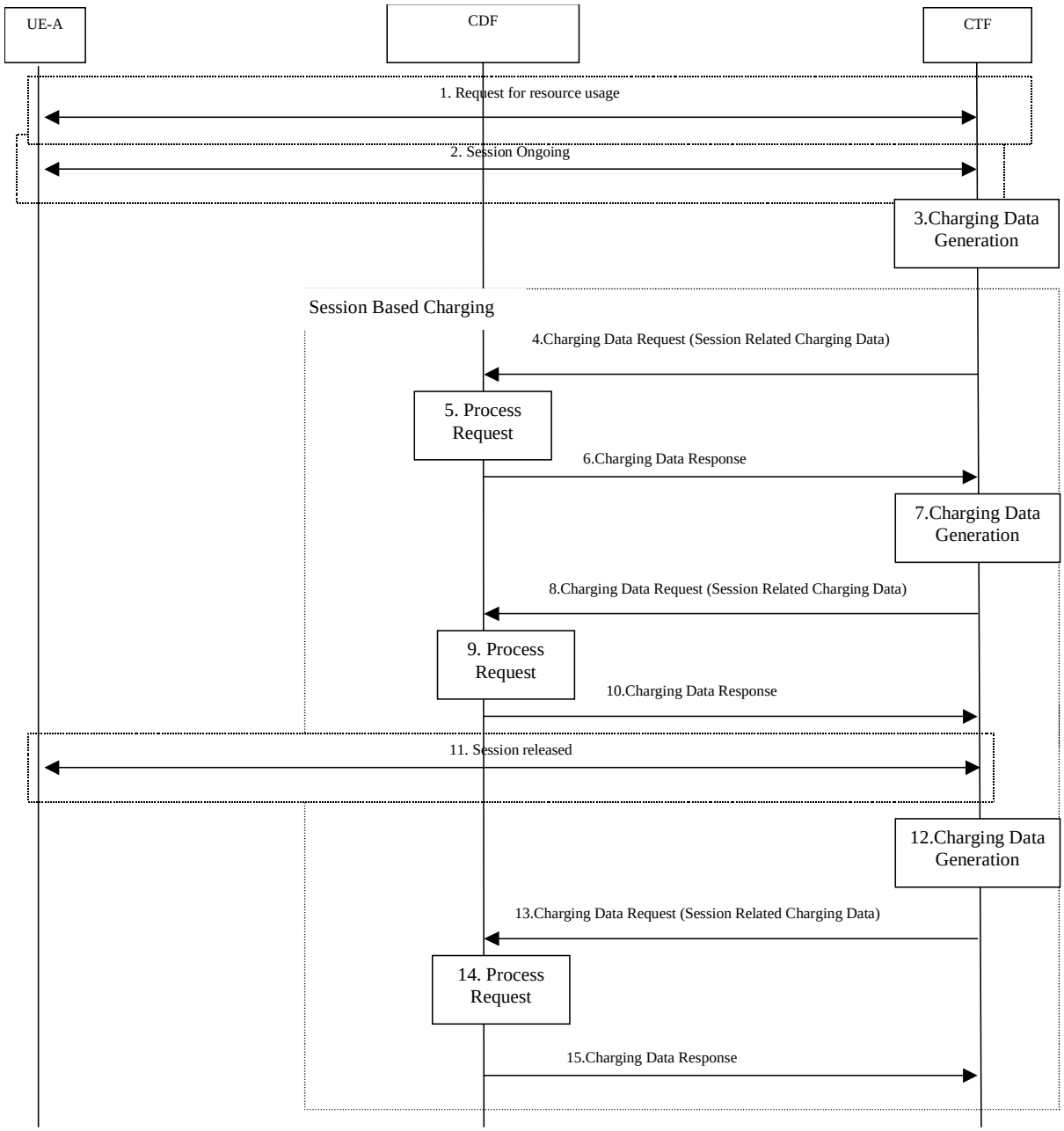


Figure 5.1.1.2 : Session based charging

1. **Request for resource usage:** UE-A requests the desired session from the network element.
2. **Session ongoing:** the network element establish the session
3. **Charging Data Generation:** the CTF generates charging data related to session.
4. **Record Charging Data Request:** the CTF requests the CDF to store event related charging data for CDR generation purposes.
5. **Process Request:** CDF stores received information. Whether the CDR is generated or not depends on CDR generation configuration.
6. **Record Charging Data Response:** the CDF informs the CTF that charging data was stored
7. **Charging Data Generation:** the CTF generates charging data related to session due of e.g. intermediate timer expiry

8. **Record Charging Data Request:** the CTF requests the CDF to store event related charging data for CDR generation purposes.
9. **Process Request:** CDF stores received information. Whether the CDR is generated or not depends on CDR generation configuration.
10. **Record Charging Data Response:** the CDF informs the CTF that charging data was stored
11. **Session release:** the session is released
12. **Charging Data Generation:** the CTF generates charging data related to session due of session termination.
13. **Record Charging Data Request:** the CTF requests the CDF to store event related charging data for CDR generation purposes.
14. **Process Request:** CDF stores received information. Whether the CDR is generated or not depends on CDR generation configuration.
15. **Record Charging Data Response:** the CDF informs the CTF that charging data was stored.

5.1.2 Basic Operation

Event and session based Charging are performed by the use of the "*Charging Data Transfer*" operation:

- "*Charging Data Request*"; sent from CTF → CDF
  After detecting a chargeable event, the CTF sends a Charging Data Request to the CDF.

- "*Charging Data Response*"; sent from CDF → CTF
  The CDF replies with a Charging Data Response, which informs the CTF that charging data was received.

Table 5.1.2.1 and table 5.1.2.2 describe the content of these operations.

Table 5.1.2.1 : Charging Data Request Content

Charging Data Request	Category	Description
Session Identifier	M	This field identifies the operation session.
Originator Node-Id	M	This field contains the identification of the source point of the operation and the realm of the operation originator.
Operation type	M	This field defines the transfer type: event for event based charging and start, interim, stop for session based charging.
Operation number	M	This field contains the sequence number of the transferred messages.
Service information	O_M	This field holds the 3GPP service specific parameter: - PS Information, - WLAN Information, - IMS Information, - PoC Information, - MBMS Information

Table 5.1.2.2: Charging Data Response Content

Charging Data Response	Category	Description
Session Identifier	M	This field identifies the operation session.
Operation result	M	This field identifies the result of the operation.
Originator Node-Id	M	This field contains the identification of the source point of the operation and the realm of the operation originator.
Originator Domain	M	This field contains the realm of the operation originator.

Editor"s note: Addition of the transfer operation interval and user identification is needed.

5.2 Online Charging scenarios

Online charging for both events and sessions between CTF and the OCF is performed using the Ro reference point. The Ro reference point supports integrity protection and authentication for the case that the CTF is outside the operator domain.

5.2.1 Basic principles

There are two sub-functions for online charging that affect online charging principles and require a more detailed description: rating and unit determination. Both rating and unit determination can be implemented centralized, i.e. on the OCF, or decentralized, that is, on the CTF.

Unit determination refers to the calculation of the number of non-monetary units (service units, data volume, time and events) that shall be assigned prior to starting service delivery.

- With Centralized Unit Determination, the OCF determines the number of non-monetary units that a certain service user can consume based on a service identifier received from the CTF.
- With the Decentralized Unit Determination approach, the CTF determines itself how many units are required to start service delivery, and requests these units from the OCF.

After checking the service user's account balance, the OCF returns the number of granted units to the CTF. The CTF is then responsible for the supervision of service delivery. Particularly, the CTF shall limit service delivery to the corresponding number of granted units.

Rating refers to the calculation of a price out of the non-monetary units calculated by the unit determination function.

- With the Centralized Rating approach, the CTF and the OCF exchange information about non-monetary units. The OCF translates these units into monetary units.
- With the Decentralized Rating approach, the corresponding rating control is performed within the CTF. Consequently, CTF and OCF exchange information about monetary units.

Three cases for online charging can be distinguished: immediate event charging (IEC), event charging with unit reservation (ECUR) and session charging with unit reservation (SCUR). These cases are further described in 3GPP TS 32.240 [1].

Editor"s note: The text above in green could be moved to the top, however, then there needs to be relation with the succeeding text.

5.2.2 Charging Scenarios

In order to perform event charging via Ro, the scenarios between the involved entities UE-A, OCF and CTF need to be defined. The charging flows shown in this subclause include scenarios with immediate event charging and event charging with reservation. In particular, the following cases are shown:

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 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 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.

5.2.2.1 Immediate Event Charging

5.2.2.1.1 Decentralized Unit Determination and Centralized Rating

In the following scenario, CTF asks the OCF to assign a defined number of units.

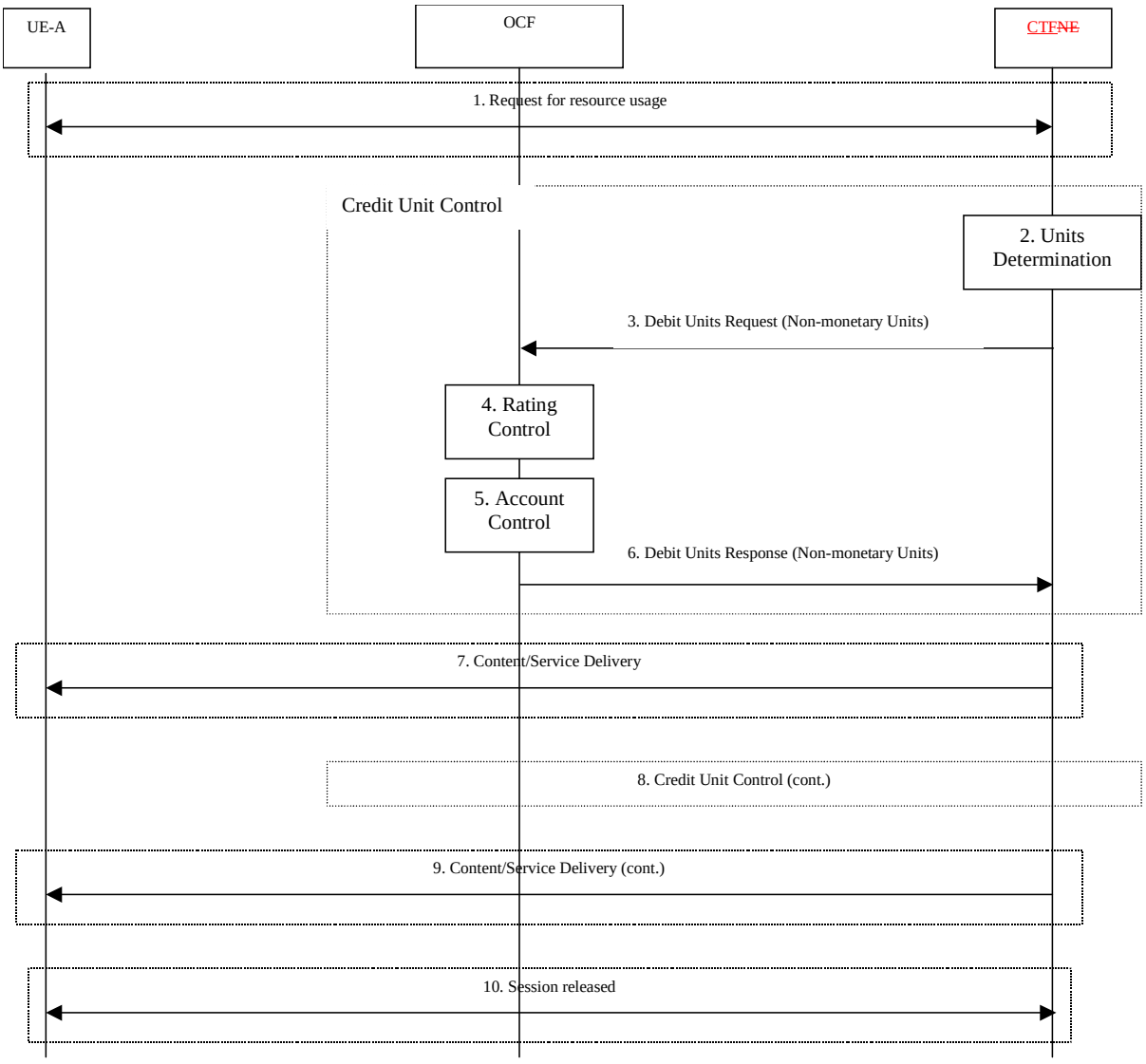


Figure 5.2.2.1.1 : Immediate Event Charging with Centralized Rating and Decentralized Unit Determination

1. **Request for resource usage:** UE-A requests the desired resource from the network element.
2. **Units Determination:** depending on the requested service the CTF determines the number of units accordingly.
3. **Debit Units Request:** the CTF requests the OCF to assign the defined number of units.
4. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units that represents the price for the number of units determined in item 2.

5. **Account Control:** provided that the user's credit balance is sufficient, the OCF triggers the deduction of the calculated amount from the subscriber's account.
6. **Debit Units Response:** the OCF informs the CTF of the number of granted units.
7. **Content/Service Delivery:** the CTF delivers the content/service at once, in fractions or in individually chargeable items, corresponding to the number of granted units.
8. **Credit Unit Control (cont.):** this function block is optional and a replication of items 2 to 6.
9. **Content/Service Delivery (cont.):** the continuation of content delivery occurs in correspondence with the occurrence of item 8.
10. **Session released:** Session is released.

5.2.2.1.2 Centralized Unit Determination and Centralized Rating

In the following scenario, CTF asks the OCF to assign units based on the service identifier specified by the CTF.

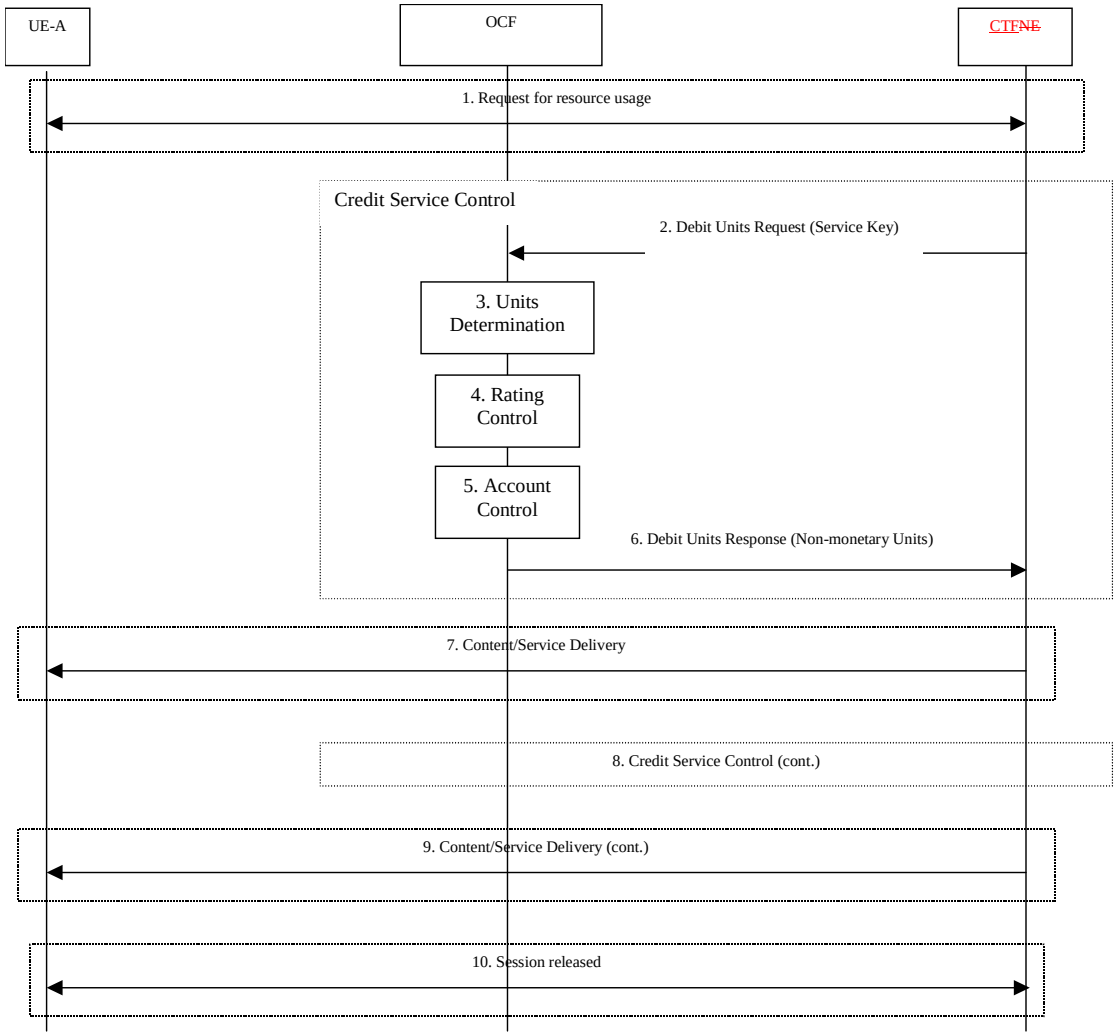


Figure 5.2.2.1.2 : Immediate Event Charging with Centralized Rating and Centralized Unit Determination

1. **Request for resource usage:** The UE-A requests the desired resource or content from the network element.
2. **Debit Units Request:** depending on the service requested by the UE-A, the CTF selects the service identifier and forwards the Debit Units Request to the OCF.
3. **Units Determination:** the OCF determines the number of non-monetary units needed for the content/service delivery, based on the received service key.
4. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units that represent the price for the number of units determined in item 3.
5. **Account Control:** provided that the user's credit balance is sufficient, the OCF triggers the deduction of the calculated amount from the subscriber's account.
6. **Debit Units Response:** the OCF informs the CTF of the number of granted units. This includes the case where the number of units granted indicates the permission to render the service that was identified by the received service key.
7. **Content/Service Delivery:** the CTF delivers the content/service at once, in fractions or in individually chargeable items, corresponding to the number of granted units.
8. **Credit Service Control (cont.):** this function block is optional and a replication of items 2 to 6.

9. **Content/Service Delivery (cont.):** the continuation of content delivery occurs in correspondence with the occurrence of item 8.
10. **Session released:** the session is released.

5.2.2.1.3 Decentralized Unit Determination and Decentralized Rating

In the following scenario, the CTF asks the OCF to assure the deduction of an amount of the specified number of monetary units from the subscriber's account.

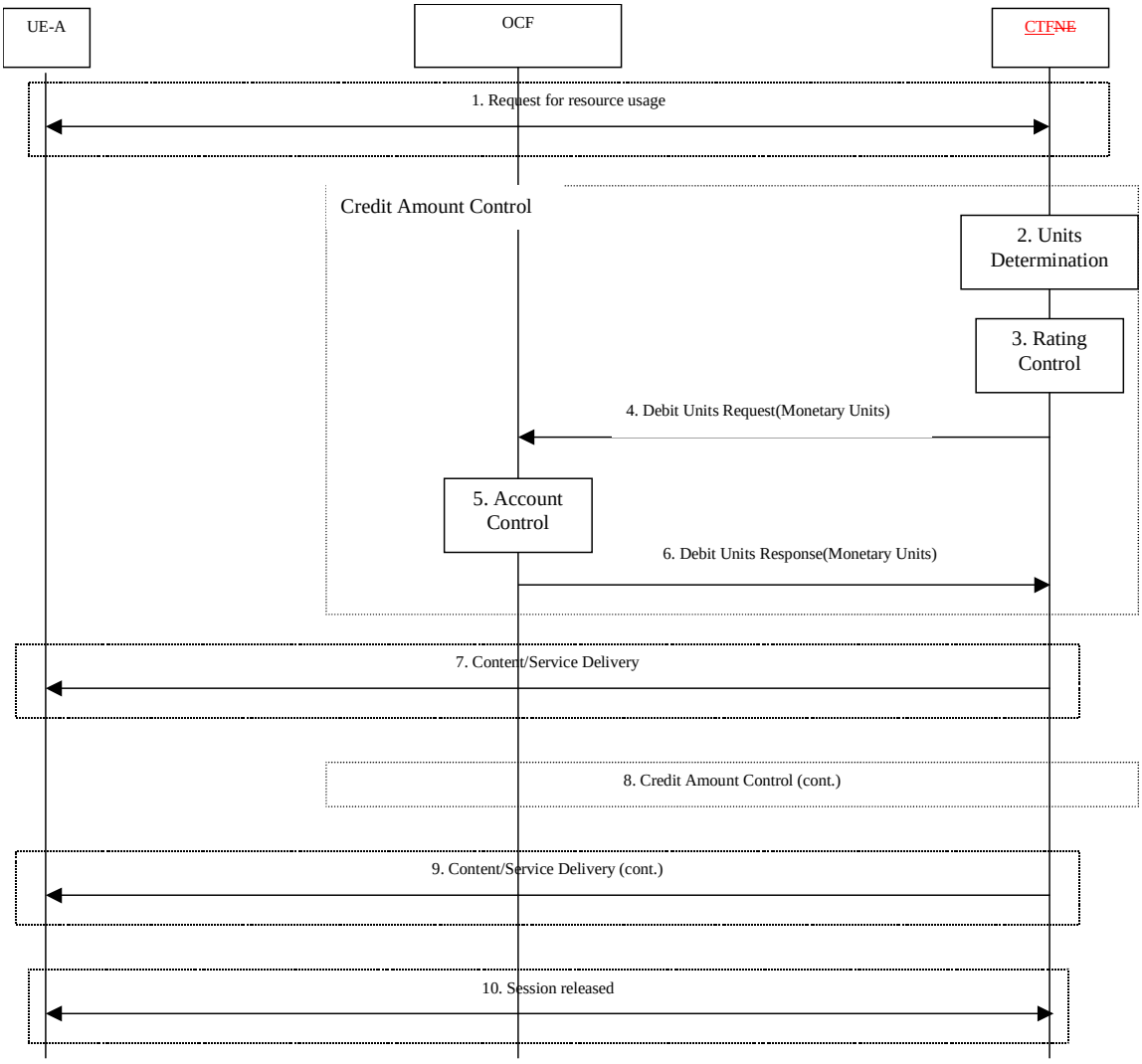


Figure 5.2.2.1.3 : Immediate Event Charging with Decentralized Rating and Decentralized Unit Determination

1. **Request for resource usage:** The UE-A requests the desired content from the network element.
2. **Units Determination:** depending on the service requested by the UE-A, the CTF determines the number of units accordingly.
3. **Rating Control:** the CTF calculates the number of monetary units that represent the price for the number of units determined in item 2.
4. **Debit Units Request:** the CTF requests the OCF to assure the deduction of an amount corresponding to the calculated number of monetary units from the subscriber's account.
5. **Account Control:** provided that the user's credit balance is sufficient, the OCF triggers the deduction of the calculated amount from the subscriber's account.
6. **Debit Units Response:** the OCF indicates to the CTF the number of deducted monetary units.
7. **Content/Service Delivery:** the CTF delivers the content/service at once, in fractions or in individually chargeable items, corresponding to the number of units as specified in items 2 and 3.

8. **Credit Amount Control (cont.):** this function block is optional and a replication of items 2 to 6.
9. **Content/Service Delivery (cont.):** the continuation of content delivery occurs in correspondence with the occurrence of item 8.
10. **Session released:** the session is released.

5.2.2.1.4 Further Options

In addition to the flows that are specified in the previous subclauses, the Debit Unit operation may alternatively be carried out concurrently with service delivery, or after completion of service delivery.

5.2.2.2 Event charging with Reservation

5.2.2.2.1 Decentralized Unit Determination and Centralized Rating

In the following scenario, the CTF requests the reservation of units prior to service delivery. An account debit operation is carried out following the conclusion of service delivery.

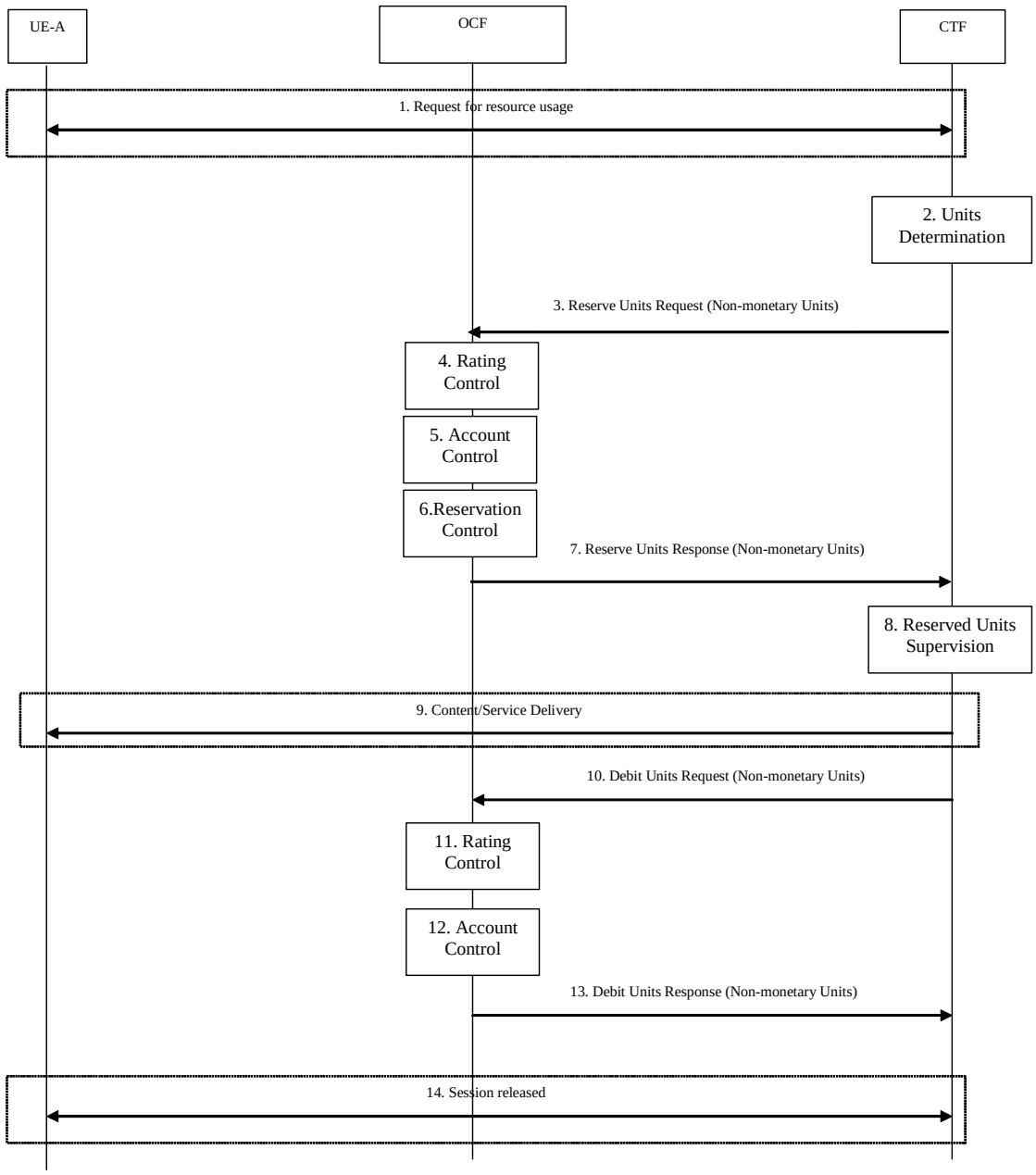


Figure 5.2.2.2.1 : Event Charging with Reservation / Decentralized Unit Determination and Centralized Rating

1. **Request for resource usage:** The UE-A requests the desired content/service from the NE.
2. **Units Determination:** depending on the requested service the CTF determines the number of units accordingly.
3. **Reserve Units Request:** the CTF requests the OCF to reserve the number of units determined in item 2.
4. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units that represents the price for the number of units determined in item 2.
5. **Account Control:** the OCF checks whether the user's account balance is sufficient for the requested reservation.
6. **Reservation Control:** if the user's account balance is sufficient then the corresponding reservation is made.

7. **Reserve Units Response:** the OCF informs the CTF of the reserved number of units. Items 3 to 7 may be repeated several times.
8. **Reserved Units Supervision:** simultaneously with the service delivery, the CTF monitors the consumption of the reserved units.
9. **Content/Service Delivery:** the CTF delivers the content/service at once, in fractions or in individually chargeable items, corresponding to the reserved number of units.
10. **Debit Units Request:** the CTF requests the OCF to assure the deduction of an amount corresponding to the consumed number of units from the subscriber's account. In the case that no further units are required for this service, an appropriate indication triggering the release of the remaining reservation is given.
11. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units to deduct from the subscriber's account.
12. **Account Control:** the OCF triggers the deduction of the calculated amount from the subscriber's account.
13. **Debit Units Response:** the OCF informs the CTF of the actually deducted units. Items 10 to 13 may be repeated several times.
14. **Session Release:** the session is released.

5.2.2.2.2 Centralized Unit Determination and Centralized Rating

In the following scenario, the CTF requests the OCF to reserve units based on the service identifier specified by the CTF. An account debit operation is carried out following the conclusion of service delivery.

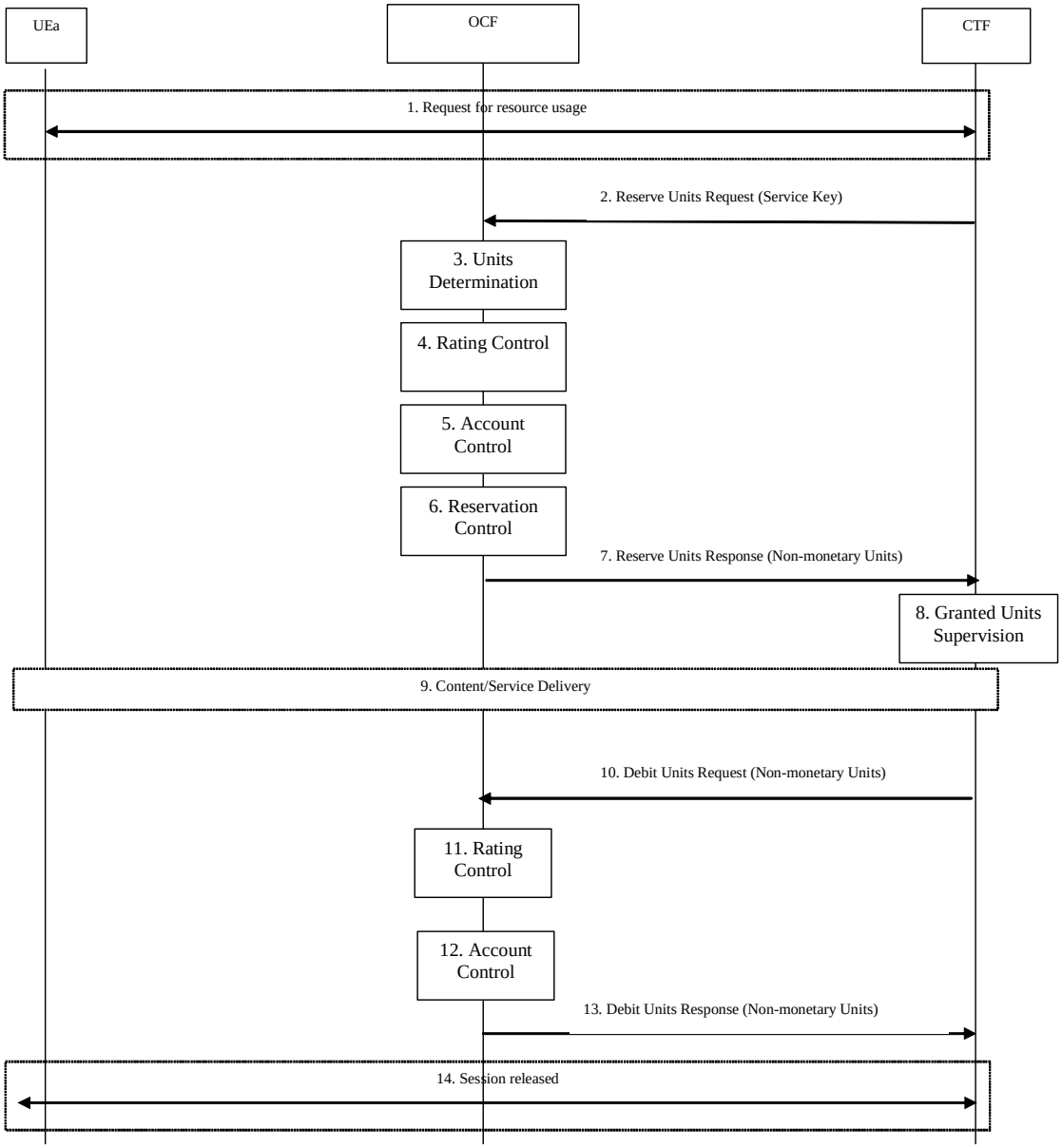


Figure 5.2.2.2.2 : Event Charging with Reservation / Centralized Unit Determination and Centralized Rating

1. **Request for resource usage:** The UE-A requests the desired content from the CTF.
2. **Reserve Units Request:** depending on the service requested by the UE-A, the CTF selects the service identifier and forwards the Reserve Units Request to the OCF.
3. **Units Determination:** the OCF determines the number of non-monetary units needed for the content/service delivery, based on the received service key.
4. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units that represent the price for the number of units determined in item 3.
5. **Account Control:** the OCF checks whether the user's account balance is sufficient for the requested reservation.
6. **Reservation Control:** if the user's account balance is sufficient, then the corresponding reservation is made.
7. **Reserve Units Response:** the OCF informs the CTF of the reserved number of units. This includes the case where the number of units reserved indicates the permission to render the service that was identified by the received service key. Items 2 to 7 may be repeated several times.

8. **Granted Units** Supervision**:** simultaneously with the service delivery, the CTF monitors the consumption of the reserved units.
9. **Content/Service Delivery:** the CTF delivers the content/service at once, in fractions or in individually chargeable items, corresponding to the reserved number of units.
10. **Debit Units Request:** the CTF provides according to previous Reserve Units Response either the request to deduct of an amount corresponding to the consumed number of units from the subscriber's account, or solely the indication of whether the service was successfully delivered or not. In the case that no further units are required for this service, an appropriate indication triggering the release of the remaining reservation is given.
11. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units to deduct from the subscriber's account.
12. **Account Control:** the OCF triggers the deduction of the calculated amount from the subscriber's account.
13. **Debit Units Response:** the OCF informs the CTF of the actually deducted units. Items 10 to 13 may be repeated several times.
14. **Session Released:** the session is released.

Editor"s note: the content of step 9 till 11 should be corrected.

5.2.2.2.3 Decentralized Unit Determination and Decentralized Rating

In the following scenario, the CTF request the OCF to assure the reservation of an amount of the specified number of monetary units from the subscriber's account. An account debit operation that triggers the deduction the amount from the subscriber's account is carried out following the conclusion of service delivery.

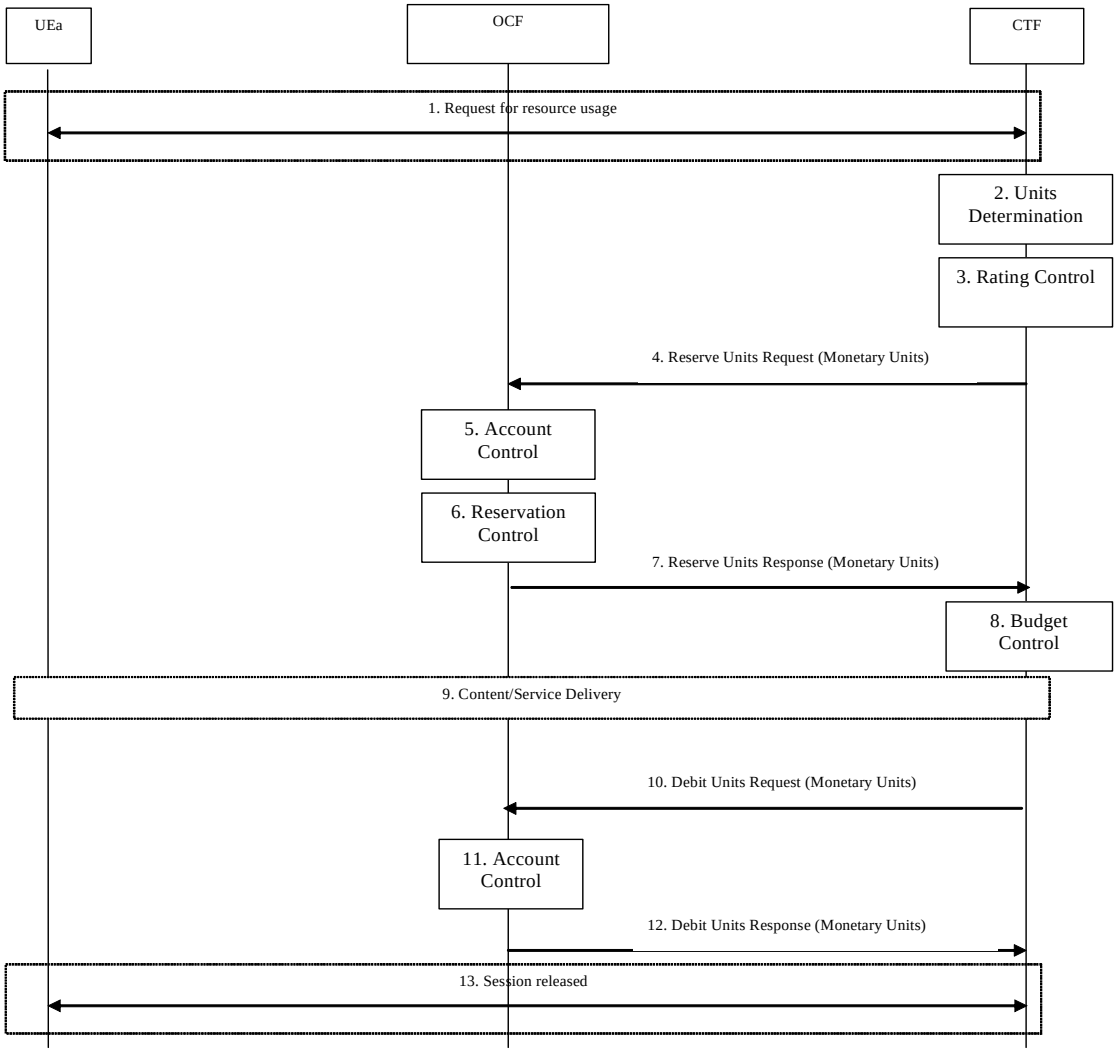


Figure 5.2.2.2.3 : Event Charging with Reservation / Centralized Unit Determination and Centralized Rating

1. **Request for resource usage:** The UE-A requests the desired content from the CTF.
2. **Units Determination:** depending on the service requested by the UE-A, the CTF determines the number of units accordingly.
3. **Rating Control:** the CTF calculates the number of monetary units that represent the price for the number of units determined in item 2.
4. **Reserve Units Request:** the CTF requests the OCF to assure the reservation of an amount corresponding to the calculated number of monetary units from the subscriber's account.
5. **Account Control:** the OCF checks whether the user's account balance is sufficient for the requested reservation.
6. **Reservation Control:** if the user's credit balance is sufficient, then the corresponding reservation is made.
7. **Reserve Units Response:** the OCF informs the CTF of the reserved number of monetary units. Items 4 to 7 may be repeated several times.
8. **Budget Control:** simultaneously with the service delivery, the CTF monitors the consumption of the granted amount.

9. **Content/Service Delivery:** the CTF delivers the content/service at once, in fractions or in individually chargeable items, corresponding to the number of units.
10. **Debit Units Request:** the CTF requests the OCF to assure the deduction of an amount corresponding to the consumed number of monetary units from the subscriber's account.
11. **Account Control:** the OCF triggers the deduction of the consumed amount from the subscriber's account.
12. **Debit Units Response:** the OCF indicates to the CTF the number of deducted monetary units. Items 10 to 12 may be repeated several times.
13. **Session Released:** the session is released.

Editor"s note: Move the above intent to the session charging clause as it is not applicable to event charging. E.g. as an addition to the description in step 9.

5.2.2.3 Session charging with Reservation

5.2.2.3.1 Decentralized Unit Determination and Centralized Rating

In the following scenario, the CTF requests the reservation of units prior to session supervision. An account debit operation is carried out following the conclusion of session termination.

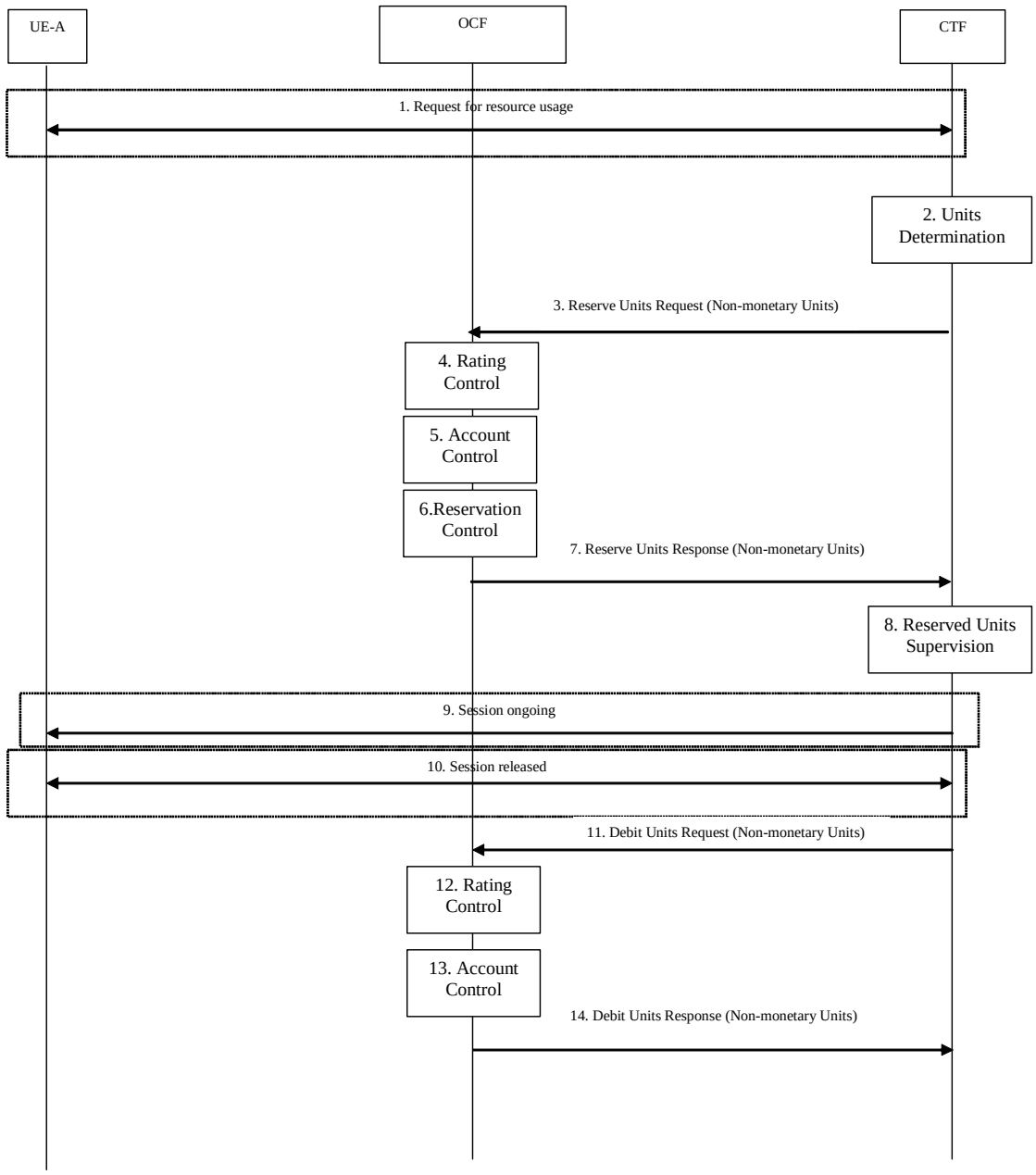


Figure 5.2.2.3.1 : Session Charging with Reservation / Decentralized Unit Determination and Centralized Rating

1. **Request for resource usage:** The UE-A requests session establishment from the CTF.
2. **Units Determination:** depending on the requested type of the session the CTF determines the number of units accordingly.
3. **Reserve Units Request:** the CTF requests the OCF to reserve the number of units determined in item 2
4. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units that represents the price for the number of units determined in item 2.
5. **Account Control:** the OCF checks whether the user's account balance is sufficient for the requested reservation.
6. **Reservation Control:** if the user's account balance is sufficient then the corresponding reservation is made.

7. **Reserve Units Response:** the OCF informs the CTF of the reserved number of units.
8. **Reserved Units Supervision:** simultaneously with the ongoing session, the CTF monitors the consumption of the reserved units.
9. **Session ongoing:** the CTF maintains the session, corresponding to the reserved number of units.
10. **Session Release:** the session is released
11. **Debit Units Request:** the CTF requests the OCF to assure the deduction of an amount corresponding to the consumed number of units from the subscriber's account. In the case that no further units are required for this service, an appropriate indication triggering the release of the remaining reservation is given.
12. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units to deduct from the subscriber's account.
13. **Account Control:** the OCF triggers the deduction of the calculated amount from the subscriber's account.
14. **Debit Units Response:** the OCF informs the CTF of the actually deducted units.

5.2.2.3.2 Centralized Unit Determination and Centralized Rating

In the following scenario, the CTF requests the OCF to reserve units based on the session identifiers specified by the CTF. An account debit operation is carried out following the conclusion of session.

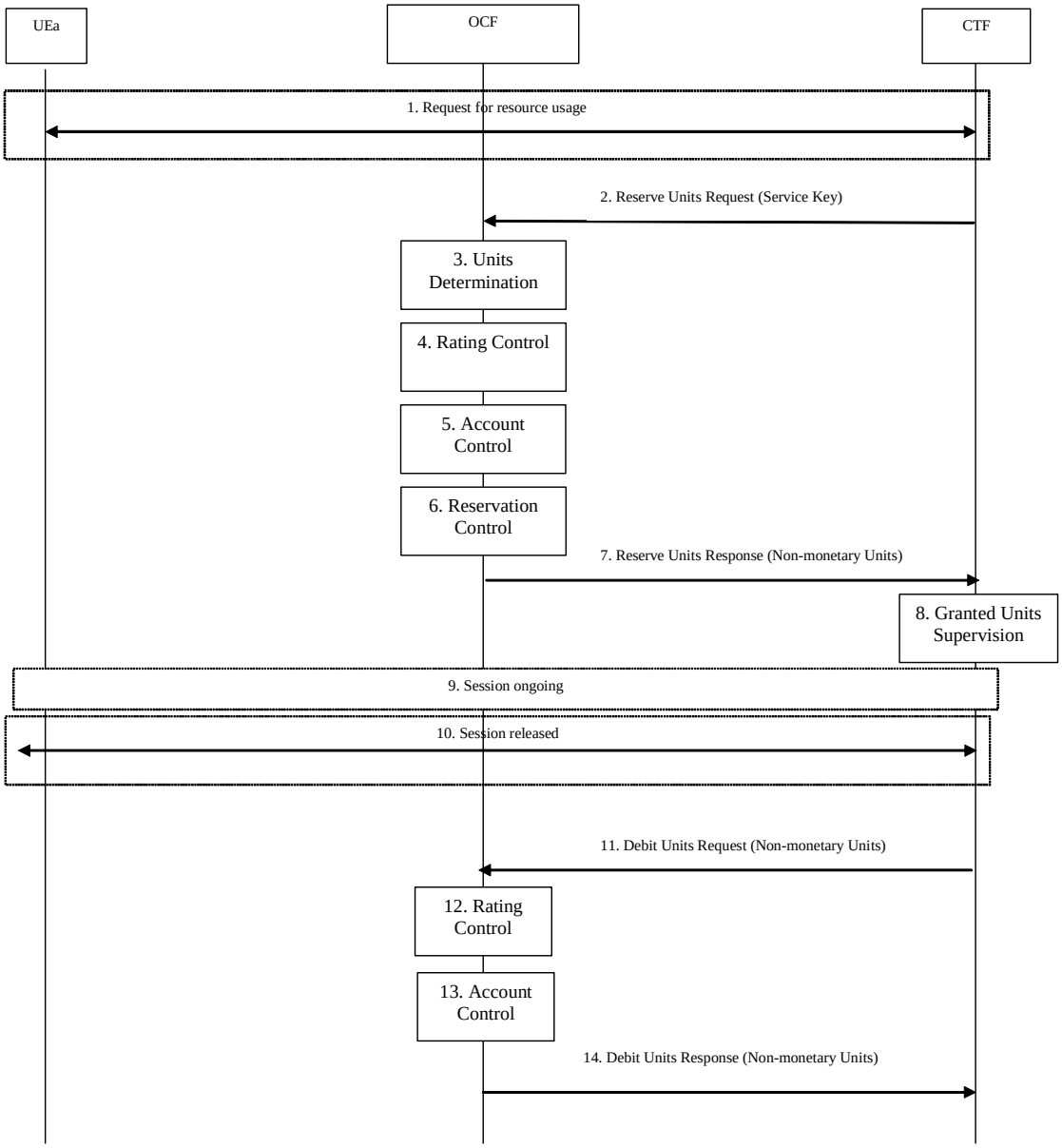


Figure 5.2.2.3.2 : Session Charging with Reservation / Centralized Unit Determination and Centralized Rating

1. **Request for resource usage:** The UE-A requests the session establishment from the CTF.
2. **Reserve Units Request:** depending on the requested type of the session by the UE-A, the CTF selects the service identifier and forwards the Reserve Units Request to the OCF.
3. **Units Determination:** the OCF determines the number of non-monetary units needed for the content/service delivery, based on the received service key.
4. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units that represent the price for the number of units determined in item 3.
5. **Account Control:** the OCF checks whether the user's account balance is sufficient for the requested reservation.
6. **Reservation Control:** if the user's account balance is sufficient, then the corresponding reservation is made.

7. **Reserve Units Response:** the OCF informs the CTF of the reserved number of units. This includes the case where the number of units reserved indicates the permission to render the service that was identified by the received service key.
8. **Granted Units** Supervision**:** simultaneously with the ongoing session, the CTF monitors the consumption of the reserved units.
9. **Content/Service Delivery:** the CTF maintains the session corresponding to the reserved number of units.
10. **Session ongoing:** the CTF provides according to previous Reserve Units Response either the request to deduct of an amount corresponding to the consumed number of units from the subscriber's account, or solely the indication of whether the session was successfully established or not. In the case that no further units are required for this service, an appropriate indication triggering the release of the remaining reservation is given.
11. **Session Released:** the session is released.
12. **Rating Control:** assisted by the rating entity the OCF calculates the number of monetary units to deduct from the subscriber's account.
13. **Account Control:** the OCF triggers the deduction of the calculated amount from the subscriber's account.
14. **Debit Units Response:** the OCF informs the CTF of the actually deducted units.

5.2.2.3.3 Decentralized Unit Determination and Decentralized Rating

In the following scenario, the CTF request the OCF to assure the reservation of an amount of the specified number of monetary units from the subscriber's account. An account debit operation that triggers the deduction the amount from the subscriber's account is carried out following the conclusion of session establishment.

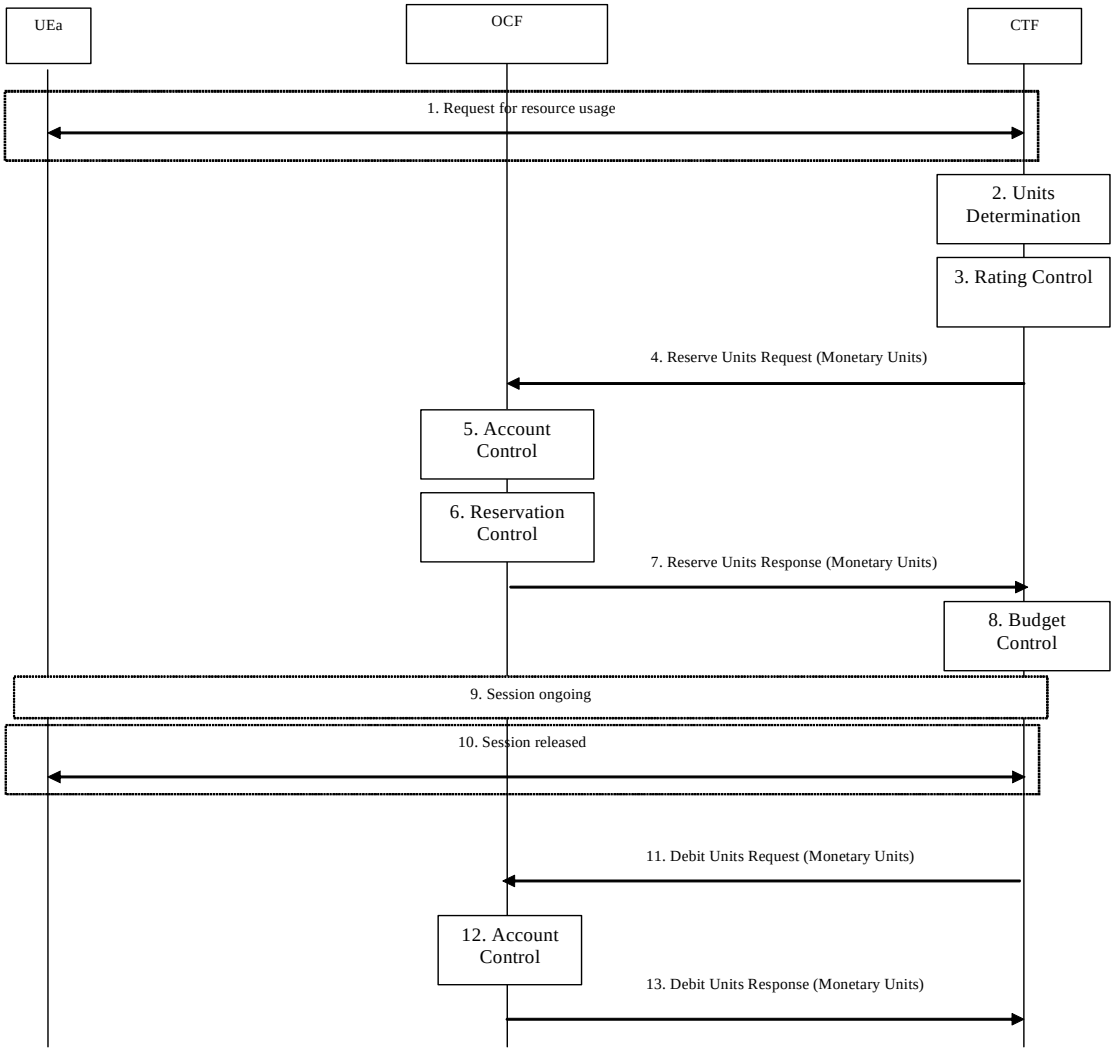


Figure 5.2.2.3.3 : Session Charging with Reservation / Decentralized Unit Determination and Decentralized Rating

1. **Request for resource usage:** The UE-A requests the session establishment from the CTF.
2. **Units Determination:** depending on the requested type of the session by the UE-A, the CTF determines the number of units accordingly.
3. **Rating Control:** the CTF calculates the number of monetary units that represent the price for the number of units determined in item 2.
4. **Reserve Units Request:** the CTF requests the OCF to assure the reservation of an amount corresponding to the calculated number of monetary units from the subscriber's account.
5. **Account Control:** the OCF checks whether the user's account balance is sufficient for the requested reservation.
6. **Reservation Control:** if the user's credit balance is sufficient, then the corresponding reservation is made.
7. **Reserve Units Response:** the OCF informs the CTF of the reserved number of monetary units.
8. **Budget Control:** simultaneously with the ongoing session, the CTF monitors the consumption of the granted amount.
9. **Session ongoing:** the CTF maintains the session corresponding to the number of units.
10. **Session Released:** the session is released.

11. **Debit Units Request:** the CTF requests the OCF to assure the deduction of an amount corresponding to the consumed number of monetary units from the subscriber's account.
12. **Account Control:** the OCF triggers the deduction of the consumed amount from the subscriber's account.
13. **Debit Units Response:** the OCF indicates to the CTF the number of deducted monetary units.

Editor"s note: If needed, it would be moved to another clause on revision.

5.2.3 Basic Operations

Immediate event charging is performed by the use of the "*Debit Units*" operation:

- "*Debit Units Request*"; sent from CTF → OCF
  After receiving a service request from the subscriber, the CTF sends a *Debit Units Request* to the OCF. The CTF may either specify a service identifier (centralised unit determination) or the number of units requested (decentralised unit determination).

- "*Debit Units Response*"; sent from OCF → CTF
  The OCF replies with a *Debit Units Response*, which informs the CTF of the number of units granted as a result of the *Debit Units Request*. This includes the case where the number of units granted indicates the permission to render the requested service.

In addition, the "*Reserve Units*" operation is used with both event charging with unit reservation, and session charging with unit reservation:

- "*Reserve Units Request*"; sent from CTF → OCF
  Request to reserve a number of units for the service to be provided by an CTF. In case of centralised unit determination, the CTF specifies a service identifier in the *Reserve Unit Request*, and the OCF determines the number of units requested. In case of decentralised unit determination, the number of units requested is specified by the CTF.

- "*Reserve Units Response*"; sent from OCF → CTF
  Response from the OCF which informs the CTF of the number of units that were reserved as a result of the "*Reserve Units Request*".

The consumed units are deducted from the subscriber's account after service delivery. Thus, the reserved and consumed units are not necessarily the same. Using this operation, it is also possible for the CTF to modify the current reservation, including the return of previously reserved units.

Table 5.2.3.1 and table 5.2.3.2 describe the content of these operations.

Table 5.2.3.1 : Debit and Reserve Units Request Content

Debit and Reserve Units Request	Category	Description
Session Identifier	M	This field identifies the operation session.
Originator Host	M	This field contains the identification of the source point of the operation.
Originator Domain	M	This field contains the realm of the operation originator.
Destination Domain	M	This field contains the realm of the operation destination.
Operation Identifier	M	This field is a unique operation identifier.
Operation Token	M	This field contains the service identifier.
Operation Type	M	This field defines the transfer type: event for event based charging and start, interim, stop for session based charging.
Operation Number	M	This field contains the sequence number of the transferred messages.
Destination Host	O_C	This field contains the identification of the destination point of the operation.
User Name	O_C	This field contains the identification of the user.
Origination State	O_C	Tbd.
Origination Timestamp	O_C	This field contains the time when the operation is requested.
Subscriber Identifier	O_M	This field contains the identification of the mobile subscriber (i.e. MSISDN) that uses the requested service.
Termination Cause	O_C	This field contains the termination reason of the service.
Requested Action	O_C	This field contains the requested action.
Multiple Operation	O_M	This field indicate the occurrence of multiple operations.
Multiple Unit Operation	O_M	This field contains the parameter for the quota management.
Subscriber Equipment Number	O_C	This field contains the identification of the mobile device (i.e. IMEI) that uses the subscriber.
Proxy Information	O_C	This field contains the parameter of the proxy.
Route Information	O_C	This field contains the parameter of the route.
Service Information	O_M	This field holds additional 3GPP service specific parameter: - PS Information, - WLAN Information, - IMS Information, - MMS Information - LCS Information, - PoC Information, - MBMS Information
Extended Information	O_C	This field holds the network/manufacturer specific extentions.

Table 5.2.3.2 : Debit and Reserve Units Response Content

Debit and Reserve Units Response	Category	Description
Session Identifier	M	This field identifies the operation session.
Operation Result	M	This field identifies the result of the operation.
Originator Host	M	This field contains the identification of the source point of the operation.
Originator Domain	M	This field contains the realm of the operation originator.
Operation Identifier	M	This field is a unique operation identifier.
Operation Type	M	This field defines the transfer type: event for event based charging and start, interim, stop for session based charging.
Operation Number	M	This field contains the sequence number of the transferred messages.
Operation Failover	O_C	This field contains an indication to the CTF whether or not a failover handling is to be used when necessary.
Multiple Unit Operation	O_M	This field contains the parameter for the quota management.
Operation Failure Action	O_C	Tbd.
Redirection Host	O_C	Tbd.
Redirection Host Usage	O_C	Tbd.
Redirection Cache Time	O_C	Tbd.
Proxy Information	O_C	This field contains the parameter of the proxy.
Route Information	O_C	This field contains the parameter of the route.
Failed parameter	O_C	This field contains missing and/or unsupported parameter that caused the failure.
Extended Information	O_C	This field holds the network/manufacturer specific extentions.

5.3 Other requirements

5.3.1 Re-authorization

The server may specify an idle timeout associated with a granted quota. Alternatively, the client may have a configurable default value. The expiry of that timer shall trigger a re-authorization request.

Mid-session service events (re-authorisation triggers) may affect the rating of the current service usage. The server may instruct the credit control client to re-authorize the quota upon a number of different session related triggers that can affect the rating conditions.

When a re-authorization is trigger, the client shall reports quota usage. The reason for the quota being reported shall be notified to the server.

5.3.2 Threshold based re-authorization triggers

The server may optionally include an indication to the client of the remaining quota threshold that shall trigger a quota re-authorization.

5.3.3 Termination action

The server may specify to the client the behaviour on consumption of the final granted units; this is known as termination action.

6 3GPP Charging Applications – Protocol Aspects

6.1 Basic Principles for Diameter Offline Charging

In order to support the offline charging principles described in the present document, the Diameter client and server must implement at least the following Diameter options listed in RFC 3588 [401], i.e. the basic functionality of Diameter accounting, as defined by the Diameter Base Protocol (RFC 3588 [401]) is re-used..

Editor"s note: Create a relation between the CTF & the Diameter client, and, the CDF and the Diameter Server.

The charging architecture implementing Diameter adheres to the structure where all communications for offline charging purposes between the CTF and the CDF are carried out on the Diameter Rf reference point, where the CTF reports charging information to the Charging Data Function (CDF). The CDF uses this information to construct and format CDRs. The above-mentioned reference points are defined in 3GPP TS 32.240 [1].

A configurable timer is supported in the CDF to supervise the reception of the ACR [Interim] and/or ACR [Stop]. An instance of the "Timer" is started at the beginning of the accounting session, reset on the receipt of an ACR [Interim] and stopped at the reception of the ACR [Stop]. Upon expiration of the timer, the CDF stops the accounting session with the appropriate error indication.

For offline charging, the client implements the accounting state machine described in RFC 3588 [401]. The server (CDF) implements the accounting state machine "SERVER, STATELESS ACCOUNTING" as specified in RFC 3588 [401], i.e. there is no order in which the server expects to receive the accounting information.

The offline charging functionality is based on the network elements reporting accounting information upon reception of various messages which trigger charging generation, as most of the accounting relevant information is contained in these messages. This reporting is achieved by sending Diameter *Accounting Requests* (ACR) [Start, Interim, Stop and Event] from the network elements to the CDF.

Following the Diameter base protocol specification, the following "types" of accounting data may be sent with regard to offline charging:

- START session accounting data.
- INTERIM session accounting data.
- STOP session accounting data.
- EVENT accounting data.

Two cases are currently distinguished for offline charging purposes:

- Event based charging; and
- Session based charging.

ACR types START, INTERIM and STOP are used for accounting data related to successful sessions. In contrast, EVENT accounting data is unrelated to sessions, and is used e.g. for a simple registration or interrogation and successful service event triggered by a network element. In addition, EVENT accounting data is also used for unsuccessful session establishment attempts.

The flows and scenarios for the above two described cases are further detailed below.

6.1.1 Event based charging

In the case of event based charging, the network reports the usage or the service rendered where the service offering is rendered in a single operation. It is reported using the ACR EVENT.

The following figure shows the transactions that are required on the Diameter offline interface in order to perform event based charging. The operation may alternatively be carried out prior to, concurrently with or after service/content delivery.

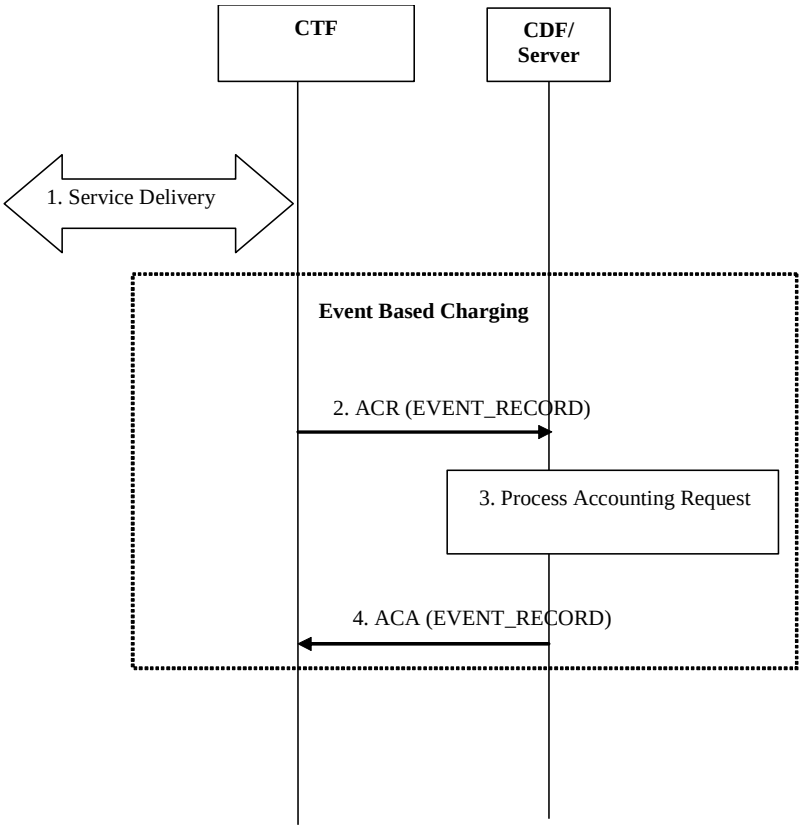


Figure 6.1.1 : Event Based offline charging

Step 1: The network element receives indication that service has been used/delivered.

Step 2: The network element (acting as client) sends *Accounting-Request* (ACR) with *Accounting-Record-Type* AVP set to EVENT_RECORD to indicate service specific information to the CDF (acting as server).

Step 3: The CDF receives the relevant service charging parameters and processes accounting request.

Step 4: The CDF returns *Accounting-Answer* message with *Accounting-Record-Type* AVP set to EVENT_RECORD to the network element in order to inform that charging information was received.

6.1.2 Session based charging

Session based charging is the process of reporting usage reports for a session and uses the START, INTERIM & STOP accounting data. During a session, a network element may transmit multiple ACR Interims' depending on the proceeding of the session.

The following figure shows the transactions that are required on the Diameter offline interface in order to perform session based charging.

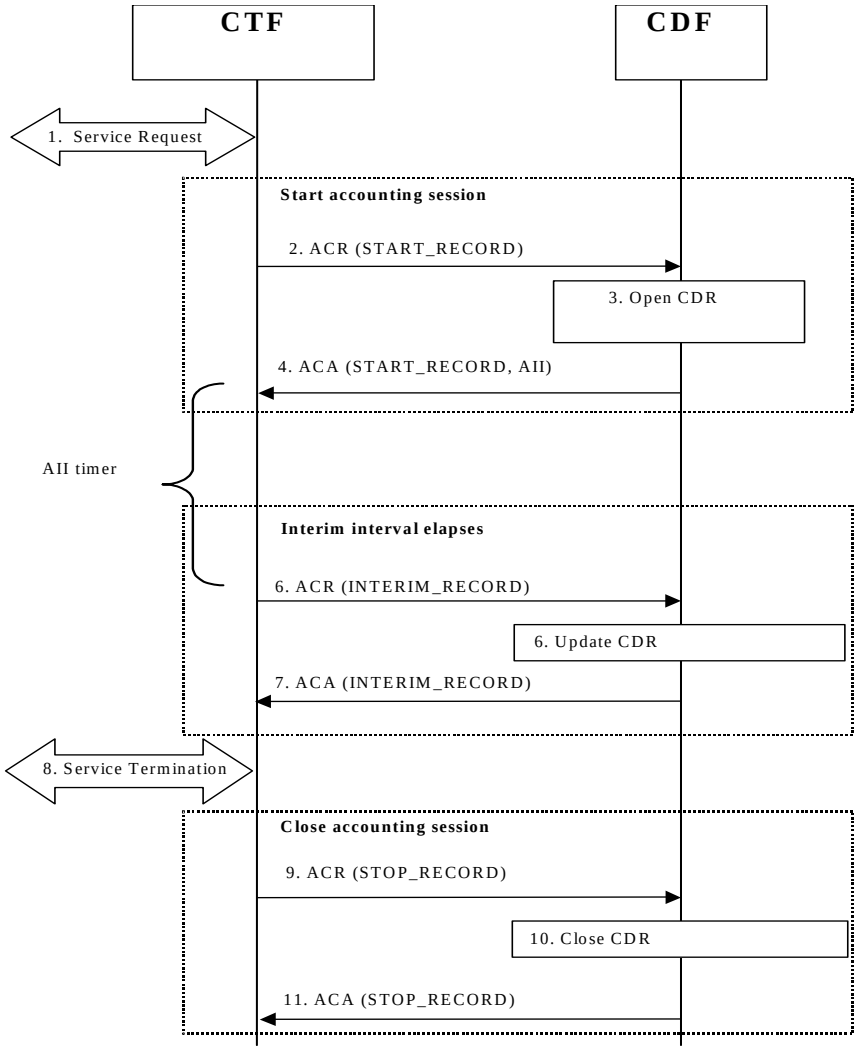


Figure 6.1.2 : Session based offline charging

Step 1: The network element receives a service request. The service request may be initiated either by the user or the other network element.

Step 2: In order to start accounting session, the network element sends a *Accounting-Request* (ACR) with *Accounting-Record-Type* AVP set to START_RECORD to the CDF.

Step 3: The CDF opens a CDR for current session.

Step 4: The CDF returns *Accounting-Answer* (ACA) message with *Accounting-Record-Type* set to START_RECORD to the network element and possibly *Acct-Interim-Interval AVP* (AII) set to non-zero value indicating the desired intermediate charging interval.

Step 5: When AII elapse the network element sends an *Accounting-Request* (ACR) with *Accounting-Record-Type* AVP set to INTERIM_RECORD to the CDF.

Step 6: The CDF updates the CDR in question.

Step 7: The CDF returns *Accounting-Answer* (ACA) message with *Accounting-Record-Type* set to INTERIM_RECORD to the network element.

Step 8: The service is terminated.

Step 9: The network element sends a *Accounting-Request* (ACR) with *Accounting-Record-Type* AVP set to STOP_RECORD to the CDF.

Step 10: The CDF updates the CDR accordingly and closes the CDR.
Step 11: The CDF returns *Accounting-Answer* (ACA) message with *Accounting-Record-Type* set to STOP_RECORD to the network element.

6.1.3 Offline charging error cases - Diameter procedures

6.1.3.1 CDF Connection Failure

When the connection towards the primary CDF is broken, the process of sending accounting information should continue towards a secondary CDF (if such a CDF is configured). For further CDF connection failure functionality, see subclause "*Transport Failure Detection*" in the RFC 3588 [401].

If no CDF is reachable the network element may buffer the generated accounting data in non-volatile memory. Once the CDF connection is working again, all accounting messages stored in the buffer is sent to the CDF, in the order they were stored in the buffer.

6.1.3.2 No Reply from CDF

In case a network element does not receive an ACA in response to an ACR, it may retransmit the ACR message. The waiting time until a retransmission is sent, and the maximum number of repetitions are both configurable by the operator. When the maximum number of retransmissions is reached and still no ACA reply has been received, the network element executes the CDF connection failure procedure as specified above.

If retransmitted ACRs' are sent, they are marked with the T-flag as described in RFC 3588 [401], in order to allow duplicate detection in the CDF, as specified in the next subclause.

6.1.3.3 Duplicate Detection

A Diameter client marks possible duplicate request messages (e.g. retransmission due to the link fail over process) with the T-flag as described in RFC 3588 [401].

If the CDF receives a message that is marked as retransmitted and this message was already received, then it discards the duplicate message. However, if the original of the re-transmitted message was not yet received, it is the information in the marked message that is taken into account when generating the CDR. The CDRs are marked if information from duplicated message(s) is used.

6.1.3.4 CDF Detected Failure

The CDF closes a CDR when it detects that expected Diameter ACRs for a particular session have not been received for a period of time. The exact behaviour of the CDF is operator configurable.

6.2 Message Contents for Offline Charging

6.2.1 Summary of Offline Charging Message Formats

6.2.1.1 General

The corresponding Diameter accounting application messages for the Charging Data Transfer operation is Accounting Request (ACR) and Accounting Answer (ACA) as specified in the Diameter Base Protocol accounting application [401].

The following table describes the use of these messages for offline charging.

Table 6.2.1.1 : Offline Charging Messages Reference Table

Command-Name	Source	Destination	Abbreviation
Accounting-Request	CTF	CDF	ACR
Accounting-Answer	CDF	CTF	ACA

6.2.1.2 Structure for the Accounting Message Formats

The following is the basic structure shared by all offline charging messages. This is based directly on the format of the messages defined in the Diameter Base Protocol Application specification [401].

Those Diameter Accounting AVPs that are used for 3GPP offline charging are marked in the table 6.2.2 and table 6.2.3 with a category as specified in TS 32.240 [1].

The following symbols are used in the message format definition:

- <AVP> indicates a mandatory AVP with a fixed position in the message.
- {AVP} indicates a mandatory AVP in the message.
- [AVP] indicates an optional AVP in the message.
- *AVP indicates that multiple occurrences of an AVP is possible.

6.2.2 Accounting-Request Message

The ACR messages, indicated by the Command-Code field set to 271 is sent by the CTF to the CDF in order to sent charging information for the request bearer / subsystem /service.

The ACR message format is defined according to the Diameter Base Protocol [401] as follows:

```
<ACR> ::= < Diameter Header: 271, REQ, PXY >
          < Session-Id >
          { Origin-Host }
          { Origin-Realm }
          { Destination-Realm }
          { Accounting-Record-Type }
          { Accounting-Record-Number }
          [ Acct-Application-Id ]
          [ Vendor-Specific-Application-Id ]
          [ User-Name ]
          [ Accounting-Sub-Session-Id ]
          [ Acct-Session-Id ]
          [ Acct-Multi-Session-Id ]
          [ Acct-Interim-Interval ]
          [ Accounting-Realtime-Required ]
          [ Origin-State-Id ]
          [ Event-Timestamp ]
        * [ Proxy-Info ]
        * [ Route-Record ]
          [ Service-Information ]
        * [ AVP ]
```

NOTE: Similar information as in subscription_id should be added as 3GPP parameter, IMEI.

Table 6.2.2 illustrates the basic structure of a 3GPP Diameter *Accounting-Request* message as used for 3GPP offline charging.

Table 6.2.2 : 3GPP Accounting-Request Message Contents

AVP	Category	Description
Session-Id	M	Used as defined in DBP [401].
Origin-Host	M	Used as defined in DBP [401].
Origin-Realm	M	Used as defined in DBP [401].
Destination-Realm	M	Used as defined in DBP [401].
Accounting-Record-Type	M	Used as defined in DBP [401].
Accounting-Record-Number	M	Used as defined in DBP [401].
Acct-Application-Id	O_M	The field corresponds to the application ID of the Diameter Accounting Application and is defined with the value 3.
Vendor-Specific-Application-Id	-	Not used in 3GPP.
Vendor-Id	-	Not used in 3GPP.
Auth-Application-Id	-	Not used in 3GPP.
Acct-Application-Id	-	Not used in 3GPP.
User-Name	-	Not used in 3GPP.
Accounting-Sub-Session-Id	-	Not used in 3GPP.
Accounting-RADIUS-Session-Id	-	Not used in 3GPP.
Acct-Multi-Session-Id	-	Not used in 3GPP.
Acct-Interim-Interval	O_C	
Accounting-Realtime-Required	-	Not used in 3GPP.
Origin-State-Id	O_C	
Event-Timestamp	O_C	
Proxy-Info	O_C	
Proxy-Host	O_C	
Proxy-State	O_C	
Route-Record	Oc	
Service-Information	O_M	This is a grouped AVP and holds the 3GPP specific parameter as defined in clause 7.2.
AVP	-	Not used in 3GPP.

NOTE: A detailed description of the AVPs is provided in clause 7.

6.2.3 Accounting-Answer Message

The Accounting Answer (ACA) messages, indicated by the Command-Code field set to 271 is sent by the CDF to the CTF in order to reply to the ACR.

The ACA message format is defined according to the Diameter Base Protocol [401] as follows:

```
<ACA> ::= < Diameter Header: 271, PXY >
          < Session-Id >
          { Result-Code }
          { Origin-Host }
          { Origin-Realm }
          { Accounting-Record-Type }
          { Accounting-Record-Number }
          [ Acct-Application-Id ]
          [ Vendor-Specific-Application-Id ]
          [ User-Name ]
          [ Accounting-Sub-Session-Id ]
          [ Acct-Session-Id ]
          [ Acct-Multi-Session-Id ]
          [ Error-Reporting-Host ]
          [ Acct-Interim-Interval ]
          [ Accounting-Realtime-Required ]
          [ Origin-State-Id ]
          [ Event-Timestamp ]
        * [ Proxy-Info ]
        * [ AVP ]
```

Table 6.2.3 illustrates the basic structure of a 3GPP Diameter *Accounting-Answer* message as used for offline charging. This message is always used by the CDF as specified below, regardless of the CTF it is received from and the ACR record type that is being replied to.

Table 6.2.3 : 3GPP Accounting-Answer (ACA) Message Content

AVP	Category	Description
Session-Id	M	Used as defined in DBP [401]
Result-Code	M	Used as defined in DBP [401]
Origin-Host	M	Used as defined in DBP [401]
Origin-Realm	M	Used as defined in DBP [401]
Accounting-Record-Type	M	Used as defined in DBP [401]
Accounting-Record-Number	M	Used as defined in DBP [401]
Acct-Application-Id	O_M	The field corresponds to the application ID of the Diameter Accounting Application and is defined with the value 3.
Vendor-Specific-Application-Id	-	Not used in 3GPP
Vendor-Id	-	Not used in 3GPP
Auth-Application-Id	-	Not used in 3GPP
Acct-Application-Id	-	Not used in 3GPP
User-Name	O_C	
Accounting-Sub-Session-Id	-	Not used in 3GPP
Accounting-RADIUS-Session-Id	-	Not used in 3GPP
Acct-Multi-Session-Id	-	Not used in 3GPP
Error-Reporting-Host	-	Not used in 3GPP
Acct-Interim-Interval	O_C	
Accounting-Realtime-Required	-	Not used in 3GPP
Origin-State-Id	O_C	
Event-Timestamp	O_C	
Proxy-Info	O_C	
Proxy-Host	O_C	
Proxy-State	O_C	
AVP	-	Not used in 3GPP

6.3 Basic Principles for Diameter Online charging

Editor's note: This clause has been added to update the document to the Rel-6 IETF dependency on the Diameter Credit Control Application and currently does not exist in the 3GPP Rel-5 3GPP TS 32.225.

6.3.1 Online Specific Credit Control Application Requirements

For online charging, the basic functionality as defined by the IETF Diameter Credit Control application is used. The basic structure follows a mechanism where the online client (CTF) requests resource allocation and reports credit control information to the Online Charging System (OCS).

The usage and values of *Validity-Time* AVP and the timer "Tcc" are under the sole control of the credit control server (OCS) and determined by operator configuration of the OCS.

Editor"s note: There may be a requirement to add a minimum value for the *Validity-Time* AVP. It may need to be moved the subsection where the *Validity-Time AVP* is handled.

The online client implements the state machine described in IETF RFC 4006 [402] for "CLIENT, EVENT BASED" and/or "CLIENT, SESSION BASED". I.e. when the client applies IEC it uses the "CLIENT, EVENT BASED" state machine, and when the client applies ECUR it uses the "CLIENT, SESSION BASED" state machine for the first, intermediate and final interrogations.

The OCS implements the state machine described in IETF RFC 4006 [402] for the "SERVER, SESSION AND EVENT BASED" in order to support Immediate Event Charging and Event Charging with Unit Reservation.

6.3.2 Diameter Description on the Ro reference point

Editor"s note: Message flows and scenarios should be moved into clause 5.

6.3.2.1 Basic Principles

For online charging the Diameter Credit Control Application (DCCA) defined in IETF RFC 4006 [402] is used with additional AVPs defined in the present document.

Three cases for control of user credit for online charging are distinguished:

- Immediate Event Charging IEC; and
- Event Charging with Unit Reservation (ECUR).
- Session Charging with Unit Reservation (SCUR)

In the case of Immediate Event Charging (IEC),the credit control process for events is controlled by the corresponding *CC-Requested-Type* EVENT_REQUEST that is sent with Credit-*Control-Request (*CCR) for a given credit control event.

In the case of Event Charging with Unit Reservation (ECUR) the *CC-Request-Type* INITIAL / TERMINATION_REQUEST are used for charging for a given credit control event, however, where a reservation is made prior to service delivery and committed on execution of a successful delivery.

Session Charging with Unit Reservation is used for credit control of sessions and uses the *CC-Request-Type* INITIAL / UPDATE and TERMINATION_REQUEST.

The network element may apply IEC, where CCR Event messages are generated, or ECUR, using CCR Initial, Termination and Update. The decision whether to apply IEC or ECUR is based on the service and/or operator's policy.

NOTE: To the extent possible alignment with IETF RFC 4006 [402] is planned. However, this can only be accomplished when the current IETF draft receives an official RFC status.

Editor"s note: Incorporate the framework from 32.200 for ECUR and IEC to this document.

Editor"s note: Include 3 scenarios. Distinguish between Event & Session.

Editor"s note: Use of CCR Update in ECUR is ffs.

6.3.3 Immediate Event Charging (IEC)

Figure 6.3.3 shows the transactions that are required on the Ro reference point in order to perform event based Direct Debiting operation. The Direct Debiting operation may alternatively be carried out prior to service/content delivery. The Network Element must ensure that the requested service execution is successful, when this scenario is used.

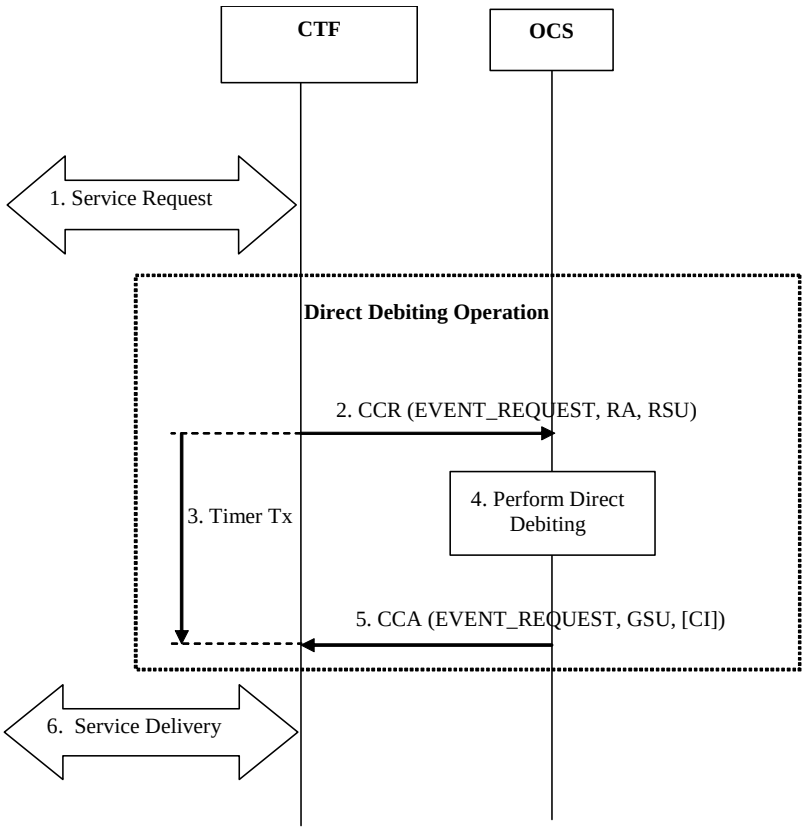


Figure 6.3.3 : IEC Direct Debiting Operation

Step 1. The network element receives a service request.
The Direct Debiting Operation is performed as described in IETF RFC 4006 [402].

Step 2. The network element performs direct debiting prior to service execution. Network element (acting as DCCA client) sends *Credit-Control-Request* (CCR) with *CC-Request-Type* AVP set to EVENT_REQUEST to indicate service specific information to the OCS (acting as DCCA server). The *Requested-Action* AVP (RA) is set to DIRECT_DEBITING. If known, the network element may include *Requested-Service-Unit* AVP (RSU) (monetary or non-monetary units) in the request message.

Step 3. Having transmitted the *Credit-Control-Request* message the network element starts the communication supervision timer 'Tx' (IETF RFC 4006 [402]). Upon receipt of the *Credit-Control- Answer* (CCA) message the network element shall stop timer Tx.

Step 4. The OCS determines the relevant service charging parameters .

Step 5. The OCS returns *Credit-Control-Answer* message with *CC-Request-Type* AVP set to EVENT_REQUEST to the network element in order to authorize the service execution (*Granted-Service-Unit* AVP (GSU) and possibly *Cost-Information* AVP (CI) indicating the cost of the service are included in the *Credit-Control-Answer* message). The *Credit-Control-Answer* message has to be checked by the network element accordingly and the requested service is controlled concurrently with service delivery.

Step 6. Service is being delivered.

NOTE: It is possible to perform also REFUND_ACCOUNT, CHECK_BALANCE and PRICE_ENQUIRY using above described mechanism IETF RFC 4006 [402].

6.3.4 Event Charging with Unit Reservation (ECUR)

Figure 6.3.4 shows the transactions that are required on the Ro reference point in order to perform the SBCC or the session based reserve and debit units operation. Multiple replications of both of these operations are possible.

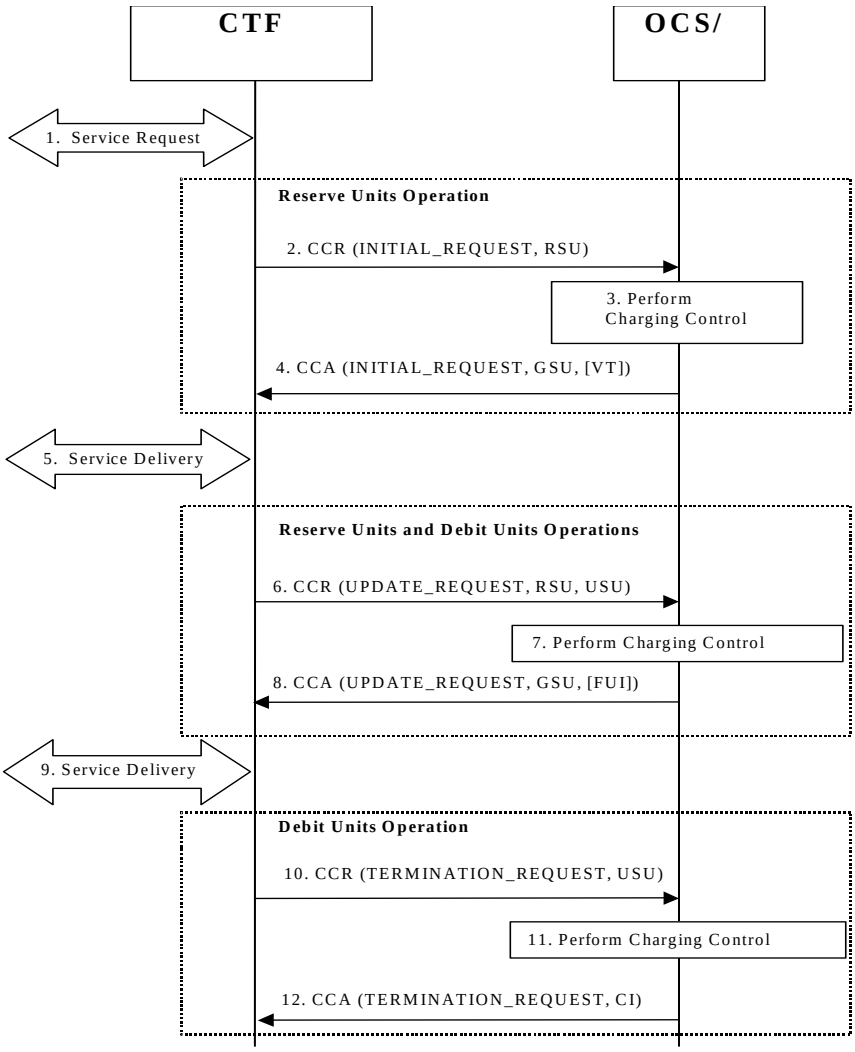


Figure 6.3.4 : ECUR for session based credit control

Step 1. The network element receives a service request. The service request may be initiated either by the user or the other network element.

Step 2. In order to perform Reserve Units operation for a number of units (monetary or non-monetary units), the network element sends a *Credit-Control-Request* (CCR) with *CC-Request-Type* AVP set to INITIAL_REQUEST to the OCS. If known, the network element may include *Requested-Service-Unit* (RSU) AVP (monetary or non monetary units) in the request message.

Step 3. If the service cost information is not received by the OCS, the OCS determines the price of the desired service according to the service specific information received by issuing a rating request to the Rating Function. If the cost of the service is included in the request, the OCS directly reserves the specified monetary amount. If the credit balance is sufficient, the OCS reserves the corresponding amount from the users account.

Step 4. Once the reservation has been made, the OCS returns *Credit-Control-Answer* (CCA) message with *CC-Request-Type* set to INITIAL_REQUEST to the network element in order to authorize the service execution (*Granted-Service-Unit* and possibly *Cost-Information* indicating the cost of the service are included in the *Credit-Control-Answer* message). The OSC may return the *Validity-Time* (VT) AVP with value field set to a non-zero value.

Step 5. Content/service delivery starts and the reserved units are concurrently controlled.

Step 6. During content/service delivery, in order to perform Debit Units and subsequent Reserve Units operations, the network element sends a CCR with *CC-Request-Type* AVP set to UPDATE_REQUEST, to report the units used and request additional units, respectively. The CCR message with *CC-Request-Type* AVP set to UPDATE_REQUEST must be sent by the network element between the INITIAL_REQUEST and TERMINATION_REQUEST either on request of the credit control application within the validity time or if the validity time is elapsed. If known, the network element may include *Requested-Service-Unit* AVP (monetary or non monetary units) in the request message. The *Used-Service-Unit* (USU) AVP is complemented in the CCR message to deduct units from both the user's account and the reserved units, respectively.

Step 7. The OCS deducts the amount used from the account. If the service cost information is not received by the OCS, the OCS determines the price of the desired service according to the service specific information received by issuing a rating request to the Rating Function. If the cost of the service is included in the request, the OCS directly reserves the specified monetary amount. If the credit balance is sufficient, the OCS reserves the corresponding amount from the users account.

Step 8. Once the deduction and reservation have been made, the OCS returns *Credit-Control-Answer* message with *CC-Request-Type* set to UPDATE_REQUEST to the network element, in order to allow the content/service delivery to continue (new *Granted-Service-Unit (GSU) AVP* and possibly *Cost-Information (CI) AVP* indicating the cumulative cost of the service are included in the *Credit-Control-Answer* message). The OCS may include in the CCA message the *Final-Unit-Indication* (FUI) AVP to indicate the final granted units.

Step 9. Content/service delivery continues and the reserved units are concurrently controlled.

Step 10. When content/service delivery is completed or the final granted units have been consumed, the network element sends CCR with *CC-Request-Type* AVP set to INTERIM_REQUEST to terminate the active credit control session and report the used units.

Step 11. The OCS deducts the amount used from the account. Unused reserved units are released, if applicable.

Step 12. The OCS acknowledges the reception of the CCR message by sending CCA message with *CC-Request-Type* AVP indicating TERMINATION_REQUEST (possibly *Cost-Information* AVP indicating the cumulative cost of the service is included in the *Credit-Control-Answer* message).

NOTE: This scenario is supervised by corresponding timers (e.g. validity time timer) that are not shown in the figure 6.3.4.

6.3.5 Session Charging with Unit Reservation (SCUR)

Figure 6.3.5 shows the transactions that are required on the Ro reference point in order to perform the SCUR.

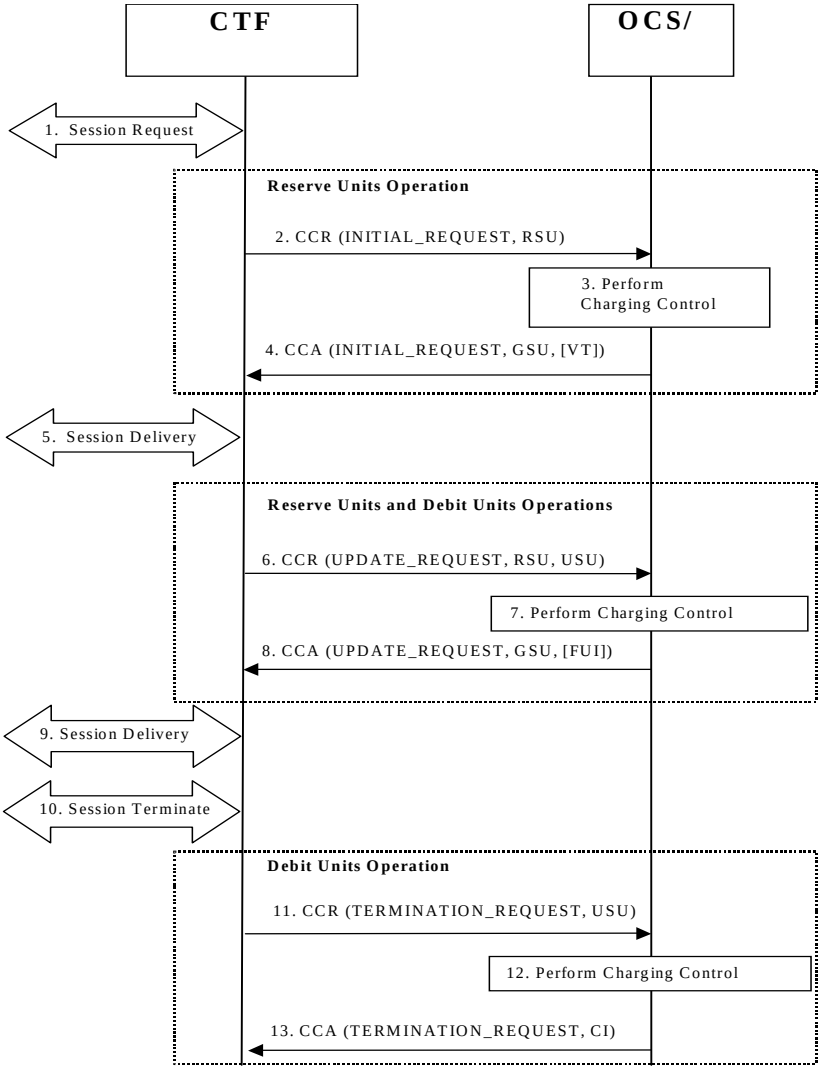


Figure 6.3.5 : SCUR for session based credit control

Step 1. The network element receives a session initiation. The session initiation may be done either by the user or the other network element.

Step 2. In order to perform Reserve Units operation for a number of units (monetary or non-monetary units), the network element sends a *Credit-Control-Request* (CCR) with *CC-Request-Type* AVP set to INITIAL_REQUEST to the OCS. If known, the network element may include *Requested-Service-Unit* (RSU) AVP (monetary or non monetary units) in the request message.

Step 3. If the service cost information is not received by the OCS, the OCS determines the price of the desired service according to the service specific information received by issuing a rating request to the Rating Function. If the cost of the service is included in the request, the OCS directly reserves the specified monetary amount. If the credit balance is sufficient, the OCS reserves the corresponding amount from the users account.

Step 4. Once the reservation has been made, the OCS returns *Credit-Control-Answer* (CCA) message with *CC-Request-Type* set to INITIAL_REQUEST to the network element in order to authorize the service execution (*Granted-Service-Unit* and possibly *Cost-Information* indicating the cost of the service are included in the *Credit-Control-Answer* message). The OSC may return the *Validity-Time* (VT) AVP with value field set to a non-zero value.

Step 5. Content/service delivery starts and the reserved units are concurrently controlled.

Step 6. During session delivery, in order to perform Debit Units and subsequent Reserve Units operations, the network element sends a CCR with *CC-Request-Type* AVP set to UPDATE_REQUEST, to report the units used and request additional units, respectively. The CCR message with *CC-Request-Type* AVP set to UPDATE_REQUEST must be sent by the network element between the INITIAL_REQUEST and TERMINATION_REQUEST either on request of the credit control application within the validity time or if the validity time is elapsed. If known, the network element may include *Requested-Service-Unit* AVP (monetary or non monetary units) in the request message. The *Used-Service-Unit* (USU) AVP is complemented in the CCR message to deduct units from both the user's account and the reserved units, respectively.

Step 7. The OCS deducts the amount used from the account. If the service cost information is not received by the OCS, the OCS determines the price of the desired service according to the service specific information received by issuing a rating request to the Rating Function. If the cost of the service is included in the request, the OCS directly reserves the specified monetary amount. If the credit balance is sufficient, the OCS reserves the corresponding amount from the users account.

Step 8. Once the deduction and reservation have been made, the OCS returns *Credit-Control-Answer* message with *CC-Request-Type* set to UPDATE_REQUEST to the network element, in order to allow the content/service delivery to continue (new *Granted-Service-Unit (GSU) AVP* and possibly *Cost-Information (CI) AVP* indicating the cumulative cost of the service are included in the *Credit-Control-Answer* message). The OCS may include in the CCA message the *Final-Unit-Indication* (FUI) AVP to indicate the final granted units.

Step 9. Session delivery continues and the reserved units are concurrently controlled.

Step 10. The session is terminated at the network element.

Step 11. The network element sends CCR with *CC-Request-Type* AVP set to TERMINATION_REQUEST to terminate the active credit control session and report the used units.

Step 12. The OCS deducts the amount used from the account. Unused reserved units are released, if applicable.

Step 13. The OCS acknowledges the reception of the CCR message by sending CCA message with *CC-Request-Type* AVP indicating TERMINATION_REQUEST (possibly *Cost-Information* AVP indicating the cumulative cost of the service is included in the *Credit-Control-Answer* message).

NOTE: This scenario is supervised by corresponding timers (e.g. validity time timer) that are not shown in figure 6.3.5.

6.3.6 Error Cases and Scenarios

This subclause describes various error cases and how these should be handled.

The failure handling behaviour is locally configurable in the network element. If the *Direct-Debiting-Failure-Handling* or *Credit-Control-Failure-Handling* AVP is not used, the locally configured values are used instead.

6.3.6.1 Duplicate Detection

The detection of duplicate request is needed and must be enabled. To speed up and simplify as much as possible the duplicate detection, the all-against-all record checking should be avoided and just those records marked as potential duplicates need to be checked against other received requests (in real-time) by the receiver entity.

The network element marks the request messages that are retransmitted after a link fail over as possible duplicates with the T-flag as described in [401]. For optimized performance, uniqueness checking against other received requests is only necessary for those records marked with the T-flag received within a reasonable time window. This focused check is based on the inspection of the *Session-Id* and *CC-Request-Number* AVP pairs.

Note that for EBCC the duplicate detection is performed in the Correlation Function that is part of the OCS. The OCS that receives the possible duplicate request should mark as possible duplicate the corresponding request that is sent over the 'Rc' reference point. However, this assumption above is for further study and needs to be clarified.

For credit control duplicate detection, please refer to the Diameter Credit Control.

6.3.6.2 Reserve Units and Debit Units Operation Failure

In the case of an OCS connection failure, and/or receiving error responses from the OCS, please refer to RFC 3588 [401] and the Diameter Credit Control for failure handling descriptions.

6.3.7 Support of Tariff Changes during an Active User Session

6.3.7.1 Support of Tariff Changes using the Tariff Switch Mechanism

After a tariff switch has been reached, all the active user sessions shall report their session usage by the end of the validity period of the current request and receive new quota for resource usage for the new tariff period.

In order to avoid the need for mass simultaneous quota refresh, the traffic usage can be split into resource usage before a tariff switch and resources used after a tariff switch.

The Tariff-Time-Change AVP is used to determine the tariff switch time as described by IETF RFC 4006 [402]. In addition to the scenarios described in IETF RFC 4006 [402], the Tariff-Time-Change AVP may also be used in the context of continuously time-based charging.

The Tariff-Change-Usage AVP is used within the Used-Service-Units AVP to distinguish reported usage before and after the tariff time change.

The Tariff-Change-Usage AVP is used within the Multiple-Services-Credit-Control AVP to allow separate quotas to be granted for use before and after the tariff switch. If this AVP is not present, the granted quota may be consumed both before and after the tariff switch, but usage must still be reported separately.

6.3.7.2 Support of Tariff Changes using Validity Time AVP

Changes to the tariffs pertaining to the service during active user sessions may also be handled using the Validity Time AVP as described by IETF RFC 4006 [402].

Editor's note: Additional details need to be added.

6.3.8 Support of Re-authorisation

Mid Diameter CC session re-authorisations of multiple active resource quotas within a DCC (sub-)session can be achieved using a single Diameter *Credit Control Request/Answer* message sequence.

The OCS may also re-authorise multiple active resource quotas within a DCC (sub-)session by using a single Diameter *Re-Auth-Request/Answer* message sequence.

New quota allocations received by the Network Element override any remaining held quota resources after accounting for any resource usage while the re-authorisation was in progress.

6.3.9 Support of Failure Handling

The Credit-Control-Failure-Handling AVP as defined in IETF RFC 4006 [402] determines what to do if the sending of Diameter credit-control messages to the OCS has been temporarily prevented. The usage of Credit-Control-Failure-Handling AVP gives flexibility to have different failure handling for credit-control session.

This AVP may be received from the OCS or may be locally configured. The value received from the OCS in the Diameter Credit-Control-Answer message always override any already existing value.

As defined in IETF RFC 4006 [402], the Tx timer is introduced to limit the waiting time in the CTF for an answer to the credit control request sent to the OCS. When the Tx timer elapses the CTF takes an action to the end user according to the value of the Credit-Control-Failure-Handling AVP.

It is possible that several concurrent Credit Control Request messages are triggered for the same online charging session. In this case, each Credit Control Request message shall reset the Tx timer as defined in IETF RFC 4006 [402].

6.3.10 Support of Failover

As defined in IETF RFC 4006 [402] if a failure occurs during an ongoing credit-control session, the CTF may move the credit control message stream to an alternative OCS if the primary OCS indicated FAILOVER_SUPPORTED in the CC-Session-Failover AVP. In case CC-Session-Failover AVP is set to FAILOVER_NOT SUPPORTED the credit control message stream is not moved to a backup OCS.

For new credit control sessions, failover to an alternative OCS should be performed if possible. For instance, if an implementation of the CTF can determine primary OCS unavailability it can establish the new credit control sessions with a possibly available secondary OCS.

Since the OCS has to maintain session states, moving the credit-control message stream to a backup OCS requires a complex charging context transfer solution. This charging context transfer mechanism by OCS is out of the scope of the 3GPP standardization work.

6.4 Message formats for Online Charging

6.4.1 Summary of Online Charging Message Formats

6.4.1.1 General

The corresponding Diameter credit control application messages for the Debit / Reserve Unit Request operation is Credit Control Request (CCR) and for the Debit / Reserve Unit Response operation is Credit Control Answer (CCA) as specified in IETF RFC 4006 [402].

The Diameter Credit Control Application (DCCA) specifies an approach based on a series of "interrogations":

- Initial interrogation.
- Zero, one or more interim interrogations.
- Final interrogation.

In addition to a series of interrogations, also a one time event (interrogation) can be used e.g. in the case when service execution is always successful.

All of these interrogations use Credit-*Control-Request* and *Credit-Control-Answer* messages. The *Credit-Control-Request* for the "interim interrogation" and "final interrogation" reports the actual number of "units" that were used, from what was previously reserved. This determines the actual amount debited from the subscriber's account.

Table 6.4.1.1 describes the use of these messages for online charging.

Table 6.4.1.1 : Online Charging Messages Reference Table

Command-Name	Source	Destination	Abbreviation
Credit-Control-Request	CTF	OCS	CCR
Credit-Control-Answer	OCS	CTF	CCA
Re-Auth-Request	OCS	CTF	RAR
Re-Auth-Answer	CTF	OCS	RAA
Capabilities-Exchange-Request	CTF	OCS	CER
Capabilities Exchange Answer	OCS	CTF	CEA
Device-Watchdog-Request	CTF/OCS	OCS/CTF	DWR
Device-Watchdog-Answer	OCS/CTF	CTF/OCS	DWA

CER/CEA and DWR/DWA are mandatory Diameter capabilities for capabilities exchange and transport failure detection.

6.4.1.2 Structure for the Credit Control Message Formats

The following is the basic structure shared by all online charging messages. This is based directly on the format of the messages defined in IETF RFC 4006 [402].

Those Diameter Accounting AVPs that are used for 3GPP online charging are marked in the table of contents 6.4.2 and 6.4.3 with a category as specified in TS 32.240 [1].

The following symbols are used in the message format definitions:

- <AVP> indicates a mandatory AVP with a fixed position in the message.

- {AVP} indicates a mandatory AVP in the message.
- [AVP] indicates an optional AVP in the message.
- *AVP indicates that multiple occurrences of an AVP is possible.

6.4.2 Credit-Control-Request Message

The CCR messages, indicated by the Command-Code field set to 272 is sent by the CTF to the OCF in order to request credits for the request bearer / subsystem /service.

The CCR message format is defined according to IETF RFC 4006 [402] as follows:

```
<CCR> ::= < Diameter Header: 272, REQ, PXY >
          < Session-Id >
          { Origin-Host }
          { Origin-Realm }
          { Destination-Realm }
          { Auth-Application-Id }
          { Service-Context-Id }
          { CC-Request-Type }
          { CC-Request-Number }
          [ Destination-Host ]
          [ User-Name ]
          [ CC-Sub-Session-Id ]
          [ Acct-Multi-Session-Id ]
          [ Origin-State-Id ]
          [ Event-Timestamp ]
         *[ Subscription-Id ]
          [ Service-Identifier ]
          [ Termination-Cause ]
          [ Requested-Service-Unit ]
          [ Requested-Action ]
         *[ Used-Service-Unit ]
          [ Multiple-Services-Indicator ]
         *[ Multiple-Services-Credit-Control ]
         *[ Service-Parameter-Info ]
          [ CC-Correlation-Id ]
          [ User-Equipment-Info ]
         *[ Proxy-Info ]
         *[ Route-Record ]
          [ Service-Information ]
         *[ AVP ]
```

Table 6.4.2 illustrates the basic structure of a 3GPP Diameter Credit Control *Credit-Control-Request* message as used for online charging.

Table 6.4.2: 3GPP Credit-Control-Request Message Content

AVP	Category	Description
Session-Id	M	This field identifies the operation session.
Origin-Host	M	This field contains the identification of the source point of the operation and the realm of the operation originator.
Origin-Realm	M	This field contains the realm of the operation originator.
Destination-Realm	M	This field contains the realm of the operator domain. The realm will be addressed with the domain address of the corresponding public URI.
Auth-Application-Id	M	The field corresponds to the application ID of the Diameter Credit Control Application and is defined with the value 4.
Service-Context-Id	M	This field indicates the supported protocol version.
CC-Request-Type	M	This field defines the transfer type: event for event based charging and start, interim, stop for session based charging.
CC-Request-Number	M	This field contains the sequence number of the transferred messages.
Destination-Host	O_C	This field contains the destination peer address of the OCS identity.
User-Name	O_C	This field contains the username. Editor"s note: The following text Tbc - for TS 32.251: The content of the field corresponds to the Protocol Configuration Options (PCO) field of the Create PDP Context Request message.
CC-Sub-Session-Id	-	Not used in 3GPP.
Acct-Multi-Session-Id	-	Not used in 3GPP.
Origin-State-Id	O_C	This field contains the state associated to the CTF.
Event-Timestamp	O_C	This field corresponds to the exact time the quota is requested.
Subscription-Id	O_M	This field contains the identification of the user that is going to access the service in order to be identified by the OCS.
Subscription-Id-Type	O_M	This field determines the type of the identifier, e.g. t value 0 is used for the international E.164 format according to ITU-T E.164 numbering plan.
Subscription-Id-Data	O_M	This field contains the user data content e.g. the MSISDN.
Service-Identifier	-	Not used in 3GPP.
Termination-Cause	O_C	This field contains the reason the credit control session was terminated.
Requested-Service-Unit	-	Not used in 3GPP, see Multiple-Services-Credit-Control.
CC-Time	-	Not used in 3GPP.
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	-	Not used in 3GPP.
CC-Input-Octets	-	Not used in 3GPP.
CC-Output-Octets	-	Not used in 3GPP.
CC-Service-Specific-Units	-	Not used in 3GPP.
AVP	-	Not used in 3GPP.
Requested-Action	O_C	The field defines the type of action if the CC-Request-Type indicates EVENT.
Used-Service-Unit	-	Not used in 3GPP, see Multiple-Services-Credit-Control.
Tariff-Change-Usage	-	Not used in 3GPP.
CC-Time	-	Not used in 3GPP.
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	-	Not used in 3GPP.
CC-Input-Octets	-	Not used in 3GPP.
CC-Output-Octets	-	Not used in 3GPP.
CC-Service-Specific-Units	-	Not used in 3GPP.
AVP	-	Not used in 3GPP.
Multiple-Services-Indicator	O_M	This field indicates whether the CTF is capable of handling multiple services independently.

Multiple-Services-Credit Control	O_M	This field contains all parameters for the CTF quota management and defines the quotas to allow traffic to flow.
Granted-Service-Unit	-	Not used in CCR.
Tariff-Change-Usage	-	Not used in CCR.
CC-Time	-	Not used in CCR.
CC-Money	-	Not used in CCR.
Unit-Value	-	Not used in CCR.
Value-Digits	-	Not used in CCR.
Exponent	-	Not used in CCR.
Currency-Code	-	Not used in CCR.
CC-Total-Octets	-	Not used in CCR.
CC-Input-Octets	-	Not used in CCR.
CC-Output-Octets	-	Not used in CCR.
CC-Service-Specific-Units	-	Not used in CCR.
AVP	-	Not used in 3GPP.
Requested-Service-Unit	O_C	This field contains the amount of requested service units for a particular category.
CC-Time	O_C	This field contains the amount of used time.
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	O_C	This field contains the requested amount of octets to be sent and received.
CC-Input-Octets	O_C	This field contains the requested amount of octets to be received.
CC-Output-Octets	O_C	This field contains the requested amount of octets to be sent.
CC-Service-Specific-Units	O_C	This field contains the requested amount of service specific units, e.g. number of events.
AVP	-	Not used in 3GPP.
Used-Service-Unit	O_C	This field contains the amount of used non-monetary service units measured for a particular category to a particular quota type.
Reporting-Reason	O_C	Used as defined in clause 7.2.
Tariff-Change-Usage	O_C	This field identifies the reporting period for the used service unit, i.e. before, after or during tariff change.
CC-Time	O_C	This field contains the amount of used time.
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	O_C	This field contains the amount of sent and received octets.
CC-Input-Octets	O_C	This field contains the amount of received octets.
CC-Output-Octets	O_C	This field contains the amount of sent octets.
CC-Service-Specific-Units	O_C	This field contains the amount of service specific units, e.g. number of events.
AVP	-	Not used in 3GPP.
Tariff-Change-Usage	-	Not used in 3GPP.
Service-Identifier	-	Not used in 3GPP.
Rating-Group	O_C	This field contains the charging key as defined in TS 23.125 [70].
G-S-U-Pool-Reference	-	Not used in 3GPP.
G-S-U-Pool-Identifier	-	Not used in 3GPP.
CC-Unit-Type	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Validity-Time	-	Not used in 3GPP.
Result-Code	-	Not used in CCR.
Final-Unit-Indication	-	Not used in 3GPP.
Final-Unit-Action	-	Not used in 3GPP.
Restriction-Filter-Rule	-	Not used in 3GPP.
Filter-Id	-	Not used in 3GPP.
Redirect-Server	-	Not used in 3GPP.
Redirect-Address-Type	-	Not used in 3GPP.
Redirect-Server-Address	-	Not used in 3GPP.
Time-Quota-Threshold	-	Not used in CCR.

Volume-Quota-Threshold	-	Not used in CCR.
Quota-Holding-Time	-	Not used in CCR.
Quota-Consumption-Time	-	Not used in CCR.
Reporting-Reason	O_C	Used as defined in clause 7.2.
Trigger-Type	O_C	Used as defined in clause 7.2.
AVP	-	Not used in 3GPP.
Service-Parameter-Info	-	Not used in 3GPP.
Service-Parameter-Type	-	Not used in 3GPP.
Service-Parameter-Value	-	Not used in 3GPP.
CC-Correlation-Id	-	Not used in 3GPP.
User-Equipment-Info	O_C	This field contains the identification of the identity and terminal capability the subscriber is using for the connection to mobile network if available.
User-Equipment-Info-Type	M	This field determines the type of the identifier. The used value is 0 for the international mobile equipment identifier and software version according to 3GPP TS 23.003.
User-Equipment-Info-Value	M	This field contains the user IMEISV.
Proxy-Info	O_C	
Proxy-Host	O_C	
Proxy-State	O_C	
Route-Record	O_C	This field contains an identifier inserted by a relaying or proxying node to identify the node it received the message from.
Service-Information	O_M	This parameter holds the 3GPP individual service specific parameters as defined in the corresponding "middle tier" TS.
AVP	O_C	A set of network/manufacturer specific extensions to the message, when available.

6.4.3 Credit-Control-Answer Message

The Credit Control Answer (CCA) messages, indicated by the Command-Code field set to 272 is sent by the OCF to the CTF in order to reply to the CCR.

The CCA message format is defined according to IETF RFC 4006 [402] as follows:

```
<CCA> ::=  < Diameter Header: 272, PXY >
           < Session-Id >
           { Result-Code }
           { Origin-Host }
           { Origin-Realm }
           { Auth-Application-Id }
           { CC-Request-Type }
           { CC-Request-Number }
           [ User-Name ]
           [ CC-Session-Failover ]
           [ CC-Sub-Session-Id ]
           [ Acct-Multi-Session-Id ]
           [ Origin-State-Id ]
           [ Event-Timestamp ]
           [ Granted-Service-Unit ]
          *[ Multiple-Services-Credit-Control ]
           [ Cost-Information]
           [ Final-Unit-Indication ]
           [ Check-Balance-Result ]
           [ Credit-Control-Failure-Handling ]
           [ Direct-Debiting-Failure-Handling ]
           [ Validity-Time]
          *[ Redirect-Host]
           [ Redirect-Host-Usage ]
           [ Redirect-Max-Cache-Time ]
          *[ Proxy-Info ]
          *[ Route-Record ]
          *[ Failed-AVP ]
           [ Service-Information ]
          *[ AVP ]
```

Table 6.4.3 illustrates the basic structure of a 3GPP Diameter Credit Control *Credit-Control-Answer* message as used for online charging. This message is always used by the OCF as specified below, independent of the receiving CTF and the CCR record type that is being replied to.

Table 6.4.3: 3GPP Credit Control Answer Message Content

AVP	Category	Description
Session-Id	M	This field identifies the operation session.
Result-Code	M	This field contains the result of the specific query.
Origin-Host	M	This field contains the identification of the source point of the operation and the realm of the operation originator.
Origin-Realm	M	This field contains the realm of the operation originator.
Auth-Application-Id	M	The field corresponds to the application ID of the Diameter Credit Control Application and is defined with the value 4.
CC-Request-Type	O_C	This field defines the transfer type: initial, update, final for session based charging and event for event based charging.
CC-Request-Number	O_C	This field contains the sequence number of the transferred messages.
User-Name	-	Not used in 3GPP.
CC-Session Failover	O_C	This field contains an indication to the CTF whether or not a failover handling is to be used when necessary.
CC-Sub-session-Id	-	Not used in 3GPP.
Acct-Multi-Session-Id	-	Not used in 3GPP.
Origin-State-Id	-	Not used in 3GPP.
Event-Timestamp	-	Not used in 3GPP.
Granted-Service-Unit	-	Not used in 3GPP, see Multiple-Services-Credit-Control.
Tariff-Time-Change	-	Not used in 3GPP.
CC-Time	-	Not used in 3GPP.
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	-	Not used in 3GPP.
CC-Input-Octets	-	Not used in 3GPP.
CC-Output-Octets	-	Not used in 3GPP.
CC-Service-Specific-Units	-	Not used in 3GPP.
AVP	-	Not used in 3GPP.
Multiple-Services-Credit-Control	O_M	
Granted-Service-Unit	O_C	
Tariff-Time-Change	O_C	
CC-Time	O_C	
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	O_C	
CC-Input-Octets	O_C	
CC-Output-Octets	O_C	
CC-Service-Specific-Units	O_C	
AVP	-	Not used in 3GPP.
Requested-Service-Unit	-	Not used in 3GPP.
Tariff-Time-Change	-	Not used in 3GPP.
CC-Time	-	Not used in 3GPP.
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	-	Not used in 3GPP.
CC-Input-Octets	-	Not used in 3GPP.
CC-Output-Octets	-	Not used in 3GPP.
CC-Service-Specific-Units	-	Not used in 3GPP.
Used-Service-Unit	-	Not used in 3GPP.

Tariff-Time-Change	-	Not used in 3GPP.
CC-Time	-	Not used in 3GPP.
CC-Money	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
CC-Total-Octets	-	Not used in 3GPP.
CC-Input-Octets	-	Not used in 3GPP.
CC-Output-Octets	-	Not used in 3GPP.
CC-Service-Specific-Units	-	Not used in 3GPP.
Tariff-Change-Usage	-	Not used in 3GPP.
Service-Identifier	-	Not used in 3GPP.
Rating-Group	O_C	
G-S-U-Pool-Reference	-	Not used in 3GPP.
G-S-U-Pool-Identifier	-	Not used in 3GPP.
CC-Unit-Type	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Validity-Time	O_C	This field defines the time in order to limit the validity of the granted quota for a given category instance.
Result-Code	O_C	
Final-Unit-Indication	O_C	
Final-Unit-Action	O_C	
Restriction-Filter-Rule	O_C	
Filter-Id	O_C	
Redirect-Server	O_C	
Redirect-Address-Type	M	
Redirect-Server-Address	M	
Time-Quota-Threshold	O_C	Used as defined in clause 7.2.
Volume-Quota-Threshold	O_C	Used as defined in clause 7.2.
Quota-Holding-Time	O_C	Used as defined in clause 7.2.
Quota-Consumption-Time	O_C	Used as defined in clause 7.2.
Reporting-Reason	-	Not used in 3GPP.
Trigger-Type	O_C	Used as defined in clause 7.2.
AVP	-	Not used in 3GPP.
Cost-Information	-	Not used in 3GPP.
Unit-Value	-	Not used in 3GPP.
Value-Digits	-	Not used in 3GPP.
Exponent	-	Not used in 3GPP.
Currency-Code	-	Not used in 3GPP.
Cost-Unit	-	Not used in 3GPP.
Final-Unit-Indication	-	Not used in 3GPP, see Multiple-Services-Credit-Control.
Final-Unit-Action	-	Not used in 3GPP.
Restriction-Filter-Rule	-	Not used in 3GPP.
Filter-Id	-	Not used in 3GPP.
Redirect-Server	-	Not used in 3GPP.
Redirect-Address-Type	-	Not used in 3GPP.
Redirect-Server-Address	-	Not used in 3GPP.
Check-Balance-Result	-	Not used in 3GPP.
Credit-Control-Failure-Handling	O_C	
Direct-Debiting-Failure-Handling	-	Not used in 3GPP.
Validity-Time	-	Not used in 3GPP.
Redirect-Host	O_C	
Redirect-Host-Usage	O_C	
Redirect-Max-Cache-Time	O_C	
Proxy-Info	O_C	
Proxy-Host	O_C	
Proxy-State	O_C	
Route-Record	O_C	This field contains an identifier inserted by a relaying or proxying node to identify the node it received the message from.
Failed-AVP	O_C	
Service-Information	O_C	This parameter holds the 3GPP individual service specific parameters as defined in the corresponding "middle tier" TS.

AVP	O_C	A set of network/manufacturer specific extensions to the message, when available.

6.4.4 Re-Auth-Request Message

Table 6.4.4 illustrates the basic structure of a Diameter Credit Control *Re-Auth-Request* message as used for online charging.

Table 6.4.4 : Re-Auth-Request (RAR) Message Contents for Online Charging

Diameter Credit Control Application AVPs	
AVP	**Used in 3GPP**
<Diameter Header: 258, REQ, PXY>	Yes
<Session-Id>	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
{Destination-Realm}	Yes
{Destination-Host}	Yes
{Auth-Application-Id}	Yes
{Re-Auth-Request-Type}	Yes
[User-Name]	Yes
[Origin-State-Id]	Yes
[Event-Timestamp]	Yes
* [Proxy-Info]	No
{ Proxy-Host }	No
{ Proxy-State }	No
* [Route-Record]	No
*[AVP]	Yes
[CC-Sub-Session-Id]	Yes
[G-S-U-Pool-Identifier]	Yes
[Service-Identifier]	Yes
[Rating-Group]	Yes

Editor's note: The rationale for "NO" above should be provided. If the message is identical to the definition in DCC the table may be replaced by a reference to DCC.

6.4.5 Re-Auth-Answer Message

Table 6.4.5 illustrates the basic structure of a Diameter Credit Control *Re-Auth-Answer* message as used for online charging.

Table 6.4.5 : Re-Auth-Answer (RAA) Message Contents for Online Charging

Diameter Credit Control Application AVPs	
AVP	**Used in 3GPP**
<Diameter Header: 258, PXY>	Yes
<Session-Id>	Yes
{Result-Code}	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
[User-Name]	Yes
[Origin-State-Id]	Yes
[Error-Message]	Yes
[Error-Reporting-Host]	Yes
*[Failed-AVP]	Yes
*[Redirect-Host]	Yes
[Redirect-Host-Usage]	Yes
[Redirect-Host-Cache-Time]	Yes
* [Proxy-Info]	No
{ Proxy-Host }	No
{ Proxy-State }	No
*[AVP]	Yes

Editor's note: The rationale for "NO" above should be provided. If the message is identical to the definition in DCC the table may be replaced by a reference to DCC.

6.4.6. Capabilities-Exchange-Request Message

The Capabilities-Exchange-Request message structure is described in [401].

6.4.7 Capabilities-Exchange-Answer Message

The Capabilities-Exchange-Answer message structure is described in [401].

6.4.8 Device-Watchdog-Request Message

The Device-Watchdog-Request message structure is described in [401].

6.4.9 Device-Watchdog-Answer Message

The Device-Watchdog-Answer message structure is described in [401].

6.5 Other procedural description of the 3GPP charging applications

6.5.1 Re-authorization

6.5.1.1 Idle timeout

The server may specify an idle timeout associated with a granted quota using the Quota-Holding-Time AVP. If no traffic associated with the quota is observed for this time, the client shall understand that the traffic has stopped and the quota is returned to the server. The client shall start the quota holding timer when quota consumption ceases. This is always when traffic ceases, i.e. the timer is re-started at the end of each packet. It applies equally to the granted time quota and to the granted volume quota. The timer is stopped on sending a CCR and re-initialised on receiving a CCA with the previous used value or a new value of Quota-Holding-Time if received.

Alternatively, if this AVP is not present, a locally configurable default value in the client shall be used. A Quota-Holding-Time value of zero indicates that this mechanism shall not be used.

6.5.1.2 Change of charging conditions

There are a number of mid-session service events (re-authorisation triggers), which could affect the rating of the current service usage, e.g. end user QoS changes or location updates. When allocating resources, the server may instruct the credit control client to re-authorize the quota upon a number of different session related triggers that can affect the rating conditions. The server instructs the Network Element to monitor for such events by using the Trigger-Type AVP in the CCA command.

When one of the activated triggers happen a credit re-authorization shall be sent to the server including information related to the service event even if all the granted service units have not been used. The quota is also being reported.

The client shall not re-authorise the quota when events which are not included in the Trigger AVP occur.

Multiple triggers monitoring may be associated to a single quota allocation by including multiple Trigger-Type AVPs.

6.5.1.3 Reporting quota usage

The credit control client shall report the quota usage under a number of circumstances. When this happens, the reason for the quota being reported is notified to the server through the use of the Reporting-Reason AVP in the CCR. The reason for reporting credit usage can occur directly in the Multiple-Services-Credit-Control AVP, or in the Used-Service-Units AVP, depending on whether it applies for all quota types or a particular quota type respectively. It shall not be used at command level. It shall always and shall only be sent when usage is being reported.

When the reason is RATING_CONDITION_CHANGE, the Trigger-Type AVP shall also be included to indicate the specific armed trigger event which caused the reporting and re-authorisation request.

6.5.2 Threshold based re-authorization triggers

The server may optionally include as part of the Multiple-Services-Credit-Control AVP, when it is providing a quota, an indication to the client of the remaining quota threshold that shall trigger a quota re-authorization. The Time-Quota-Threshold AVP indicates the threshold in seconds when the granted quota is time, and the Volume-Quota-Threshold AVP indicates the threshold in octets when the granted quota is volume.

If the threshold triggers were included along with the quota granted, the Credit Control client, then, shall seek re-authorisation from the server for the quota when the quota contents fall below the supplied threshold. The client shall allow service to continue whilst the re-authorisation is progress, until the original quota had been consumed.

6.5.3 Termination action

The termination action is sent over the Ro reference point. Two different approaches are specified:

- The Final-Unit-Indication AVP with Final-Unit-Action TERMINATE does not include any other information. When the user has consumed the final granted units, the network element shall terminate the service. This is the default handling applicable whenever the client receives an unsupported Final-Unit-Action value. A final Credit-Control-Request message to the server shall be sent if the Final-Unit-Indication AVP indicating action TERMINATE was present at command level or Multiple-Services-Credit-Control AVP level. If the Final-Unit-Indication AVP is at command level, the CC-Request-Type AVP in the request is set to the value TERMINATION_REQUEST. If the Final-Unit-Indication AVP is at Multiple-Services-Credit-Control level, the network element shall set the CC-Request-Type AVP to the value UPDATE_REQUEST and report the Used-Service-Unit AVP for the service that has terminated, as defined in IETF RFC 4006 [402].

- Another termination action consists in re-directing packets corresponding to a terminated service (consumption of the final granted units) to an application server. This allows the client to redirect user originated requests to a top-up server so that network access can be re-instated. This functionality is achieved with the server returning a "REDIRECT" and redirect-to URL in the Final-Units-Action AVP of the Multiple-Services-Credit-Control AVP or at command level. Upon receiving this result code, the Network Element shall apply the redirection. The URL should be categorized so that the End-User"s ability to reach it is guaranteed.

6.5.4 Quota consumption time

The server may optionally indicate to the client that the quota consumption must be stopped after a period equal to the Quota Consumption Time in which no packets are received or at session termination, whichever is sooner. This is indicated by including the Quota-Consumption-Time AVP in the CCA. The idle period equal to the Quota Consumption Time is included in the reported usage. The quota is consumed normally during gaps in traffic of duration less than or equal to the Quota-Consumption-Time. Quota consumption resumes on receipt of a further packet belonging to the service data flow.

If packets are allowed to flow during a Credit Control Request (Update)/Credit Control Answer exchange, and the Quota-Consumption-Time AVP value in the provided quota is the same as in the previously provided quota, then the Quota-Consumption-Time runs normally through this procedure. For example, if 5 seconds of a 10 second QCT timer have passed when a CCR(U) is triggered, and the CCA(U) returns 2 seconds later, then the QCT timer will expire 3 seconds after the receipt of the CCA and the remaining unaccounted 5 seconds of usage will be recorded against the new quota even though no packets were transmitted with the new quota.

In the case of a new quota with the Quota-Consumption-Time AVP, or when packets are blocked during the CCR(U)/CCA procedure then the Quota-Consumption-Time stops running (if it was running) and quota consumption begins again when the next service data flow packet matching the Charging Rule is received.

If a Quota-Consumption-Time AVP value of zero is provided, or if no Quota-Consumption-Time AVP is present in the CCA, the quota is consumed continuously from the point at which it is granted.

7 Summary of used Attribute Value Pairs

7.1 Diameter AVPs

The use of the Attribute Value Pairs (AVPs) that are defined in the Diameter Protocol is specified in clause 6.2 for offline charging and in clause 6.4 for online charging. The information is summarized in the table 7.1 with the accounting AVPs and in table 7.2 with credit control AVPs listed in alphabetical order. Detailed specification of these AVPs is available in this specification.

The 3GPP Charging Application uses the value 10415 (3GPP) as *Vendor-Id*.

Those Diameter AVPs that are used are marked "Yes" in the following tables. Those Diameter AVPs that are not used are marked "-" in the following tables. This implies that their content can (M) or (Oc) be used by the CDF for offline and for the OCF for online charging purposes.

Table 7.1: Use Of IETF Diameter AVPs

AVP Name	AVP Code	Used in				Value Type	AVP Flag rules				
		ACR	ACA	CCR	CCA		Must	May	Should not	Must not	May Encr.
Accounting-Realtime-Required	483	-	-	-	-	Enumerated	-	-	-	-	-
Accounting-Record-Number	485	M	M	-	-	Unsigned32	M	P	-	V	Y
Accounting-Record-Type	480	M	M	-	-	Enumerated	M	P	-	V	Y
Accounting-Sub-Session-Id	287	-	-	-	-	Unsigned64	-	-	-	-	-
Acct-Application-Id	259	O_C	O_C	-	-	Unsigned32	M	P	-	V	N
Acct-Interim-Interval	85	O_C	O_C	-	-	Unsigned32	M	P	-	V	Y
Acct-Multi-Session-Id	50	-	-	-	-	Unsigned32	-	-	-	-	-
Acct-Session-Id	44	-	-	-	-	OctetString	-	-	-	-	-
Auth-Application-Id	258	-	-	M	M	Unsigned32	M	P	-	V	N
AVP	*	-	-	-	-	Grouped	-	-	-	-	-
CC-Correlation-Id	411	-	-	-	-	OctetString	-	-	-	-	-
CC-Input-Octets	412	-	-	O_C	O_C	Unsigned64	-	P,M	-	V	Y
CC-Money	413	-	-	-	-	Grouped	-	-	-	-	-
CC-Output-Octets	414	-	-	O_C	O_C	Unsigned64	M	P	-	V	Y
CC-Request-Number	415	-	-	M	M	Unsigned32	M	P	-	V	Y
CC-Request-Type	416	-	-	M	M	Enumerated	M	P	-	V	Y
CC-Service-Specific-Units	417	-	-	O_C	O_C	Unsigned64	M	P	-	V	Y
CC-Session-Failover	418	-	-	-	-	Enumerated	-	-	-	-	-
CC-Sub-Session-Id	419	-	-	-	-	Unsigned64	-	-	-	-	-
CC-Time	420	-	-	O_C	O_C	Unsigned32	M	P	-	V	Y
CC-Total-Octets	421	-	-	O_C	O_C	Unsigned64	M	P	-	V	Y
CC-Unit-Type	454	-	-	-	-	Enumerated	-	-	-	-	-
Check-Balance-Result	422	-	-	-	-	Enumerated	-	-	-	-	-
Cost-Information	423	-	-	-	-	Grouped	-	-	-	-	-
Cost-Unit	424	-	-	-	-	UTF8String	-	-	-	-	-
Credit-Control	426	-	-	-	-	Enumerated	-	-	-	-	-
Credit-Control-Failure-Handling	427	-	-	-	O_C	Enumerated	M	P	-	V	Y
Currency-Code	425	-	-	-	-	Unsigned32	-	-	-	-	-
Destination-Host	293	-	-	O_C	-	DiamIdent	M	P	-	V	N
Destination-Realm	283	M	-	M	-	DiamIdent	M	P	-	V	N
Direct-Debiting-Failure-Handling	428	-	-	-	-	Enumerated	-	-	-	-	-
Error-Message	281	-	-	-	-	UTF8String	-	-	-	-	-
Error-Reporting-Host	294	-	-	-	-	DiamIdent	-	-	-	-	-
Event-Timestamp	55	O_C	O_C	-	-	Time	M	P	-	V	N
Exponent	429	-	-	-	-	Integer32	-	-	-	-	-
Failed-AVP	279	-	-	-	O_C	Grouped	M	P	-	V	N
Filter-Id	11	-	-	-	O_C	UTF8String	M	P	-	V	Y
Final-Unit-Action	449	-	-	-	O_C	Enumerated	M	P	-	V	Y
Final-Unit-Indication	430	-	-	-	O_C	Grouped	M	P	-	V	Y
Granted-Service-Unit	431	-	-	-	O_C	Grouped	M	P	-	V	Y
G-S-U-Pool-Identifier	453	-	-	-	-	Unsigned32	-	-	-	-	-
G-S-U-Pool-Reference	457	-	-	-	-	Grouped	-	-	-	-	-

AVP Name	AVP Code	Used in				Value Type	AVP Flag rules				
		ACR	ACA	CCR	CCA		Must	May	Should not	Must not	May Encr.
Multiple-Services-Credit-Control	456	-	-	O_M	O_M	Grouped	M	P	-	V	Y
Multiple-Services-Indicator	455	-	-	O_M	O_M	Enumerated	M	P	-	V	Y
Origin-Host	264	M	M	M	M	DiamIdent	M	P	-	V	N
Origin-Realm	296	M	M	M	M	DiamIdent	M	P	-	V	N
Origin-State-Id	278	O_C	O_C	-	-	Unsigned32	M	P	-	V	N
Proxy-Info	284	-	-	O_C	O_C	Grouped	M	-	-	P,V	N
Proxy-Host	280	-	-	M	M	DiamIdent	M	-	-	P,V	N
Proxy-State	33	-	-	M	M	OctetString	M	-	-	P,V	N
Rating-Group	432	-	-	O_C	O_C	Unsigned32	M	P	-	V	Y
Redirect-Address-Type	433	-	-	M	M	Enumerated	M	P	-	V	Y
Redirect-Host	292	-	-	-	O_C	DiamURI	M	P	-	V	N
Redirect-Host-Usage	261	-	-	-	O_C	Enumerated	M	P	-	V	N
Redirect-Max-Cache-Time	262	-	-	-	O_C	Unsigned32	M	P	-	V	N
Redirect-Server	434	-	-	-	O_C	Grouped	M	P	-	V	Y
Redirect-Server-Address	435	-	-	-	M	UTF8String	M	P	-	V	Y
Requested-Action	436	-	-	O_C	-	Enumerated	M	P	-	V	Y
Requested-Service-Unit	437	-	-	O_C	-	Grouped	M	P	-	V	Y
Restriction-Filter-Rule	438	-	-	-	O_C	IPFilterRule	M	P	-	V	Y
Result-Code	268	-	M	-	M	Unsigned32	M	P	-	V	N
Route-Record	282	-	-	O_C	O_C	DiamIdent	M	-	-	P,V	N
Service-Context-Id	461	-	-	M	-	UTF8String	M	P	-	V	Y
Service-Identifier	439	-	-	-	-	UTF8String	-	-	-	-	-
Service-Parameter-Info	440	-	-	-	-	Grouped	-	-	-	-	-
Service-Parameter-Type	441	-	-	-	-	Unsigned32	-	-	-	-	-
Service-Parameter-Value	442	-	-	-	-	OctetString	-	-	-	-	-
Session-Id	263	M	M	M	M	UTF8String	M	P	-	V	Y
Subscription-Id	443	-	-	O_C	-	Grouped	M	P	-	V	Y
Subscription-Id-Data	444	-	-	M	-	UTF8String	M	P	-	V	Y
Subscription-Id-Type	450	-	-	M	-	Enumerated	M	P	-	V	Y
Tariff-Change-Usage	452	-	-	O_C	-	Enumerated	M	P	-	V	Y
Tariff-Time-Change	451	-		-	O_C	Time	M	P	-	V	Y
Unit-Value	445	-		-	-	Grouped	-	-	-	-	-
Used-Service-Unit	446	-		O_C	-	Grouped	M	P	-	V	Y
User-Equipment-Info	458	-		O_C	-	Grouped	-	P,M	-	V	Y
User-Equipment-Info-Type	459	-		M	-	Enumerated	-	P,M	-	V	Y
User-Equipment-Info-Value	460	-		M	-	OctetString	-	P,M	-	V	Y
User-Name	1	O_C	O_C	-	-	UTF8String	M	P	-	V	Y
Value-Digits	447	-	-	-	-	Integer64	-	-	-	-	-
Validity-Time	448	-	-	-	O_C	Unsigned32	M	P	-	V	Y
Vendor-Id	266	-	-	-	-	Unsigned32	-	-	-	-	-
Vendor-Specific-Application-Id	260	-	-	-	-	Grouped	-	-	-	-	-

NOTE: *Result-Code* AVP is defined in Diameter Base Protocol [401]. However, new values are used in offline and online charging applications. These additional values are defined below.

7.1.1 Acct-Application-Id AVP

The *Acct-Application-Id* AVP (AVP code 259) shall contain the value of 3 as defined in [401] according 3GPP TS 29.230 [206].

7.1.2 Auth-Application-Id AVP

The *Auth-Application-Id* AVP (AVP code 258) shall contain the value of 4 as defined in IETF RFC 4006 [402] according 3GPP TS 29.230 [206].

7.1.3 Multiple-Services-Credit-Control

The *Multiple-Services-Credit-Control* AVP (AVP code 456) is of type grouped as specified in IETF RFC 4006 [402]. It contains additional 3GPP specific charging parameters.

It has the following ABNF grammar:

<Multiple-Services-Credit-Control> ::= < AVP Header: 456 >

[Granted-Service-Unit]
[Requested-Service-Unit]
*[Used-Service-Unit]
~~[Tariff-Change-Usage]~~
~~*[Service-Identifier]~~
[Rating-Group]
~~*[G-S-U-Pool-Reference]~~
[Validity-Time]
[Result-Code]
[Final-Unit-Indication]
[Time-Quota-Threshold]
[Volume-Quota-Threshold]
[Quota-Holding-Time]
[Quota-Consumption-Time]
*[Reporting-Reason]
*[Trigger-Type]
~~*[AVP]~~

7.1.4 Rating-Group AVP

The *Rating-Group* AVP (AVP code 432), is defined in IETF RFC 4006 [402]. It contains the charging key (defined in 3GPP TS 23.125 [70]). Each quota allocated to a Diameter CC session has a unique Rating Group value as specified in IETF RFC 4006 [402].

7.1.5 Result-Code AVP

This subclause defines new *Result-Code* AVP (AVP code 298) values that must be supported by all Diameter implementations that conform to the present document. The Result-Code AVP operates as describes in RFC 3588 [401] and IETF RFC 4006 [402].

The following result code descriptions are examples of the possible uses for the code:

Transient Failures (4xxx):

DIAMETER_END_USER_SERVICE_DENIED 4010

The OCF denies the service request due to service restrictions (e.g. terminate rating group) or limitations related to the end-user, for example the end-user's account could not cover the requested service.

DIAMETER_CREDIT_CONTROL_NOT_APPLICABLE 4011

The OCF determines that the service can be granted to the end user but no further credit control needed for the service (e.g. service is free of charge or the PDP context is treated for offline charging).
DIAMETER_CREDIT_LIMIT_REACHED 4012

The OCF denies the service request since the end- user's account could not cover the requested service. If the CCR contained used-service-units they are deducted, if possible.

Permanent Failures (5xxx):

DIAMETER_AUTHORIZATION_REJECTED 5003

This error code is used to inform PDP Context has to be terminated in the CCR message and to inform blacklist the rating group in the Multiple-Service-Credit-Control AVP.

DIAMETER_USER_UNKNOWN 5030

The specified end user could not be found in the OCF.

DIAMETER_RATING_FAILED 5031

This error code is used to inform the CTF that the OCF cannot rate the service request due to insufficient rating input, incorrect AVP combination or due to an AVP or an AVP value that is not recognized or supported in the rating. For Flow Based Charging this error code is used if the Rating group is not recognized. The Failed-AVP AVP MUST be included and contain a copy of the entire AVP(s) that could not be processed successfully or an example of the missing AVP complete with the Vendor-Id if applicable. The value field of the missing AVP should be of correct minimum length and contain zeroes.

7.1.6 Service-Context-Id AVP

The *Service-Context-Id* AVP is defined in IETF RFC 4006 [402]. It is of type UTF8String and contains a unique identifier of the Diameter Credit Control service specific document that applies to the request. This is an identifier allocated by the service provider/operator, by the service element manufacturer or by a standardization body and MUST uniquely identify a given Diameter Credit Control service specific document. The format of the Service-Context-Id is:

"extensions".MNC.MCC."Release"."service-context" "@" "domain"

The 3GPP specific values for "service-context" "@" "domain" are:

- For PS charging: 32251@3gpp.org
- For WLAN charging: 32252@3gpp.org
- For IMS charging: 32260@3gpp.org
- For MMS service charging: 32270@3gpp.org
- For LCS service charging: 32271@3gpp.org
- For PoC service charging: 32272@3gpp.org
- For MBMS service charging: 32273@3gpp.org

The "Release" indicates the 3GPP Release the service specific document is based upon e.g. 6 for Release 6.

As a minimum, Release "service-context" "@" "domain" shall be used. If the minimum is used all operator configurable parameters (Oc and Om) are optional.

The MNC.MCC identifies the operator implementing the service specific document, which is used to determine the specific requirements for the operator configurable parameters.

The "extensions" is operator specific information to any extensions in a service specific document.

7.1.7 User-Name AVP

The *User-Name* AVP (AVP code 1) contains the Private User Identity [201], if available in the node.

7.1.8 Vendor-Id AVP

The *Vendor-Id* AVP (AVP code 266), as part of the *Vendor-Specific-Application-Id* grouped AVP, shall contain the value of 10415, which is the IANA registered value for '3GPP' in 3GPP TS 29.230 [206].

7.2 3GPP specific AVPs

For the purpose of offline charging additional AVPs are used in ACR / ACA and for online charging additional AVPs are used in CCR / CCA. All 3GPP specific AVPs mentioned are relevant for both offline and online charging unless specifically excluded. The information is summarized in the following table along with the AVP flag rules.

Detailed descriptions of AVPs that are used specifically for 3GPP charging are provided in the subclauses below the table. However, for AVPs that are just borrowed from other applications only the reference (e.g. IETF RFC 4006 [402]), is provided in the following table and the detailed description is not repeated.

Table 7.2: 3GPP specific AVPs

AVP Name	AVP Code	Used in				Value Type	AVP Flag rules				
		ACR	ACA	CCR	CCA		Must	May	Should not	Must not	May Encr.
Application-provided-called-party-address	837	X	-	-	-	UTF8String	V,M	P			N
Application-Server	836	X	-	-	-	UTF8String	V,M	P			N
Application-Server-Information	850	X	-	-	-	Grouped	V,M	P			N
Authorized-QoS	849	X	-	-	-	UTF8String	V,M	P			N
Bearer-Service	854	X	-	-	-	OctetString	V,M	P			N
Called-Party-Address	832	X	-	-	-	UTF8String	V,M	P			N
Calling-Party-Address	831	X	-	-	-	UTF8String	V,M	P			N
Cause-Code	861	X		-	-	Enumerated	V,M	P			N
Content-Disposition	828	X	-	-	-	UTF8String	V,M	P			N
Content-Length	827	X	-	-	-	UTF8String	V,M	P			N
Content-Type	826	X	-	-	-	UTF8String	V,M	P			N
Event	825	X	-	-	-	UTF8String	V,M	P			N
Event-Type	823	X	-	-	-	Grouped	V,M	P			N
Expires	888	X	-	-	-	Unsigned32	V,M	P			N
GGSN-Address	847	X	-	-	-	Address	V,M	P			N
GPRS-Charging-Id	846	X	-	X	-	UTF8String	V,M	P			N
IMS-Charging-Identifier	841	X	-	X	-	UTF8String	V,M	P			N
IMS-Information	876	X	-	X	-	Grouped	V,M	P			N
Incoming-Trunk-Group-Id	852	X	-	-	-	UTF8String	V,M	P			N
Inter-Operator-Identifier	838	X	-	-	-	Grouped	V,M	P			N
LCS-Information	878	X	-	X	-	Grouped	V,M	P			N
Mandatory-Capability [204]	604	X	-	-	-	Unsigned32					
Media-Initiator-Flag	882	X	-	-	-	Enumerated	V,M	P			N
Message-Body	889	X	-	-	-	Grouped	V,M	P			N
MBMS-Information	880	X	-	X	-	Grouped	V,M	P			N
MMS-Information	877	-	-	X	-	Grouped	V,M	P			N
Node-Functionality	862	X	-.	-	-	Enumerated	V,M	P			N
Number-Of-Participants	885	X	-	X	-	Enumerated	V,M	P			N
Optional-Capability [204]	605	X	-	-	-	Unsigned32					
Originating-IOI	839	X	-	-	-	UTF8String	V,M	P			N
Originator	864	X	-	-	-	Enumerated	V,M	P			N
Outgoing-Trunk-Group-Id	853	X	-	-	-	UTF8String	V,M	P			N
Participants-Involved	887	X	-	X	-	UTF8String	V,M	P			N
PoC-Controlling-Address	TBD	X		X		UTF8String	V,M	P			N
PoC-Group-Name	TBD	X		X		UTF8String	V,M	P			N
PoC-Information	879	X	-	X	-	Grouped	V,M	P			N
PoC-Server-Role	883	X	-	X	-	Enumerated	V,M	P			N
PoC-Session-Type	884	X	-	X	-	Enumerated	V,M	P			N
PS-Append-Free-Format-Data	867	X	-	-	X	Enumerated	V,M	P			N
PS-Free-Format-Data	866	X	-	-	X	OctetString	V,M	P			N
PS-Furnish-Charging-Information	865	X	-	-	X	Grouped	V,M	P			N
PS-Information	874	X	-	X	X	Grouped	V,M	P			N
Quota-Consumption-Time	881	-	-	-	X	Unsigned32	V,M	P			N
Quota-Holding-Time	871	-	-	-	X	Unsigned32	V,M	P			N
Reporting-Reason	872	-	-	X	-	Enumerated	V,M	P			N
Role-of-Node	829	X	-	-	-	Enumerated	V,M	P			N
SDP-Media-Component	843	X	-	-	-	Grouped	V,M	P			N
SDP-Media-Description	845	X	-	-	-	UTF8String	V,M	P			N
SDP-Media-Name	844	X	-	-	-	UTF8String	V,M	P			N
SDP-Session-Description	842	X	-	-	-	UTF8String	V,M	P			N
Served-Party-IP-Address	848	X	-	-	-	Address	V,M	P			N
Server-Capabilities [204]	603	X	-	-	-	Grouped					N
Service-Id	855	X	-	-	-	UTF8String	V,M	P			N
Service-Information	873	X	-	X	X	Grouped	V,M	P			N
Service-Specific-Data	863	X	-	-	-	UTF8String	V,M	P			N

AVP Name	AVP Code	Used in				Value Type	AVP Flag rules				
		ACR	ACA	CCR	CCA		Must	May	Should not	Must not	May Encr.
SIP-Method	824	X	-	-	-	UTF8String	V,M	P			N
SIP-Request-Timestamp	834	X	-	-	-	UTF8String	V,M	P			N
SIP-Response-Timestamp	835	X	-	-	-	UTF8String	V,M	P			N
Talk-Burst-Exchange	860	X	-	-	-	Grouped	V,M	P			N
Terminating-IOI	840	X	-	-	-	UTF8String	V,M	P			N
Time-Quota-Threshold	868	-	-	-	X	Unsigned64	V,M	P			N
Time-Stamps	833	X	-	-	-	Grouped	V,M	P			N
Trigger-Type	870	-	-	X	X	Enumerated	V,M	P			N
Trunk-Group-Id	851	X	-	-	-	Grouped	V,M	P			N
User-Data [204]	606	X	-	-	-	OctetString	V,M	P			N
User Session Id	830	X	-	-	-	UTF8String	V,M	P			N
Volume-Quota-Threshold	869	-	-	-	X	Unsigned64	V,M	P			N
WAG-Address	890	X	-	X	-	Address	V,M	P			N
WAG-PLMN-Id	891	X	-	X	-	OctetString	V,M	P			N
WLAN-Information	875	X	-	X	-	Grouped	V,M	P			N
WLAN-Radio-Container	892	X	-	X	-	Grouped	V,M	P			N
WLAN-Technology	893	X	-	X	-	Unsigned32	V,M	P			N
WLAN-UE-Local-IPAddress	894	X	-	X	-	Address	V,M	P			N

7.2.1 Adaptations AVP

The *Adaptations* AVP (AVP code xxx) is of type Enumerated and indicates whether the originator allows adaptation of the content (default Yes).

The values indicating whether adaptations are allowed are:

0 Yes

1 No

7.2.2 Additional-Content-Information AVP

The Additional-Content-Information AVP (AVPcode xxx) is of type Grouped and identifies any subsequent content types. It is used to identify each content (including re-occurences) within an MM when the Type-Number AVP or Additional-Type-Information AVP from the Content-Type AVP indicate a multi-part content.

It has the following ABNF grammar:

```
Additional-Content-Information:: =    < AVP Header: xxx >
                                      [ Type-Number ]
                                      [ Additional-Type-Information ]
                                      [ Content-Size ]
```

7.2.3 Additional-Type-Information AVP

The *Additional-Type-Information* AVP (AVP code xxx) is of type UTF8String and identifies any additional information beyond well-known media types or non-well-known media types.

7.2.4 Address-Data AVP

The *Address-Data* AVP (AVP code xxx) is of type UTF8String and indicates the address information and formatted according type of address indicated in the Address-Type AVP and according to MMS encapsulation [209].

7.2.5 Address-Domain AVP

The *Address-Domain* AVP (AVP code xxx) is of type Grouped and indicates the domain/network to which the associated address resides. If this AVP is present, at least one of the AVPs described within the grouping must be included.

It has the following ABNF:

Address-Domain :: = < AVP Header: xxx >

[Domain-Name]
[3GPP-IMSI-MCC-MNC]

7.2.6 Address-Type AVP

The *Address-Type* AVP (AVP code xxx) is of type Enumerated and indicates the type of address carried within the Address-Information AVP.

It has the following values:

0 e-mail address

1 MSISDN

2 IPv4 Address

3 IPv6 Address

4 Numeric Shortcode

5 Alphanumeric Shortcode

6 Other

7.2.7 Addressee-Type AVP

The Addressee-Type AVP (AVP code xxx) is of type Enumerated and identifies the how the recipient is addressed in the header of an MM.

The following values are defined:

0 TO ;

1 CC ;

2 BCC.

7.2.8 Applic-ID AVP

The *Applic-ID* AVP (AVP code xxx) is of type UTF8String and holds the identification of the destination application that the underlying MMS abstract message was addressed to.

7.2.9 Additional-Content-Information AVP

The Additional-Content-Information AVP (AVPcode xxx) is of type Grouped and identifies any subsequent content types. It is used to identify each content (including re-occurrences) within an MM when the Type-Number AVP or Additional-Type-Information AVP from the Content-Type AVP indicate a multi-part content.

It has the following ABNF grammar:

Additional-Content-Information:: = < AVP Header: xxx >
[Type-Number]
[Additional-Type-Information]
[Content-Size]

7.2.10 Aux-Applic-Info AVP

The *Aux-Applic-Info* AVP (AVP code xxx) is of type UTF8String and holds additional application/implementation specific control information.

7.2.11 Application-provided-Called-Party-Address AVP

The *Application-Provided-Called-Party-Address* AVP (AVP code 837) is of type UTF8String and holds the called party number (SIP URI, E.164), if it is determined by an application server.

7.2.12 Application-Server AVP

The *Application-Server* AVP (AVP code 836) is of type UTF8String and holds the SIP URL(s) of the AS(s) addressed during the session.

7.2.13 Application-Server-Information AVP

The *Application-Server-Information* AVP (AVP code 850) is of type Grouped and contains information about application servers visited through ISC interface.

It has the following ABNF grammar:

<Application-Server-Information>::=<AVP Header: 850 >

[Application-Server]

*[Application-Provided-Called-Party-Address]

7.2.14 Authorised-QoS AVP

The *Authorised-QoS* AVP (AVP code 849) is of type UTF8String and holds the Authorised QoS as defined in TS 23.207 [200] / TS 29.207 [203] and applied via the Go reference point.

7.2.15 Aux-Applic-Info AVP

The *Aux-Applic-Info* AVP (AVP code xxx) is of type UTF8String and holds additional application/implementation specific control information.

7.2.16 Bearer-Service AVP

The *Bearer-Service* AVP (AVP code 854) is of type OctetString and holds the used bearer service for the PSTN leg.

7.2.17 Called-Party-Address AVP

The *Called-Party-Address* AVP (AVP code 832) is of type UTF8String and holds the address (Public User ID: SIP URL, E.164, etc.) of the party to whom a session is established.

7.2.18 Calling-Party-Address AVP

The *Calling-Party-Address* AVP (AVP code 831) is of type UTF8String and holds the address (Public User ID: SIP URL, E.164, etc.) of the party initiating a session.

7.2.19 Cause-Code AVP

The *Cause-Code* AVP (AVP code 861) is of type Enumerated and includes the cause code value from IMS node. It is used in Accounting-request[stop] and/or Accounting-request[event] messages.

Within the cause codes, values ≤ 0 are reserved for successful causes while values ≥ 1 are used for failure causes. In case of errors where the session has been terminated as a result of a specific known SIP error code, then the SIP error code is also used as the cause code.

Successful cause code values.

"Normal end of session" 0

The cause "Normal end of session" is used in Accounting-request[stop] message to indicate that an ongoing SIP session has been normally released either by the user or by the network (SIP BYE message initiated by the user or initiated by the network has been received by the IMS node after the reception of the SIP ACK message).

"Successful transaction" -1

The cause "Successful transaction" is used in Accounting-request[event] message to indicate a successful SIP transaction (e.g. REGISTER, MESSAGE, NOTIFY, SUBSCRIBE). It may also be used by an Application Server to indicate successful service event execution.

"End of SUBSCRIBE dialog" -2

The cause "End of SUBSCRIBE dialog" is used to indicate the closure of a SIP SUBSCRIBE dialog . For instance a successful SIP SUBSCRIBE transaction terminating the dialog has been detected by the IMS node (i.e. SUBSCRIBE with expire time set to 0).

"2xx Final Response" -2xx

The cause-code "2xx Final Response"(except 200) is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 2xx Final response [405].

"3xx Redirection" -3xx

The cause "3xx Redirection" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 3xx response [405].

"End of REGISTER dialog" -3

The cause "End of REGISTER dialog" is used to indicate the closure of a SIP REGISTER dialog. For instance a successful SIP REGISTER transaction terminating the dialog has been detected by the IMS node (i.e. REGISTER with expire time set to 0).

Failure cause code values.

"Unspecified error" 1

The cause "Unspecified error" is used when the SIP transaction is terminated due to an unknown error.

" 4xx Request failure" 4xx

The cause "4xx Request failure" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 4xx error response [405].

"5xx Server failure" 5xx

The cause "5xx Server failure" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 5xx error response [405].

"6xx Global failure" 6xx

The cause "6xx Global failure" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 6xx error response [405].

"Unsuccessful session setup" 2

The cause "Unsuccessful session setup" is used in the Accounting-request[stop] when the SIP session has not been successfully established (i.e. Timer H expires and SIP ACK is not received or SIP BYE is received after reception of the 200OK final response and SIP ACK is not received) [202] [405].

"Internal error" 3

The cause "Internal error" is used when the SIP transaction is terminated due to an IMS node internal error (e.g. error in processing a request/response).

7.2.20 Charging-Rule-Base-Name AVP

The *Charging-Rule-Base-Name* AVP (AVP code 1004) is of type OctetString, and it indicates the group name of charging rules residing in the TPF. The default Charging-Rule-Base-Name corresponds with the pre-defined group of charging rules as specified in 3GPP TS 29.210 [205].

7.2.21 Class-Identifier AVP

The *Class-Identifier* AVP (AVP code xxx) is of type Enumerated and

The values are:

0 Personal

1 Advertisement

2 Informational

3 Auto

7.2.22 Content-Class AVP

The *Content-Class* AVP (AVP code xxx) is of type Enumerated and classifies the content of the MM to the highest content class to which the MM belongs, as defined in MMS Encapsulation [209].

The classes can be one of the following:

0 text

1 image-basic

2 image-rich

3 video-basic

4 video-rich

5 megapixel

6 content-basic

7 content-rich

7.2.23 Content-Disposition AVP

The *Content-Disposition* AVP (AVP code 828) is of type UTF8String and indicates how the message body or a message body part is to be interpreted (e.g. session, render), as described in [406].

7.2.24 Content-Length AVP

The *Content-Length* AVP (AVP code 827) is of type UTF8String and holds the size of the message-body, as described in [406].

7.2.25 Content-Size AVP

The Content-Size AVP (AVP code xxx) is of type Unsigned32 and indicates the size in bytes of the specified content type.

7.2.26 Content-Type AVP

The *Content-Type* AVP (AVP code 826) is of type UTF8String and holds the media type (e.g. application/sdp, text/html) of the message-body, as described in [406].

7.2.27 Delivery-Report-Requested AVP

The *Delivery-Report-Requested* AVP (AVP code xxx) is of type Enumerated and indicates whether a delivery report has been requested by the originator MMS User Agent or not.

The values for whether a report was requested are:

0 No

1 Yes

7.2.28 Domain-Name AVP

The *Domain-Name* AVP (AVP code xxx) is of type UTF8String and represents a fully qualified domain name (FQDN).

7.2.29 DRM-Content AVP

The *DRM-Content* AVP (AVP code xxx) is of type Enumerated and indicates if the MM contains DRM-protected content.

The values are:

0 No

1 Yes

7.2.30 Event AVP

The *Event* AVP (AVP code 825) is of type UTF8String and holds the content of the "Event" header.

7.2.31 Event-Type AVP

The *Event-Type* AVP (AVP code 823) is of type Grouped and contains information about the type of chargeable telecommunication service/event for which the accounting-request message is generated.

It has the following ABNF grammar:

<Event-Type>:: = <AVP Header: 823 >

[SIP-Method]
[Event]
[Expires]

7.2.32 Expires AVP

The *Expires* AVP (AVP code 888) is of type Unsigned32 and holds the content of the "Expires" header.

Editor"s note: to be clarified.

7.2.33 File-Repair-Supported AVP

The File-Repair-Supported AVP (AVP code xxx) is of type Enumerated and indicates whether the MBMS user service supports point-to-point file repair. The following values are supported:

SUPPORTED (1)

The MBMS user service does support point-to-point file repair.

NOT_SUPPORTED (2)

The MBMS user service does not support point-to-point file repair.

7.2.34 GGSN-Address AVP

The *GGSN-Address* AVP (AVP code 847) is of type Address and holds the IP-address of the GGSN that generated the GPRS Charging ID, as described in [1].

7.2.35 GPRS-Charging-ID AVP

The *GPRS-Charging-ID* AVP (AVP code 846) is of type UTF8String and holds a sequence number generated by the GGSN at PDP context activation, as described in [1].

7.2.36 IMS-Charging-Identifier (ICID) AVP

The *IMS-Charging-Identifier* AVP (AVP code 841) is of type UTF8String and holds the IMS Charging Identifier (ICID) as generated by a IMS node for a SIP session and described in subclause 5.2.4.10.

7.2.37 IMS-Information AVP

The *IMS-Information* AVP (AVP code 876) is of type Grouped. Its purpose is to allow the transmission of additional IMS service specific information elements.

It has the following ABNF grammar:

```
IMS-Information :: =    < AVP Header: 876>

                        [ Event-Type ]
                        [ Role-Of-Node ]
                        { Node-Functionality }
                        [ User-Session-ID ]
                        [ Calling-Party-Address ]
                        [ Called-Party-Address ]
                        [ Time-Stamps ]
                        * [ Application-Server-Information ]
                        [ Inter-Operator-Identifier ]
                        [ IMS-Charging-Identifier ]
                        * [ SDP-Session-Description ]
                        * [ SDP-Media-Component ]
                        [ GGSN-Address ]
                        [ Served-Party-IP-Address ]
                        [ Server-Capabilities ]
                        [ Trunk-Group-ID ]
                        [ Bearer-Service ]
                        [ Service-Id ]
                        [ Service-Specific-Data ]
                        [ Message-Body ]
                        [ Cause-Code ]
```

7.2.38 Incoming-Trunk-Group-ID AVP

The *Incoming-Trunk-Group-ID* AVP (AVP code 852) is of type UTF8String and identifies the incoming PSTN leg.

7.2.39 Inter-Operator-Identifier AVP

The *Inter-Operator-Identifier* AVP (AVP code 838) is of type Grouped and holds the identification of the network neighbours (originating and terminating) as exchanged via SIP signalling and described in [404].

It has the following ABNF grammar:

```
<Inter-Operator-Identifier>:: = < AVP Header: 838 >

                                [ Originating-IOI ]
```

[Terminating-IOI]

7.2.40 LCS-Information AVP

The LC*S-Information* AVP (AVP code 878) is of type Grouped. Its purpose is to allow the transmission of additional LCS service specific information elements.

It has the following ABNF grammar:

LCS-Information :: = < AVP Header: 878>

[…]
[…]

7.2.41 MBMS-Information AVP

The MBM*S-Information* AVP (AVP code 880) is of type Grouped. Its purpose is to allow the transmission of additional MBMS service specific information elements.

It has the following ABNF grammar:

MBMS-Information :: = < AVP Header: 880>

{ TMGI }
{ MBMS-Service-Type }
{ MBMS-User-Service-Type }
[File-Repair-Supported]
[Required-MBMS-Bearer-Capabilities]
[MBMS-2G-3G-Indicator]
[RAI]
*[MBMS-Service-Area]
[MBMS-Session-Identity]

7.2.42 MBMS-Service-Area AVP

The MBMS-Service-Area AVP (AVP code xxx) is of type tbd.

7.2.43 MBMS-Service-Type AVP

The MBMS-Service-Type AVP (AVP code xxx) is of type tbd.

7.2.44 MBMS-Session-Identity AVP

The MBMS-Session-Identity AVP (AVP code xxx) is of type tbd.

7.2.45 MBMS-User-Service-Type AVP

The MBMS-User-Service-Type AVP (AVP code xxx) is of type Enumerated and indicates type of service the MBMS user service that is being delivered. The following values are supported:

DOWNLOAD (1)

The MBMS user service of type: download.

STREAMING (2)

The MBMS user service is of type: streaming.

7.2.46 Media-Initiator-Flag AVP

The *Media-Initiator-Flag* AVP (AVP code 882) is of type Enumerated and indicates which party has requested the session modification. The default value is "0" indicating the called party initiated the modification.

[0] called party

[1] calling party

[2] unknown

7.2.47 Message-Body AVP

The *Message-Body* AVP (AVP Code 889) is of type Grouped AVP and holds information about the message bodies including user-to-user data.

It has the following ABNF grammar:

```
<Message-Body>::=   < AVP Header: 889 >

                    [Content-Type]
                    [Content-Length]
                    [Content-Disposition]
                    [Originator]
```

7.2.48 Message-Class AVP

The *Message-Class* AVP (AVP code xxx) is of type Grouped.

It has the following ABNF grammar:

```
Message-Class :: =      < AVP Header: xxx >
                        [ Class-Identifier ]
                        [ Token-Text ]
```

7.2.49 Message-ID AVP

The *Message-ID* AVP (AVP code xxx) is of type UTF8String and holds the MM identification provided by the originating MMS Relay/Server.

7.2.50 Message-Size AVP

The *Message-Size* AVP (AVP code xxx) is of type Unsigned32 and holds the total size in bytes of the MM calculated according to TS 23.140 [208] .

7.2.51 Message-Type AVP

The *Message-Type* AVP (AVP code xxx) is of type Enumerated and holds the type of the message according to the MMS transactions e.g. submission, delivery.

The following values are defined and are as specified in MMS Encapsulation [209]:

1 m-send-req
2 m-send-conf
3 m-notification-ind
4 m-notifyresp-ind
5 m-retrieve-conf
6 m-acknowledge-ind
7 m-delivery-ind
8 m-read-rec-ind
9 m-read-orig-ind
20 m-forward-req
11 m-forward-conf
12 m-mbox-store-conf
13 m-mbox-view-conf
14 m-mbox-upload-conf
15 m-mbox-delete-conf

7.2.52 MM-Content-Type AVP

The *MM-Content-Type* AVP (AVP code xxx) is of type Grouped and indicates the overall content type of the MM content and includes information about all the contents of an MM.

It has the following ABNF grammar:

```
MM-Content-Type :: =    < AVP Header: xxx >
                        [ Type-Number ]
                        [ Additional-Type-Information ]
                        [ Content-Size ]
                        * [ Additional-Content-Information ]
```

7.2.53 MMBox-Storage-Information AVP

Editor's Note: To Be Defined.

7.2.54 MMS-Information AVP

The MM*S-Information* AVP (AVP code 877) is of type Grouped. Its purpose is to allow the transmission of additional MMS service specific information elements.

It has the following ABNF grammar:

```
MMS-Information :: =    < AVP Header: 877>

                        [Originator-Address]
                        * [Recipient-Address]
                        [Submission-Time]
                        [MM-Content-Type]
                        [Priority]
                        [Message-ID]
                        [Message-Type]
                        [Message-Size]
                        [Message-Class]
```

[Delivery-Report-Requested]
[Read-Reply-Report-Requested]
[MMBox-Storage-Information]
[Applic-ID]
[Reply-Applic-ID]
[Aux-Applic-Info]
[Content-Class]
[DRM-Content]
[Adaptations]

7.2.55 Node-Functionality AVP

The *Node-Functionality* AVP (AVP code 862) is of type Enumerated and includes the *functionality* identifier of the *node*.

The functionality identifier can be one of the following:

S-CSCF 0
P-CSCF 1
I-CSCF 2
MRFC 3
MGCF 4
BGCF 5
AS 6

7.2.56 Number-Of-Participants

The Number-Of-Participants AVP (AVP code 885) is of type Integer32 and holds the number of invited parties of the PoC session.

7.2.57 Originating-IOI AVP

The *Originating-IOI* AVP (AVP code 839) is of type UTF8String (alphanumeric string) and holds the Inter Operator Identifier (IOI) for the originating network as generated by the IMS network element which takes responsibility for populating this parameter [404] in a SIP request [202].

The Originating IOI contains the following values:

- Type 1 IOI: IOI of the visited network where the P-CSCF is located.
- Type 2 IOI:
  - IOI of the home network of the originating end user where the S-CSCF is located in case a session is initiated from the IMS. In case of redirection by the S-CSCF, *Originating-IOI* AVP indicates the terminating party's network operator from which the session is redirected.
  - IOI of the originating network where the MGCF is located in case a session is initiated from the PSTN toward the IMS.
- Type 3 IOI:
  - IOI of the home network (originating side or terminating side) where the S-CSCF is located when forwarding a SIP request [202] to an AS (proxy, terminating UA or redirect server or B2BUA).
  - IOI of the service provider network where the AS is located when an AS (originating UA or B2BUA) initiates a SIP request [202].

For further details on the Type 1, Type 2 and Type 3 IOIs, please refer to 3GPP TS 32.240 [1].

7.2.58 Originator AVP

The *Originator* AVP (AVP code 864) is of type Enumerated and indicates the originating party of the message body. The following values are defined:

Calling Party 0

Called Party 1

7.2.59 Originator-Address AVP

The *Originator-Address* AVP (AVP code xxx) is of type Grouped. Its purpose is to identify the originator of a MM.

It has the following ABNF grammar:

```
Originator-Address :: =     < AVP Header: xxx >
                            [ Address-Type ]
                            [ Address-Data ]
                            [ Address-Domain ]
```

7.2.60 Outgoing-Trunk-Group-ID AVP

The *Outgoing-Trunk-Group-ID* AVP (AVP code 853) is of type UTF8String and identifies the outgoing PSTN leg.

7.2.61 Participants-Involved AVP

The *Participants-Involved* AVP (AVP code 887) is of type UTF8String and holds the list of address (Public User ID: SIP URI, TEL URI, MSISDN) of the parties who are involved into the PoC session.

7.2.62 PDG-Address AVP

The PDG-Address AVP (AVP code tbd) is of type Address and contains the PDG IP address.

7.2.63 PDG-Charging-Id AVP

The PDG-Charging-Id AVP (AVP code tbd) is of type Unsigned32 and contains the charging identifier generated by the PDG for the tunnel. Charging identifier is generated at tunnel establishment and transferred to 3GPP AAA Server.

Different PDGs allocate the charging identifier independently of each other and may allocate the same numbers. PDG-Charging-Id together with PDG-Address constitutes a unique identifier for the tunnel.

Coding of this AVP is same as 3GPP-Charging-Id coding described in 3GPP TS 29.061 [207].

7.2.64 PoC-Controlling-Address AVP

The *PoC-Controlling-Address* AVP (AVP code xxx) is of type UTF8String and identifies the PoC server performing the controlling function for the associated PoC session.

7.2.65 PoC-Group-Name

The *PoC-Group-Name* AVP (AVP code xxx) is of type UTF8String and identifies a pre-arranged group. Included if the session is a pre-arranged group session

7.2.66 PoC-Information AVP

The PoC-*Information* AVP (AVP code 879) is of type Grouped. Its purpose is to allow the transmission of additional PoC service specific information elements.

It has the following ABNF grammar:

PoC-Information :: = < AVP Header: 879>

[PoC-Server-Role]
[PoC-Session-Type]
[Number-Of-Participants]
[Participants-Involved]
[Talk-Burst-Exchange]
[PoC-Controlling-Address]
[PoC-Group-Name]

7.2.67 PoC-Server-Role AVP

The PoC Server Role AVP (AVP code 883) is of type Enumerated and specifies the role of the PoC server.

The identifier can be one of the following:

0 Participating PoC Server

1 Controlling PoC Server

7.2.68 PoC-Session-Type AVP

The PoC Session Type AVP (AVP code 884) is of type Enumerated and specifies the type of the PoC session.

The identifier can be one of the following, refer Appendix C.5.1 in OMA-CP-POC []:

0 1 to 1 PoC session

1 chat PoC group session

2 pre-arranged PoC group session

3 ad-hoc PoC group session

7.2.69 Priority AVP

The *Priority* AVP (AVP code xxx) is of type Enumerated and the priority (importance) of the message if specified by the originator MMS User Agent.

The values are:

0 Low

1 Normal

2 High

7.2.70 PS-Append-Free-Format-Data AVP

The PS-Append-Free-Format-Data AVP (AVP code 867) is of type enumerated and indicates if the information sent in the PS-Free-Format-Data AVP must be appended to the PS-free-format-data stored for the online-session.

The following values are defined:

0 "Append": If this AVP is present and indicates "Append", the GGSN shall append the received PS free format data to the PS free format data stored for the online charging session.

1 "Overwrite": If this AVP is absent or in value "Overwrite", the GGSN shall overwrite all PS free format data already stored for the online charging session.

The GGSN shall ignore this AVP if no PS free format data is stored for the online charging session.

7.2.71 PS-Free-Format-Data AVP

The PS-Free-Format-Data AVP (AVP code 866) is of type OctectString and holds online charging session specific data.

7.2.72 PS-Furnish-Charging-Information AVP

The PS-Furnish-Charging-Information AVP (AVP code 865) is of type Grouped. Its purpose is to add online charging session specific information, received via the Ro reference point, onto the Rf reference point in order to facilitate its inclusion in CDRs. This information element may be received in a CCA message via the Ro reference point. In situations where online and offline charging are active in parallel, the information element is transparently copied into an ACR to be sent on the Rf reference point.

It has the following ABNF grammar:

PS-Furnish-Charging-Information :: = < AVP Header: 865>

{ GPRS-Charging-Id }
{ PS-Free-Format-Data }
[PS-Append-Free-Format-Data]

7.2.73 PS-Information AVP

The *PS-Information* AVP (AVP code 874) is of type Grouped. Its purpose is to allow the transmission of additional PS service specific information elements.

It has the following ABNF grammar:

PS-Information :: = < AVP Header: 874>

[IMSI]
[MSISDN]
[Charging-Id]
[PDP Type]
[PDP-Address]
[GPRS-Negotiated-QoS-Profile]
[SGSN-Address]
[GGSN-Address]
[CG-Address]
[IMSI-MCC-MNC]
[GGSN- MCC-MNC]
[NSAPI]
[APN-Info]
[Session-Stop-Indicator]
[Selection-Mode]
[Charging-Characteristics]
[SGSN-PLMN-Id]
[MS-TimeZone]
[CAMEL-Charging-Info]
[Charging-Rule-Base-Name]
[Calling-Party-Address]
[IMS-Charging-Identifier]
[User-Location-Info]
[Radio-Access-Technology]
[PS-Furnish-Charging-Information]

7.2.74 Read-Reply-Report-Requested AVP

The *Read-Reply-Report-Requested* AVP (AVP code xxx) is of type Enumerated and indicates whether a read reply report has been requested by the originator MMS User Agent or not.

The values for whether a report was requested are:

0 No

1 Yes

7.2.75 Recipient-Address AVP

The *Recipient-Address* AVP (AVP code xxx) is of type Grouped. Its purpose is to identify the recipient of a MM.

It has the following ABNF grammar:

```
Recipient-Address :: =  < AVP Header: xxx >
                        [ Address-Type ]
                        [ Address-Data ]
                        [ Address-Domain ]
                        [ Addressee-Type ]
```

7.2.76 Reply-Applic-ID AVP

The *Reply-Applic-ID* AVP (AVP code xxx) is of type UTF8String and holds the identifier of a 'reply path', i.e. the identifier of the application to which delivery reports, read-reply reports and reply-MMs are addressed.

7.2.77 Quota-Consumption-Time AVP

The Quota-Consumption-Time AVP (AVP code 881) is of type Unsigned32 and contains an idle traffic threshold time in seconds. This AVP may be included within the Multiple-Services-Credit-Control AVP when this AVP also contains a Granted-Service-Units AVP containing a CC-Time AVP (i.e. when the granted quota is a time quota).

7.2.78 Quota-Holding-Time AVP

The Quota-Holding-Time AVP (AVP code 871) is of type Unsigned32 and contains the quota holding time in seconds. The client shall start the quota holding timer when quota consumption ceases. This is always when traffic ceases, i.e. the timer is re-started at the end of each packet. The Credit Control Client shall deem a quota to have expired when no traffic associated with the quota is observed for the value indicated by this AVP. The timer is stopped on sending a CCR and re-initialised on receiving a CCA with the previous used value or a new value of Quota-Holding-Time if received.

This optional AVP may only occur in a CCA command. It is contained in the Multiple-Services-Credit-Control AVP. It applies equally to the granted time quota and to the granted volume quota.

A Quota-Holding-Time value of zero indicates that this mechanism shall not be used. If the Quota-Holding-Time AVP is not present, then a locally configurable default value in the client shall be used.

7.2.79 Reporting-Reason AVP

The Reporting-Reason AVP (AVP code 872) is of type Enumerated and specifies the reason for usage reporting for one or more types of quota for a particular category. It can occur directly in the Multiple-Services-Credit-Control AVP, or in the Used-Service-Units AVP within a Credit Control Request command reporting credit usage. It shall not be used at command level. It shall always and shall only be sent when usage is being reported.

The following values are defined for the Reporting-Reason AVP:

THRESHOLD (0)

- This value is used to indicate that the reason for usage reporting of the particular quota type indicated in the Used-Service-Units AVP where it appears is that the threshold has been reached.

QHT (1)

- This value is used to indicate that the reason for usage reporting of all quota types of the Multiple-Service-Credit-Control AVP where its appears is that the quota holding time specified in a previous CCA command has been hit (i.e. the quota has been unused for that period of time).

FINAL (2)

- This value is used to indicate that the reason for usage reporting of all quota types of the Multiple-Service-Credit-Control AVP where its appears is that a normal PDP context termination has happened.

QUOTA_EXHAUSTED (3)

- This value is used to indicate that the reason for usage reporting of the particular quota type indicated in the Used-Service-Units AVP where it appears is that the quota has been exhausted.

VALIDITY_TIME (4)

- This value is used to indicate that the reason for usage reporting of all quota types of the Multiple-Service-Credit-Control AVP where its appears is that the credit authorization lifetime provided in the Validity-Time AVP has expired.

OTHER_QUOTA_TYPE (5)

- This value is used to indicate that the reason for usage reporting of the particular quota type indicated in the Used-Service-Units AVP where it appears is that, for a multi-dimensional quota, one reached a trigger condition and the other quota is being reported.

RATING_CONDITION_CHANGE (6)

- This value is used to indicate that the reason for usage reporting of all quota types of the Multiple-Service-Credit-Control AVP where its appears is that a change has happened in some of the rating conditions that were previously armed (through the Trigger-Type AVP, e.g. QoS, Radio Access Technology,…). The specific condition that has changed is indicated in an associated Trigger-Type AVP.

FORCED_REAUTHORISATION (7)

- This value is used to indicate that the reason for usage reporting of all quota types of the Multiple-Service-Credit-Control AVP where its appears is that it is there has been a Server initiated re-authorisation procedure, i.e. receipt of RAR command

POOL_EXHAUSTED (8)

- This value is used to indicate that the reason for usage reporting of the particular quota type indicated in the User-Service-Units AVP where it appears is that granted units are still available in the pool but are not sufficient for a rating group using the pool.

The values QHT, FINAL, VALIDITY_TIME, FORCED_REAUTHORISATION, RATING_CONDITION_CHANGE apply for all quota types and are used directly in the Multiple-Services-Credit-Control AVP, whereas the values THRESHOLD, QUOTA_EXHAUSTED and OTHER_QUOTA_TYPE apply to one particular quota type and shall occur only in the Used-Service-Units AVP. The value POOL_EXHAUSTED apply to all quota types using the credit pool and occurs in the Used-Service-Units AVP. It may optionally occur in the Multiple-Services-Credit-Control AVP if all quota types use the same pool.

When the value RATING_CONDITION_CHANGE is used, the Trigger-Type AVP shall also be included to indicate the specific event which caused the re-authorisation request.

7.2.80 Role-of-node AVP

The *Role-Of-Node* AVP (AVP code 829) is of type Enumerated and specifies the role of the AS/CSCF.

The identifier can be one of the following:

ORIGINATING_ROLE 0
The AS/CSCF is applying an originating role, serving the calling subscriber.

TERMINATING_ROLE 1
The AS/CSCF is applying a terminating role, serving the called subscriber.

PROXY ROLE 2
The AS is applying a proxy role.

B2BUA_ROLE 3
The AS is applying a B2BUA role.

7.2.81 SDP-Media-Component AVP

The *SDP- Media-Component* AVP (AVP code 843) is of type Grouped and contains information about media used for a IMS session.

It has the following ABNF grammar:

<SDP-Media-Component>:: = <AVP Header: 843 >

[SDP-Media-Name]
*[SDP-Media-Description]
[Media-Initiator-Flag]
[Authorized-QoS]
[GPRS-Charging-Id]

7.2.82 SDP-Media-Description AVP

The *SDP-Media-Description* AVP (AVP code 845) is of type UTF8String and holds the content of an "attribute-line" (i=, c=, b=, k=, a=, etc.) related to a media component, as described in [406]. The attributes are specifying the media described in the SDP-Media-Name AVP.

7.2.83 SDP-Media-Name AVP

The *SDP-Media-Name* AVP (AVP code 844) is of type UTF8String and holds the content of a "m=" line in the SDP data.

7.2.84 SDP-Session-Description AVP

The *SDP-Session-Description* AVP (AVP code 842) is of type UTF8String and holds the content of an "attribute-line" (i=, c=, b=, k=, a=, etc.) related to a session, as described in [406].

7.2.85 Served-Party-IP-Address AVP

The *Served-Party-IP-Address* AVP (AVP code 848) is of type Address and holds the IP address of either the calling or called party, depending on whether the P-CSCF is in touch with the calling or the called party. This AVP is only provided by the P-CSCF.

7.2.86 Service-ID AVP

The *Service-ID* AVP (AVP code 855) is of type UTF8String and identifies the service the MRFC is hosting. For conferences the conference ID is used as the value of this parameter.

7.2.87 Service-Information AVP

The *Service-Information* AVP (AVP code 873) is of type Grouped. Its purpose is to allow the transmission of additional 3GPP service specific information elements which are not described in this document.

It has the following ABNF grammar:

Service-Information :: = < AVP Header: 873>

[PS-Information]
[WLAN-Information]
[IMS-Information]
[MMS-Information]
[LCS-Information]
[PoC-Information]
[MBMS-Information]

The format and the contents of the fields inside the Service-Information AVP are specified in the middle-tier documents which are applicable for the specific service. Note that the formats of the fields are service-specific, i.e. the format will be different for the various services.

Further fields may be included in the Service-Information AVP when new services are introduced.

7.2.88 Service-Specific-Data AVP

The *Service-Specific-Data* AVP (AVP Code 863) is of type UTF8String and holds service specific data if and as provided by an Application Server.

7.2.89 SIP-Method AVP

The *SIP-Method* AVP (AVP code 824) is of type UTF8String and holds the name of the SIP Method (INVITE, UPDATE etc.) causing an accounting request to be sent to the CDF.

7.2.90 SIP-Request-Timestamp AVP

The *SIP-Request-Timestamp* AVP (AVP code 834) is of type UTF8String and holds the time in UTC format of the initial SIP request (e.g. Invite).

7.2.91 SIP-Response-Timestamp AVP

The *SIP-Response-Timestamp* AVP (AVP code 835) is of type UTF8String and holds the time in UTC format of the response to the initial SIP request (e.g. 200 OK).

7.2.92 Submission-Time AVP

The *Submission-Time* AVP (AVP code xxx) is of type Time and indicates the time at which the MM was submitted or forwarded as specified in the corresponding MM1 message.

7.2.93 Talk-Burst-Exchange AVP

The *Talk-Burst-Exchange* AVP (AVP code 860) is of type Grouped and holds the talk burst related charging data.

It has the following ABNF grammar:

<Talk-Burst-Exchange>:: = < AVP Header: 860 >

[Number-Of-Talk-Bursts]
[Talk-Burst-Volume]
[Talk Bursts-Time]
[Number-Of-Received-Talk-Bursts]
[Received-Talk-Burst-Volume]
[Received-Talk-Burst-Time]

7.2.94 Terminating-IOI AVP

The *Terminating-IOI* AVP (AVP code 840) is of type UTF8String (alphanumeric string) and holds the Inter Operator Identifier (IOI) for the originating network as generated by the IMS network element which takes responsibility for populating this parameter [404] in a SIP response [202].

The Terminating IOI contains the following values:

- Type 1 IOI: IOI of the home network where the S-CSCF is located.
- Type 2 IOI:
  - IOI of the home network of the terminating end user where the S-CSCF is located in case a session is initiated toward the IMS. In case of redirection by the S-CSCF, *Terminating-IOI* AVP indicates the terminating party's network operator to which the session is redirected.
  - IOI of the terminating network where the MGCF is located in case a session is initiated from the IMS toward the PSTN.
- Type 3 IOI:
  - IOI of the service provider network (originating side or terminating side) where the AS (proxy, terminating UA or redirect server or B2BUA) is located when receiving a SIP request [202].
  - IOI of the home network operator contacted by an AS when an AS (originating UA or B2BUA) initiates a SIP request [202].

For further details on the Type 1, Type 2 and Type 3 IOIs, please refer to 3GPP TS 32.240 [1].

7.2.95 Time-Quota-Threshold AVP

The *Time-Quota-Threshold* AVP (AVP code 868) is of type Unsigned64 and contains a threshold value in seconds. This AVP may be included within the Multiple-Services-Credit-Control AVP when this AVP also contains a Granted-Service-Units AVP containing a CC-Time AVP (i.e. when the granted quota is a time quota).

If received, the Credit Control client shall seek re-authorisation from the server for the quota when the quota contents fall below the supplied threshold. The client shall allow service to continue whilst the re-authorisation is progress, until the time at which the original quota would have been consumed.

7.2.96 Time-Stamps AVP

The *Time-Stamps* AVP (AVP code 833) is of type Grouped and holds the time of the initial SIP request and the time of the response to the initial SIP Request.

It has the following ABNF grammar:

<Time-Stamps>:: = < AVP Header: 833 >

[SIP-Request-Timestamp]
[SIP-Response-Timestamp]

7.2.97 TMGI AVP

The *TMGI* AVP (AVP code xxx) is of type tbd.

7.2.98 Token-Text AVP

The *Token-Text* AVP (AVP code xxx) is of type UTF8String and contains extension information for the Message-Class AVP.

7.2.99 Trigger-Type AVP

The *Trigger-Type* AVP (AVP code 870) is of type Enumerated and indicates a single re-authorisation event type.

When included in the Credit Control Answer command, the Trigger-Type AVP indicates the events that shall cause the credit control client to re-authorise the associated quota. The client shall not re-authorise the quota when events which are not included in the Trigger AVP occur.

When included in the Credit Control Request command indicates the specific event which caused the re-authorisation request of the Reporting-Reason with value RATING_CONDITION_CHANGE associated.

It has the following values:

CHANGE_IN_SGSN_IP_ADDRESS (1)

- This value is used to indicate that a change in the SGSN IP address shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGE_IN_QOS (2)

- This value is used to indicate that a change in the end user negotiated QoS shall cause the credit control client to ask for a re-authorisation of the associated quota.

NOTE 1: This should not be used in conjunction with enumerated values 10 to 23.

CHANGE_IN_LOCATION (3)

- This value is used to indicate that a change in the end user location shall cause the credit control client to ask for a re-authorisation of the associated quota.

NOTE 2: This should not be used in conjunction with enumerated values 30 to 34.

CHANGE_IN_RAT (4)

- This value is used to indicate that a change in the radio access technology shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_TRAFFIC_CLASS (10)

- This value is used to indicate that a change in the end user negotiated traffic class shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_RELIABILITY_CLASS (11)

- This value is used to indicate that a change in the end user negotiated reliability class shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_DELAY_CLASS (12)

- This value is used to indicate that a change in the end user negotiated delay class shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_PEAK_THROUGHPUT (13)

- This value is used to indicate that a change in the end user negotiated peak throughput shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_PRECEDENCE_CLASS (14)

- This value is used to indicate that a change in the end user negotiated precedence class shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_MEAN_THROUGHPUT (15)

- This value is used to indicate that a change in the end user negotiated mean throughput shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_MAXIMUM_BIT_RATE_FOR_UPLINK (16)

- This value is used to indicate that a change in the end user negotiated uplink maximum bit rate shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_MAXIMUM_BIT_RATE_FOR_DOWNLINK (17)

- This value is used to indicate that a change in the end user negotiated downlink maximum bit rate shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_RESIDUAL_BER (18)

- This value is used to indicate that a change in the end user negotiated residual BER shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_SDU_ERROR_RATIO (19)

- This value is used to indicate that a change in the end user negotiated SDU error ratio shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_TRANSFER_DELAY (20)

- This value is used to indicate that a change in the end user negotiated transfer delay shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_TRAFFIC_HANDLING_PRIORITY (21)

- This value is used to indicate that a change in the end user negotiated traffic handling priority shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_GUARANTEED_BIT_RATE_FOR_UPLINK (22)

- This value is used to indicate that a change in the end user negotiated uplink guaranteed bit rate shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINQOS_GUARANTEED_BIT_RATE_FOR_DOWNLINK (23)

- This value is used to indicate that a change in the end user negotiated downlink guaranteed bit rate shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINLOCATION_MCC (30)

- This value is used to indicate that a change in the MCC of the serving network shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINLOCATION_MNC (31)

- This value is used to indicate that a change in the MNC of the serving network shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINLOCATION_RAC (32)

- This value is used to indicate that a change in the RAC where the end user is located shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINLOCATION_LAC (33)

- This value is used to indicate that a change in the LAC where the end user is located shall cause the credit control client to ask for a re-authorisation of the associated quota.

CHANGEINLOCATION_CellId (34)

- This value is used to indicate that a change in the Cell Identity where the end user is located shall cause the credit control client to ask for a re-authorisation of the associated quota.

7.2.100 Trunk-Group-ID AVP

The *Trunk-Group-ID* AVP (AVP code 851) is of type Grouped and identifies the incoming and outgoing PSTN legs.

It has the following ABNF grammar:

<Trunk-Group-ID>:: = <AVP Header: 851>

[Incoming-Trunk-Group-ID]
[Outgoing-Trunk-Group-ID]

7.2.101 Type-Number AVP

The *Type-Number* AVP (AVP code xxx) is of type Enumerated and identifies the well-known media types. The values are taken from OMNA WSP Content Type Codes database [210]

7.2.102 User-Session-ID AVP

The *User-Session-Id* AVP (AVP code 830) is of type UTF8String and holds the session identifier. For a SIP session the *Session-ID* contains the SIP Call ID, as defined in [405].

7.2.103 Volume-Quota-Threshold AVP

The *Volume-Quota-Threshold* AVP (AVP code 869) is of type Unsigned64 and contains a threshold value in octets. This AVP may be included within the Multiple-Services-Credit-Control AVP when this AVP also contains a Granted-Service-Units AVP containing a CC-Total-Octets, CC-Input-Octets or CC-Output-Octets AVP (i.e. when the granted quota is a volume quota).

If received, the Credit Control client shall seek re-authorisation from the server for the quota when the quota contents fall below the supplied threshold. The client shall allow service to continue whilst the re-authorisation is progress, up to the volume indicated in the original quota.

7.2.104 WAG-Address AVP

The WAG-Address AVP (AVP code 890) is of type Address and contains the WAG IP address.

7.2.105 WAG-PLMN-Id AVP

The WAG-PLMN-Id AVP (AVP code 891) is of type OctetString and contains the WAG PLMN id (MCC and MNC).

Coding of this AVP is same as 3GPP-SGSN-MCC-MNC coding described in 3GPP TS 29.061 [207].

7.2.106 WLAN-Information AVP

The WLAN-*Information* AVP (AVP code 875) is of type Grouped. Its purpose is to allow the transmission of additional WLAN service specific information elements. The format and the contents of the fields inside the WLAN-Information AVP is specified in TS 32.252 [22].

It has the following ABNF grammar:

WLAN-Information :: = < AVP Header: 875>

[WAG-Address]
[WAG-PLMN-Id]
[WLAN-Radio-Container]
[WLAN-UE-Local-IPAddress]

7.2.107 WLAN-Radio-Container AVP

The WLAN-Radio-Container AVP (AVP code 892) is of type Grouped. The WLAN-Radio-Container AVP has the following format:

WLAN-Radio-Container :: = < AVP Header: 892>
[Operator-Name]
[Location-Type]
[Location-Information]
[WLAN-Technology]

The Operator-Name, Location-Type and Location-Information AVPs are defined in TS 29.234 [207].

7.2.108 WLAN-Session-Id AVP

The *WLAN-Session-Id* AVP (AVP code tbd) is of type Unsigned32 and contains the charging id generated by the AAA Server for the session.

Coding of this AVP is same as 3GPP-Charging-Id coding described in TS 29.234 [207].

Editors Note: It is not yet added to TS 29.234 that AAA Server shall deliver WLAN-Session-Id to PDG. This is required for correlating 3GPP IP Access charging data to Direct IP Access charging data to avoid double billing.

7.2.109 WLAN-Technology AVP

The *WLAN-Technology* AVP (AVP code 893) is of type Unsigned32. Actual content of this AVP is tbd.

7.2.110 WLAN-UE-Local-IPAddress AVP

The *WLAN-UE-Local-IPAddress* AVP (AVP code 894) is of type Address and contains the UE"s local IP address.

Annex A (informative): Bibliography

a) The 3GPP charging specifications

- 3GPP TS 32.250: "Telecommunication management; Charging management; Circuit Switched (CS) domain charging".
- 3GPP TS 32.251: "Telecommunication management; Charging management; Packet Switched (PS) domain charging".
- 3GPP TS 32.252: "Telecommunication management; Charging management; Wireless Local Area Network (WLAN) charging".
- 3GPP TS 32.260: "Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging".
- 3GPP TS 32.270: "Telecommunication management; Charging management; Multimedia Messaging Service (MMS) charging".
- 3GPP TS 32.271: "Telecommunication management; Charging management; Location Services (LCS) charging".
- 3GPP TS 32.298: "Telecommunication management; Charging management; Charging Data Record (CDR) encoding rules description".
- 3GPP TS 32.297: "Telecommunication management; Charging management; Charging Data Record (CDR) file format and transfer".
- 3GPP TS 32.296: "Telecommunication management; Charging management; Online Charging System (OCS) applications and interfaces".
- 3GPP TS 32.295: "Telecommunication management; Charging management; Charging Data Record (CDR) transfer".

b) Common 3GPP specifications

- 3GPP TS 33.201: "Access domain security".

c) other Domain and Service specific 3GPP / ETSI specifications

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d) Relevant ITU Recommendations

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e) Relevant IETF RFCs

- IETF RFC 959 (1985): "File Transfer Protocol".
- IETF RFC 1350 "TFTP Protocol".

Annex B (informative): Change history

Change history								
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Cat**	**Old**	**New**
Mar 2004	SA_23	SP-040145	--	--	Submitted to TSG SA#23 for Information	--	1.0.0	
Sep 2004	SA_25	SP-040554	--	--	Submitted to TSG SA#25 for Approval	--	2.0.0	6.0.0
Dec 2004	SA_26	SP-040776	0001	--	Reassign Vendor specific AVP codes - Align with CN4"s 29.230	A	6.0.0	6.1.0
Dec 2004	SA_26	SP-040776	0002	--	Add Threshold based re-authorisation triggers	B	6.0.0	6.1.0
Dec 2004	SA_26	SP-040776	0003	--	Add Re-authorisation triggers for flow-based online charging – Align with Stage 2	B	6.0.0	6.1.0
Dec 2004	SA_26	SP-040776	0004	--	Add missing elements and other corrections	F	6.0.0	6.1.0
Dec 2004	SA_26	SP-040775	0005	--	Add definition of a new 3GPP-specific AVP: PS Furnish Charging Information AVP - Align with 32.251	B	6.0.0	6.1.0
Mar 2005	SA_27	SP-050030	0006	--	Correction of missing Service Specific Data AVP (Attribute Value Pair)	A	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0007	--	Correction of criteria for the presence of the GPRS charging ID in the Diameter Accounting messages - Align with SA2"s TS 23.228	A	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0008	--	Correct the description of Charging Key	F	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0009	--	Correction of Termination action	B	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0010	--	Correction of missing Quota-Consumption-Time	F	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0011	--	Correction of cause code for 2xx events	F	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0012	--	Correction of missing cause code to distinguishing deregistration charging event	F	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0013	--	Correction to Session Charging with Unit Reservation (SCUR)	F	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0014	--	Correction to Server-Capabilities AVP	F	6.1.0	6.2.0
Mar 2005	SA_27	SP-050030	0015	--	Correction on Tariff Switch handling	F	6.1.0	6.2.0
Jun 2005	SA_28	SP-050276	0016	--	Correction to scope	F	6.2.0	6.3.0
Jun 2005	SA_28	SP-050276	0017	--	Correction to references	F	6.2.0	6.3.0
Sep 2005	SA_29	SP-050636	0018	--	Correct reporting reason AVP (Attribute Value Pair) to support credit pooling	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050636	0019	--	Correct Quota Holding Time handling for stopping the associated timer	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050636	0020	--	Correct Charging-Rule-Base-Name AVP (Attribute Value Pair) – Align with TS 29.210	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050437	0021	--	Updates to Trigger-Type AVP (Attribute Value Pair)	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050437	0022	--	Add missing Service-Context-Identifier values	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050437	0023	--	Correct Result Code AVP (Attribute Value Pair)	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050437	0024	--	Add IMS-Information AVP (Attribute Value Pair) - Align with TS 32.260	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050443	0025	--	Correct Diameter message description - Align with TS 29.230	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050437	0026	--	Correct IOI (Inter Operator Identifier) AVP (Attribute Value Pair) description - Align with TS 32.240	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050437	0027	--	Add missing Credit Control Failure Handling and Failover Support	F	6.3.0	6.4.0
Sep 2005	SA_29	SP-050440	0028	--	Add missing description for MMS AVPs (Attribute Value Pairs)	F	6.3.0	6.4.0
Dec 2005	SA_30	SP-050702	0029	--	Correct the PoC specific information for charging provided by PoC servers	F	6.4.0	6.5.0
Dec 2005	SA_30	SP-050700	0030	--	Correct Debit Units operation parameter - Align with IETF RFC 4006	F	6.4.0	6.5.0
Dec 2005	SA_30	SP-050802	0031	--	Correct Message-Type AVP to reflect trigger point for MM submission	F	6.4.0	6.5.0
Dec 2005	SA_30	SP 050654	--	--	Created for reference by TISPAN	--	6.5.0	7.0.0

History

Document history		
V7.0.0	December 2005	Publication