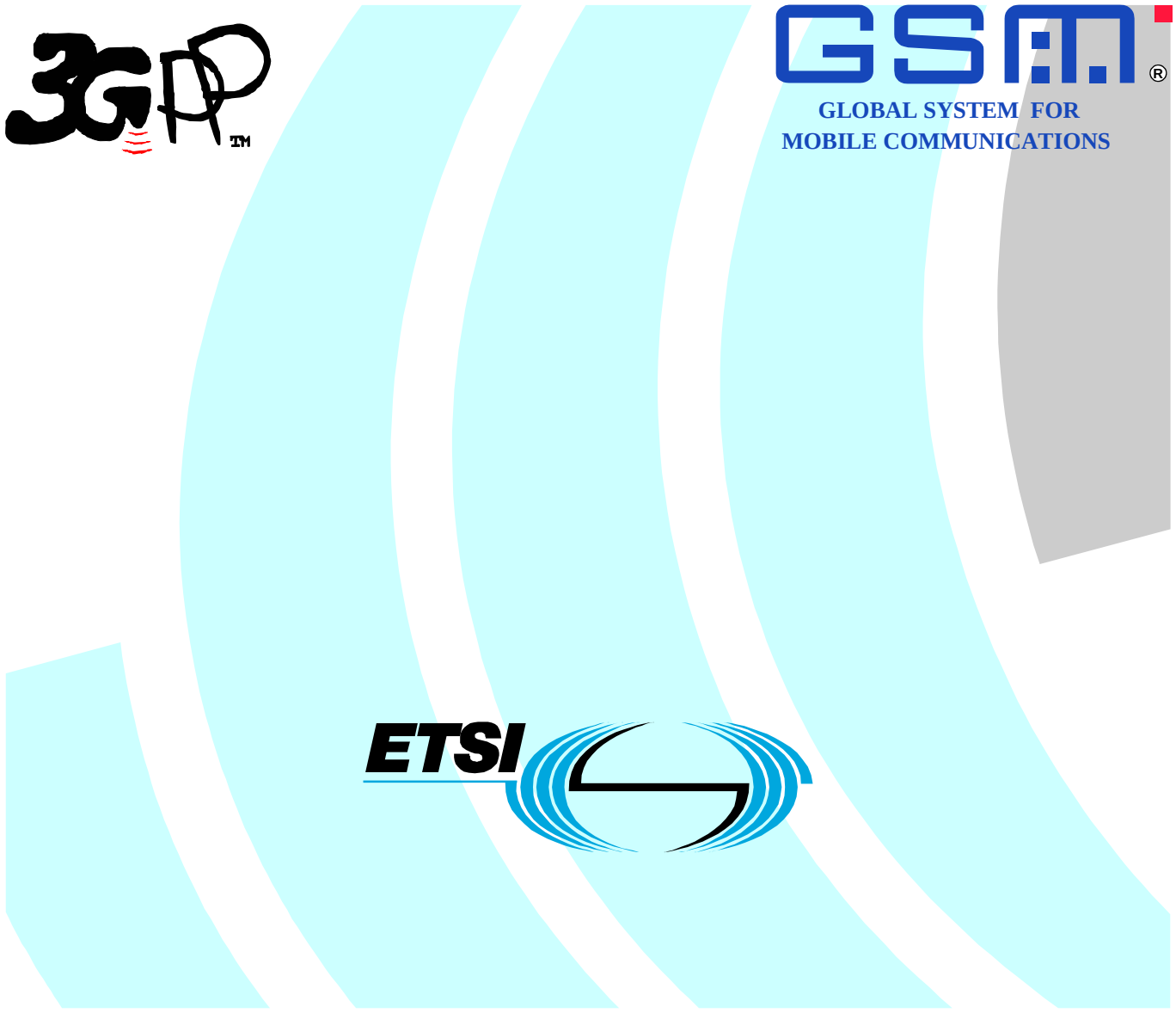
ETSI TS 132 225 V5.1.0 (2002-12)

Technical Specification

Digital cellular telecommunications system (Phase 2+);
Universal Mobile Telecommunications System (UMTS);
Telecommunication management;
Charging management;
Charging data description
for the IP Multimedia Subsystem (IMS)
(3GPP TS 32.225 version 5.1.0 Release 5)



Reference
RTS/TSGS-0532225v510

Keywords
GSM, UMTS

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, send your comment to:
editor@etsi.org

Copyright Notification

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

All published ETSI deliverables shall include information which directs the reader to the above source of information.

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:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document covers both online and offline charging for the IMS. For clarity, the terms Offline Charging and Online charging as applied to the IMS are defined here in clause 3. These definitions are the same as listed in TS 32.200 [2].

The IMS charging architecture details, requirements, definitions and principles are listed in TS 32.200 [2] and therefore are not repeated here.

In the present document the charging data triggers, message content and format are specified along with the transport of these messages using the Diameter protocol. Details about charging message flows and the definitions of the Diameter AVPs are also included in the present document. This information is divided into two main clauses: Online Charging and Offline Charging.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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

[2] 3GPP TS 32.200: "Telecommunication management; Charging management; Charging principles".

[3] IETF Internet-Draft, "Diameter Base Protocol". http://www.ietf.org/internet-drafts/draft-ietf-aaa-diameter-12.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.

[4] 3GPP TS 33.201: "Access domain security".

[5] 3GPP TS 23.218: "IP Multimedia (IM) session handling; IM call model; Stage 2".

[6] IETF RFC 2486: "The Network Access Identifier".

[7] 3GPP TS 23.207: "End to end quality of service concept and architecture".

[8] 3GPP TS 29.207: "Policy control over Go interface".

[9] ITU-T Recommendation X.690: "Information technology - ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)".

[10] ITU-T Recommendation X.691: "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".

[11] ITU-T Recommendation X.693: "Information Technology - ASN.1 encoding rules: XML encoding Rules (XER)".

[12] 3GPP TS 24.228: "Signalling flows for the IP multimedia call control based on SIP and SDP; Stage 3".

[13] IETF Internet-Draft, "Diameter Credit Control Application". http://www.ietf.org/internet-drafts/draft-hakala-diameter-credit-control-04.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.

[14] 3GPP TS 24.229: "IP Multimedia Call Control Protocol based on SIP and SDP; Stage 3."

[15] IETF Internet-Draft, "Private Extensions to the Session Initiation Protocol (SIP) for the 3rd Generation Partnership Projects (3GPP)". http://www.ietf.org/internet-drafts/draft-garcia-sipping-3gpp-p-headers-01.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.

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

[17] IETF Internet-Draft, "SDP: Session Description Protocol". http://www.ietf.org/internet-drafts/draft-ietf-mmusic-sdp-new-10.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.

[18] 3GPP TS 23.228: "IP Multimedia Subsystem (IMS); Stage 2".

[19] 3GPP TS 29.229: "Cx and Dx Interfaces based on the Diameter protocol; Protocol Details".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of th 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

3.2 Symbols

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

Bi	The Interface between the IMS charging function and the BS
Rb	Online Charging Reference Point between Session Charging Function and Correlation Function
Rc	Online Charging Reference Point between ECF and Correlation Function
Re	Online Charging Reference Point towards a Rating Server
Rf	Offline Charging Reference Point between an IMS Network Entity or an AS and CCF
Ro	Online Charging Reference Point between an AS or MRFC and the ECF

3.3 Abbreviations

For the purposes of the present document, the abbreviations defined in TR 21.905 [1], TS 32.200 [2] and the following apply:

ABNF	Augmented Backus-Naur Form
ACA	Accounting Answer
ACR	Accounting Request
AS	Application Server
ASA	Abort Session Answer
ASR	Abort Session Request

AVP	Attribute Value Pair
B2BUA	Back-to-Back User Agent
BGCF	Breakout Gateway Control Function
BS	Billing System
CCF	Charging Collection Function
CDR	Charging Data Record
CPCF	Content Provider Charging Function
ECF	Event Charging Function
ECUR	Event Charging with Unit Reservation
CSCF	Call Session Control Function (I-Interrogating; P-Proxy; and S-Serving)
IEC	Immediate Event Charging
IMS	IP Multimedia Subsystem
ISC	IMS Service Control
MGCF	Media Gateway Control Function
MRFC	Media Resource Function Controller
MRFP	Multimedia Resource Function Processor
OCS	Online Charging System
SCCF	Subscriber Content Charging Function
SDP	Session Description Protocol
SIP	Session Initiation Protocol
UA	User Agent
UE	User Equipment

4 Offline and Online Charging

4.1 Implementation of Offline and Online Charging

The IMS charging architecture, described in TS 32.200 [2], specifies that for offline charging all communications between the IMS network entities and the CCF are carried out on the Rf interface. On the other hand, for online charging the Ro interface is used by the AS and MRFC towards the Event Charging Function and the ISC interface is used between the S-CSCF and the Session Charging Function. The rules governing the selection of the proper interfaces are described in the subclauses below.

4.1.1 Usage of Rf and Ro Interfaces

The AS and MRFC are able to distinguish whether to apply offline or online charging, i.e. whether to send charging information on the Rf interface to the CCF or on the Ro interface to the ECF (or to use both). The decision of which interface to use is based on the information (CCF and/or ECF address) the AS/MRFC receive in the SIP signaling and the system configuration as provisioned by the operator. If the AS/MRFC only receive the CCF address and do not receive an ECF address then they use only the Rf interface. If only the ECF address was provided then they use only the Ro interface. In cases where both CCF and ECF addresses are provided it is possible to use both interfaces simultaneously.

However, operators may overrule the addresses received via the SIP signalling and use their own configured rules instead. Operators may configure locally on the AS/MRFC an ECF and/or CCF address. The CCF address may be locally configured on all other IMS nodes. The choice of whether the IMS nodes use the locally configured addresses or the addresses received by SIP signalling, and the decision on which interface(s) to use, is left for operator configuration.

4.1.2 Usage of Rf and ISC Interfaces

All other IMS nodes (S-CSCF, P-CSCF, I-CSCF, BGCF and MGCF) apply offline charging via the Rf interface using the CCF address as received via SIP signaling or the locally configured CCF address. The S-CSCF supports online charging using the ISC interface, i.e. if the application server addressed over ISC is the Session Charging Function of the OCS.

4.1.3 Support of Local File Storage

The present document does not mandate the support of persistent storage on the IMS nodes nor does it require any protocol except Diameter to be used for either online or offline charging. However, if an IMS node supports a local persistent storage media, it should be able to store the accounting information as contained in the Diameter messages on this local filestore. Operator's post-processing systems may then collect the contents of the filestore (e.g. via FTP) applying the same file transfer procedures as those that are used when accessing the Bi interface at the CCF.

4.2 Diameter Protocol Basic Principles and Use

The present document defines a 3GPP IMS charging Diameter application, which utilizes the Diameter Base Protocol [3]. This application is used for both online and offline charging. The generic description of the protocol is provided in the subclauses below while the portions of the protocol application associated with offline and online charging are described in clauses 5 and 6, respectively.

4.2.1 Basic Principles

The IMS charging Diameter application is based on the following general principles:

- The basic functionality of Diameter, as defined by the Diameter Base Protocol [3] is re-used in IMS.
- For offline charging IMS network elements report accounting information to the Charging Collection Function (CCF). The CCF uses this information to construct and format CDRs.
- For online charging, the AS and MRFC in the IMS network report accounting information to the Event Charging Function (ECF). The ECF uses this information to support the event based charging (content charging) function of the OCS.

4.2.2 Application Requirement for the Base Protocol

4.2.2.1 Offline Specific Base Protocol Requirements

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 [3]:

- To send/receive Abort-Session-Request.
- To send/receive Abort-Session-Answer.

All other options of the Diameter Base Protocol are beyond the scope of the present document.

If *Acct-Interim-Interval* AVP is not used or its value field is set to 0, the timer Ts should have a configurable default value.

For offline charging, the client implements the state machine described in [3]. The server (CCF) implements the STATELESS ACCOUNTING state machine as specified in [3], i.e. there is no order in which the server expects to receive the accounting information.

4.2.2.2 Online Specific Base Protocol Requirements

If *Acct-Interim-Interval* AVP is not used or its value field is set to 0, the timer Ts should have a configurable default value.

The online client (e.g. AS, MRFC) implements the state machine described in [13] for "CLIENT, EVENT BASED" or "CLIENT, SESSION BASED", i.e. when the client applies Immediate Event Charging (IEC) it uses the "CLIENT, EVENT BASED" state machine, or when the client applies Event Charging with Unit Reservation (ECUR) it uses the "CLIENT, SESSION BASED" state machine.

The online charging server that is part of the OCS implements the state machine described in [13] for the "SERVER, SESSION AND EVENT BASED" in order to support Immediate Event Charging and Event Charging with Unit Reservation.

4.2.2.3 Security Considerations

Diameter security is addressed in the base protocol [3]. Network security is specified in TS 33.201 [4].

5 Offline Charging

5.1 Diameter Description on the Rf Interfaces

5.1.1 Basic Principles

The offline charging functionality is based on the IMS network nodes reporting accounting information upon reception of various SIP methods or ISUP messages, 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 IMS nodes to the CCF and/or ECF.

The Diameter client uses ACR Start, Interim and Stop in procedures related to successful SIP sessions. It uses ACR Events for unsuccessful SIP sessions and for session unrelated procedures. Further details are specified in the tables below and in subclause 5.1.2.

It is operator configurable in the nodes for which SIP method or ISUP messages an *Accounting Request* is sent, with the exception that if accounting information is collected for sessions the ACR [Start] and ACR [Stop] messages are mandatory according to the tables below. Table 5.1 describes all possible ACRs that might be sent from a P-CSCF, I-CSCF, S-CSCF, MGCF or BGCF. A list of node specific ACRs, along with the AVPs to be included are detailed in section 5.1.3.3.

The ACRs to be sent from a MRFC are described in table 5.2.

In the tables below, the terms "configurable" implies that operators may enable or disable the generation of an ACR message by the IMS node in response to a particular "Triggering SIP Method /ISUP Message". However, for those table entries marked with *, the operator can enable or disable the ACR message based on whether or not the SIP (Re) Invite message that is replied to by the "Triggering SIP Method /ISUP Message" carried piggybacked user data.

Table 5.1: Accounting Request Messages Triggered by SIP Methods or ISUP Messages for all IMS nodes except for MRFC and AS

Diameter Message	Triggering SIP Method /ISUP Message	Mandatory/Configurable
ACR [Start]	SIP 200 OK acknowledging an initial SIP INVITE	Mandatory
	ISUP:ANM (applicable for the MGCF)	Mandatory
ACR [Interim]	SIP 200 OK acknowledging a SIP RE-INVITE [e.g. change in media components]	Configurable
	Expiration of AVP [Acct-Interim-Interval]	Configurable
ACR [Stop]	SIP BYE message	Mandatory
	SIP Final Response with error codes 4xx, 5xx or 6xx, indicating termination of an ongoing session	Mandatory
	ISUP:REL (applicable for the MGCF)	Mandatory
ACR [Event]	SIP 200 OK acknowledging non-session related SIP messages, which are:	
	SIP NOTIFY	Configurable
	SIP MESSAGE	Configurable
	SIP REGISTER	Configurable
	SIP SUBSCRIBE	Configurable
	SIP Final Response (4xx, 5xx or 6xx), indicating an unsuccessful SIP session set-up	Configurable *
	SIP Final Response (4xx, 5xx or 6xx), indicating an unsuccessful session-unrelated procedure	Configurable *
	SIP CANCEL, indicating abortion of a SIP session set-up	Configurable *
	I-CSCF completing a Cx Query that was issued in response to a SIP INVITE	Configurable

NOTE: SIP SUBSCRIBE with the field "Expires" set to 0 means unsubscribe. SIP REGISTER with its "Expires" header field or "Expires" parameter equal to 0 means Deregistration [14].

Table 5.2: Accounting Request Messages Triggered by SIP Methods for the MRFC

Diameter Message	Trigger	Mandatory/Configurable
ACR [Start]	SIP 200 OK acknowledging an SIP INVITE for initiating a multimedia ad hoc conferencing session	Mandatory
ACR [Interim]	SIP ACK acknowledging a SIP INVITE to connect an UE to the conferencing session	Configurable
	Expiration of AVP [Acct-Interim-Interval]	Configurable
ACR [Stop]	SIP BYE message	Mandatory
	SIP Final Response with error codes 4xx, 5xx or 6xx indicating termination of an ongoing session	Mandatory

ASs support all four ACR types (Start/Interim/Stop/Event). The use of ACR Start, Interim and Stop (Session Charging) versus ACR Event (Event Charging) depends on the services provided by the application server. Example flows for an AS employing Event Charging and an AS using Session Charging are shown in subclause 5.1.2.1.3.

The ability of SIP methods not listed in tables 5.1 and 5.2 to trigger ACRs is for further study.

5.1.2 Message Flows and Types

The flows described in the present document specify the charging communications between IMS entities and the charging functions for different charging scenarios. The SIP messages associated with these charging scenarios are shown primarily for general information and to illustrate the charging triggers. They are not intended to be exhaustive of all the SIP message flows discussed in TS 24.228 [12].

5.1.2.1 Message Flows - Successful Cases and Scenarios

5.1.2.1.1 Session Related Procedures

5.1.2.1.1.1 Session Establishment - Mobile Origination

Figure 5.1 shows the Diameter transactions that are required between CSCF and CCF during session establishment originated by a UE.

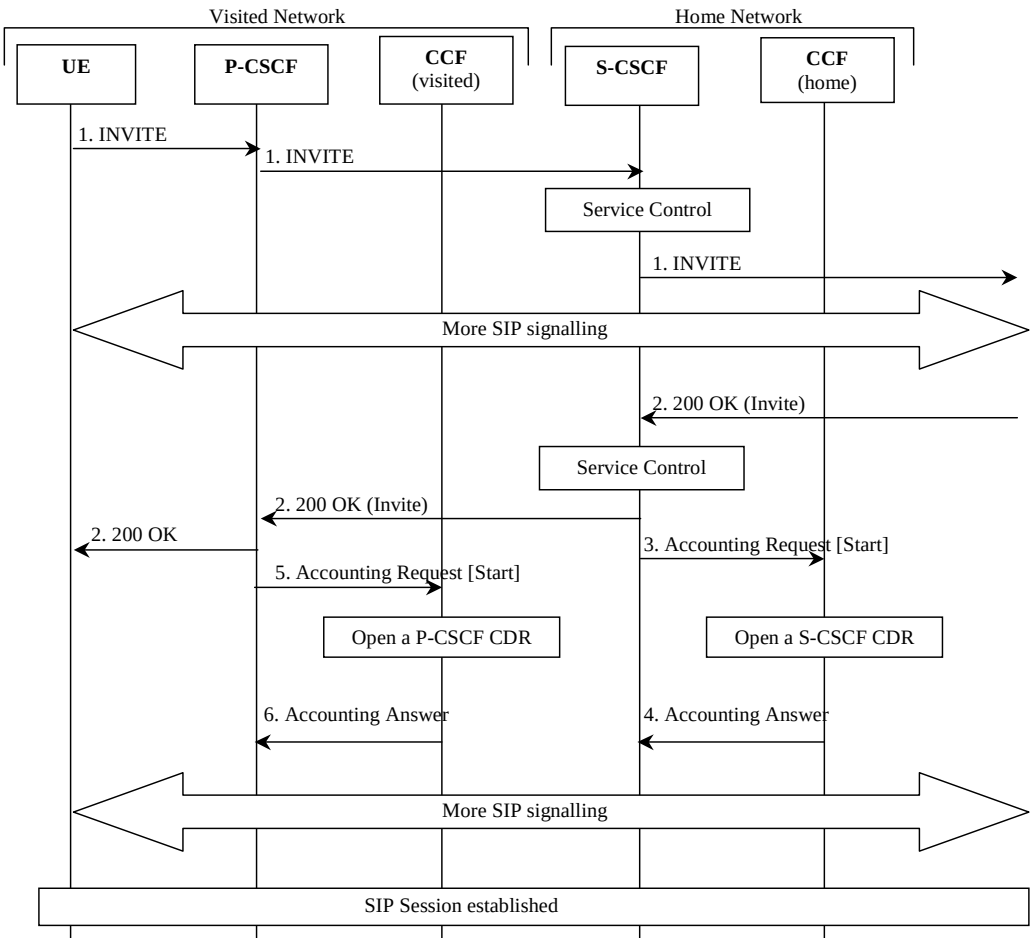


Figure 5.1: Message Sequence Chart for Session Establishment (Mobile Origination)

1. The session is initiated.
2. The destination party answers and a final response is received.
3. Upon reception of the final response, the S-CSCF sends an *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD to record start of a user session and start of a media component in the S-CSCF CDR.
4. The CCF acknowledges the reception of the data and opens a S-CSCF CDR.
5. Same as 3, but for P-CSCF.
6. Same as 4, but creating a P-CSCF CDR.

5.1.2.1.1.2 Session Establishment - Mobile Termination

Figure 5.2 shows the Diameter transactions that are required between CSCF and CCF during a session establishment that is terminated to a mobile. The I-CSCF is only involved in the INVITE transaction.

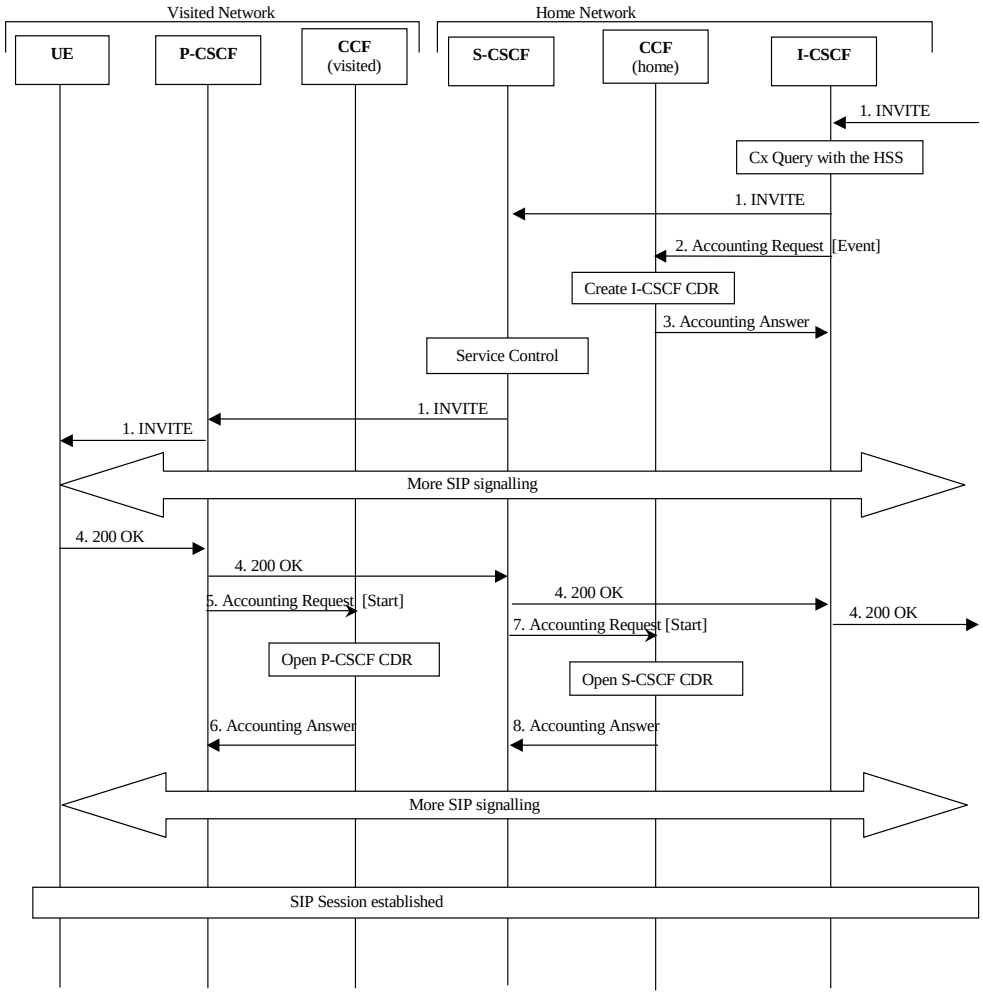


Figure 5.2: Message Sequence Chart for Session Establishment (Mobile Termination)

1. The session is initiated.
2. Upon completing a Cx query the I-CSCF sends an *Accounting Request* with the *Accounting-Record-Type* set to EVENT.
3. The CCF acknowledges the data received and creates an I-CSCF CDR.
4. The destination party answers and a final response is sent.
5. - 8. These steps are identical to the corresponding steps described in subclause 5.1.2.1.1.1.

5.1.2.1.1.3 Mid-Session Procedures

Figure 5.3 shows the Diameter transactions that are required between CSCF and CCF when a UE generates a Re-Invite in mid-session, e.g. in order to modify media component(s), or when the hold and resume procedure is executed.

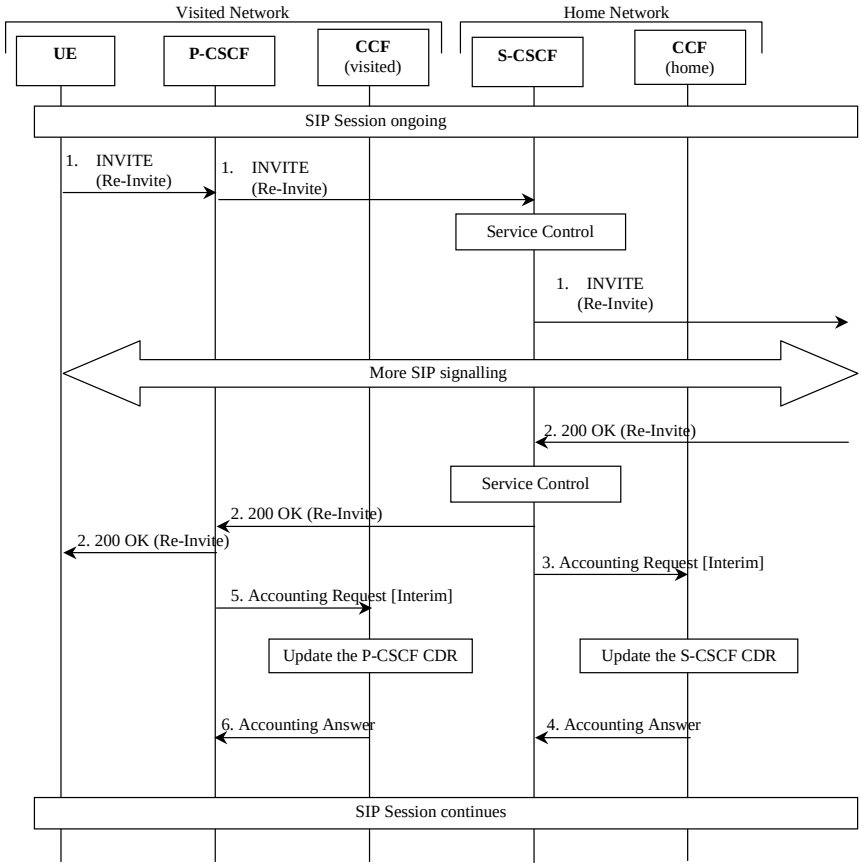


Figure 5.3: Message Sequence Chart for Media Modification

1. Modified media information is received from the subscriber.
2. The destination party acknowledges the media modification.
3. At modification of a media, the S-CSCF sends *Accounting-Request* with *Accounting-Record-Type* indicating INTERIM_RECORD to record modification of a media component in the S-CSCF CDR.
4. The CCF acknowledges the reception of the data and updates the S-CSCF CDR.
5. Same as 3, but for P-CSCF.
6. Same as 4, updating the P-CSCF CDR.

5.1.2.1.1.4 Session Release - Mobile Initiated

Figure 5.4 shows the Diameter transactions that are required between CSCF and CCF for a session release that is initiated by the UE.

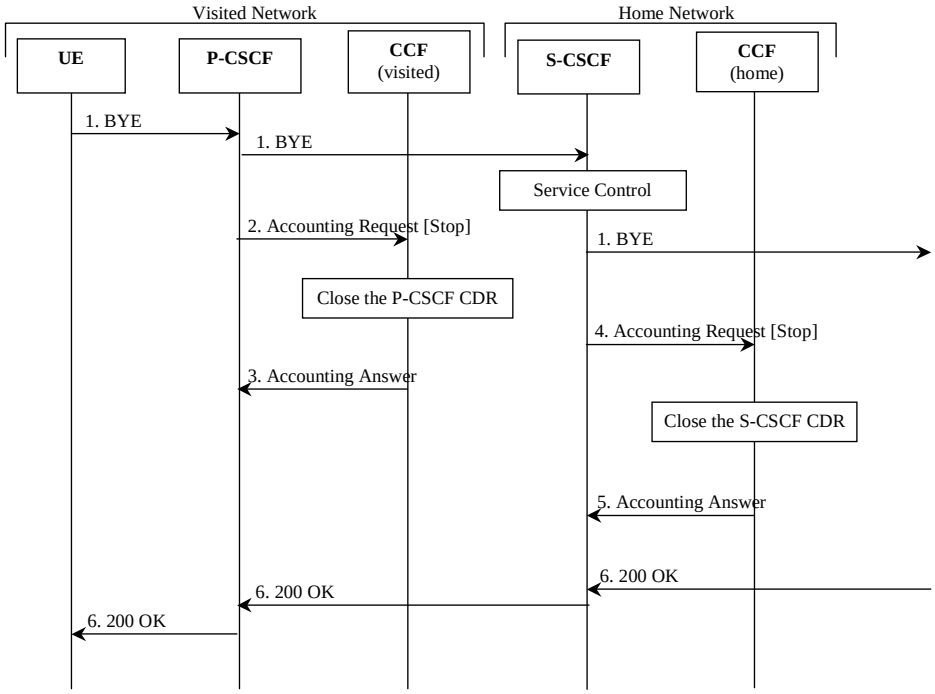


Figure 5.4: Message Sequence Chart for Session Release

1. The session is released.
2. At session termination the P-CSCF sends *Accounting-Request* with *Accounting-Record-Type* indicating STOP_RECORD to record stop of a session and stop of a media component in the P-CSCF CDR.
3. The CCF acknowledges the reception of the data and closes the P-CSCF CDR.
4. Same as 2, but for S-CSCF.
5. Same as 3, closing the S-CSCF CDR.
6. The release is acknowledged.

5.1.2.1.1.5 Session Release - Network Initiated

The message flow for this case is identical to the mobile initiated session release described in subclause 5.1.2.1.1.4. However, before invoking the procedure, the UE receives a command requesting session release from the network.

5.1.2.1.1.6 Session Release - CCF initiated

The IMS operator may request the release of SIP session(s) upon certain trigger conditions being met, for example as soon as a fraud is detected. The communication between CCF and external functions that convey that request to the CCF is not in the scope of the present document.

Figure 5.5 shows the Diameter transactions that are required between CCF and S-CSCF in order to release an ongoing SIP session.

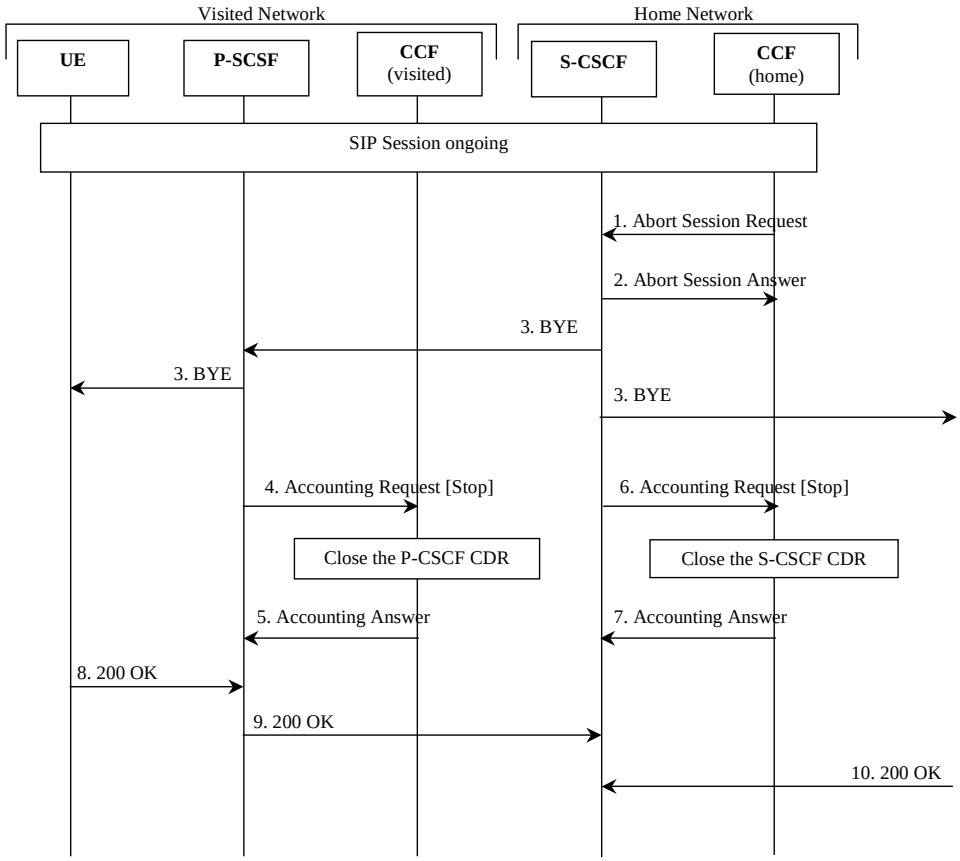


Figure 5.5: Message Sequence Chart for CCF Initiated Session Release

1. The CCF may initiate the SIP session release by sending an *Abort-Session-Request* message to the S-CSCF.
2. The S-CSCF acknowledges the *Abort-Session-Request* by sending an *Abort-Session-Answer* message to the CCF. Upon receiving the *Abort-Session-Answer,* the CCF closes the CDR. The record closure time in the CDR is the time when the *Abort-Session-Answer* message has been received.
3. The S-CSCF initiates the SIP session release by sending SIP BYE request to both the originating and the terminating parties, as specified in TS 23.218 [5].
4. At session termination the P-CSCF sends *Accounting-Request* with *Accounting-Record-Type* indicating STOP_RECORD to record stop of a session and stop of a media component in the P-CSCF CDR.
5. The CCF acknowledges the reception of the data and closes the P-CSCF CDR CDR.
6. Same as 4, but for S-CSCF.
7. Same as 5, but for S-CSCF CDR.
8. - 10. The S-CSCF receives the 200 OK responses from originating and terminating parties.

The S-CSCF should not be restricted to receiving *Abort Session Request*s only from a CCF, since such requests may be sent to an S-CSCF from other (i.e. non-IMS) sources, e.g. an operator's fraud detection system.

5.1.2.1.2 Session-Unrelated Procedures

Figure 5.6 shows the Diameter transactions that are required between CSCF and CCF for session-unrelated IMS procedures, i.e. those that relate to the Diameter ACR [Event], as listed in table 5.1.

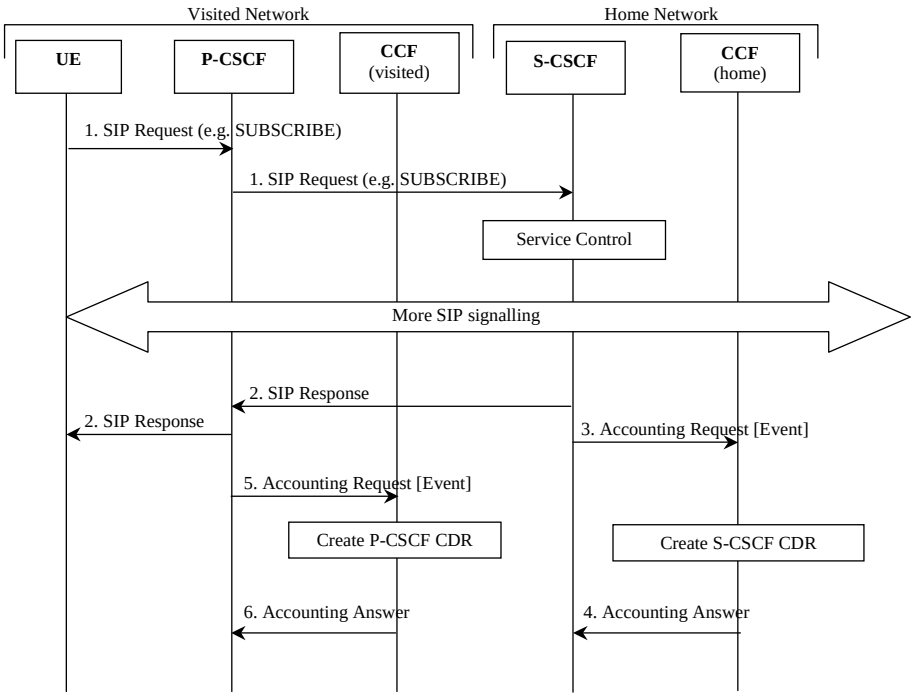


Figure 5.6: Message Sequence Chart for Session-Unrelated Procedure

1. The P-CSCF receives a "SIP Request" (e.g. SUBSCRIBE) from the subscriber.
2. The "SIP Request" is acknowledged by the "SIP Response" as follows:
   - in the successful case, a 200 OK message is returned;
   - in case of failure an appropriate SIP error message is returned.

Depending on the used SIP method, there might be additional signalling between steps 1 and 2.

3. After the completion of the procedure, the S-CSCF sends *Accounting-Request* with *Accounting-Record-Type* indicating EVENT_RECORD to record transaction specific information in the S-CSCF CDR.
4. The CCF acknowledges the reception of the data and produces an S-CSCF CDR.
5. Same as 3, but for P-CSCF.
6. Same as 4, creating a P-CSCF CDR.

5.1.2.1.3 PSTN Related Procedures

5.1.2.1.3.1 Session Establishment - PSTN Initiated

Figure 5.7 shows the Diameter transactions that are required between MGCF and CCF during session establishment initiated from the PSTN side.

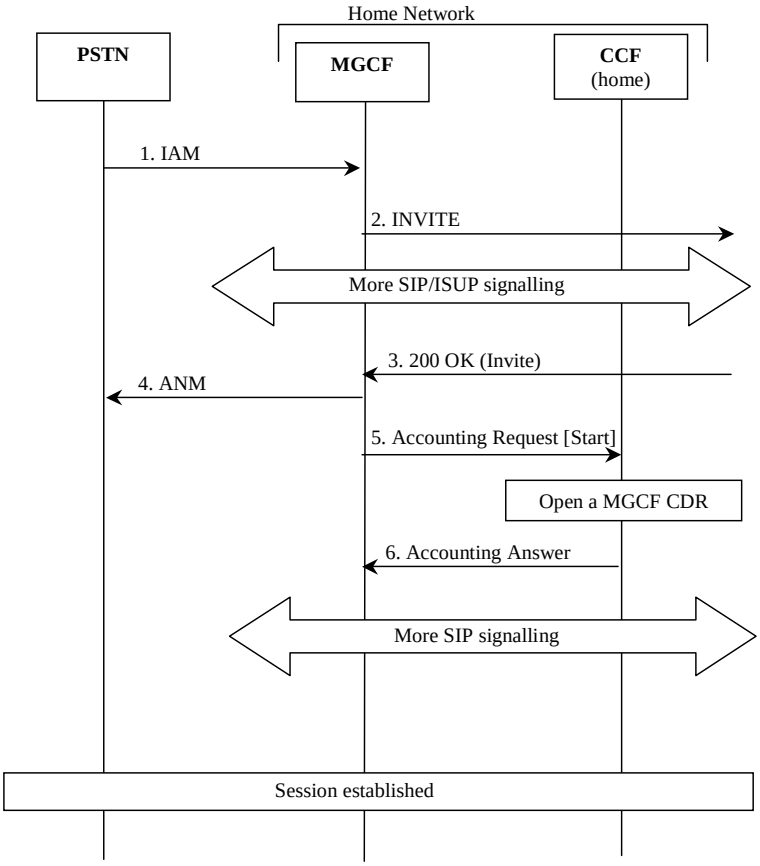


Figure 5.7: Message Sequence Chart for Session Establishment (PSTN Initiated)

1. The session is originated from the PSTN.
2. The session setup is triggered in the IMS.
3. The destination party answers and a final response is received.
4. MGCF forwards an answer message to the PSTN.
5. Upon reception of the final response, the MGCF sends an *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD to record start of a user session and start of a media component in the MGCF CDR.
6. The CCF acknowledges the reception of the data and opens a MGCF CDR.

5.1.2.1.3.2 Session Establishment - IMS Initiated

Figure 5.8 shows the Diameter transactions that are required between BGCF, MGCF and CCF during session establishment initiated from the IMS side.

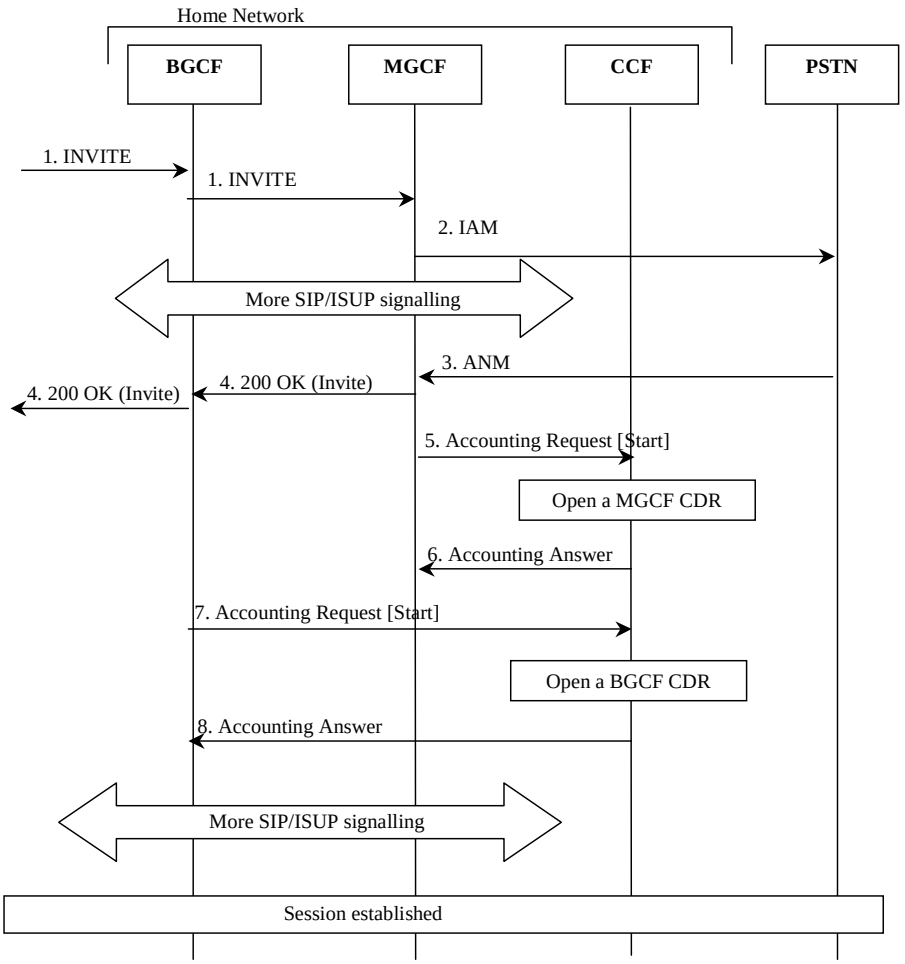


Figure 5.8: Message Sequence Chart for Session Establishment (IMS Initiated)

1. The session is originated from the IMS.
2. A session towards PSTN is established.
3. The destination party answers and an answer message is received.
4. A final response message is sent to the session originator.
5. Upon reception of the answer message, the MGCF sends an *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD to record start of a user session and start of a media component in the MGCF CDR.
6. The CCF acknowledges the reception of the data and opens a MGCF CDR.
7. Upon reception of the 200 OK message, the BGCF sends an *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD to record start of a user session and start of a media component in the BGCF CDR.
8. The CCF acknowledges the reception of the data and opens a BGCF CDR.

5.1.2.1.3.3 Session Release - PSTN Initiated

Figure 5.9 shows the Diameter transactions that are required between BGCF, MGCF and CCF during a PSTN initiated session release. The BGCF is only involved if the session had been initiated from the IMS side.

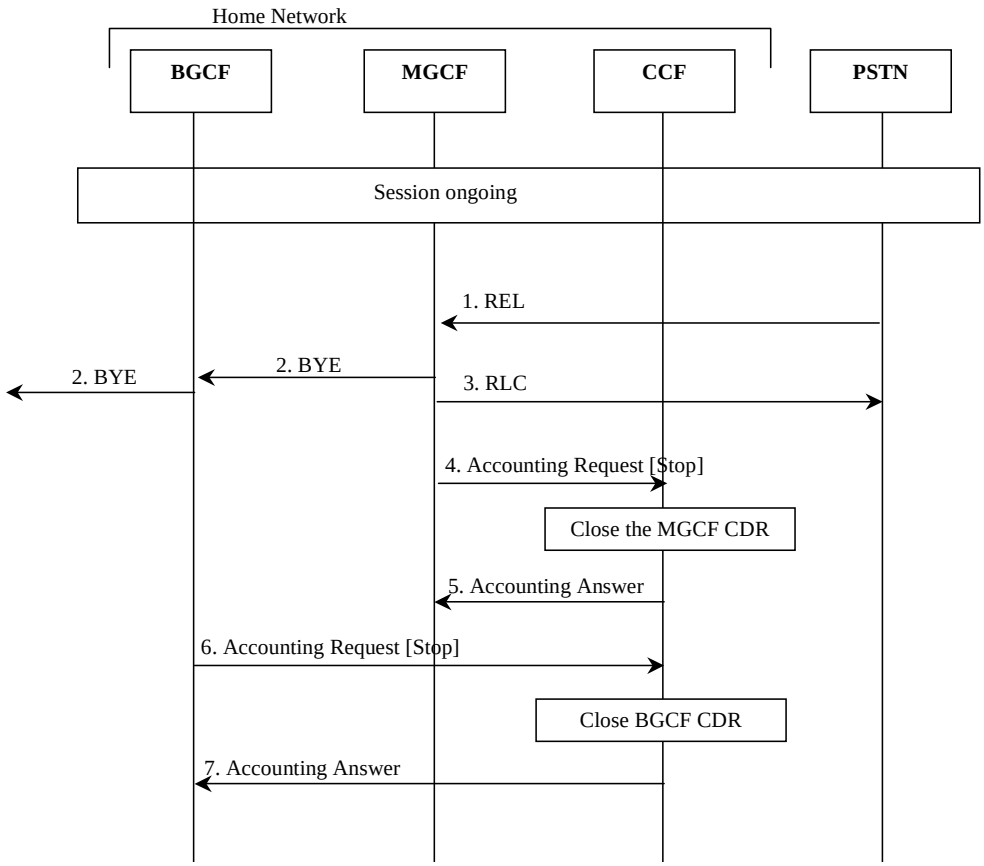


Figure 5.9: Message Sequence Chart for Session Release (PSTN initiated)

1. The session release is initiated from PSTN.
2. Session release continues within IMS.
3. The reception of the release message is acknowledged.
4. Upon reception of the release message, the MGCF sends an *Accounting-Request* with *Accounting-Record-Type* indicating STOP_RECORD to record stop of a session in the MGCF CDR.
5. The CCF acknowledges the reception of the data and closes the MGCF CDR.
6. Same as 4, but for BGCF.
7. Same as 5, but for BGCF.

5.1.2.1.3.4 Session Release - IMS Initiated

Figure 5.10 shows the Diameter transactions that are required between BGCF, MGCF and CCF during a IMS initiated session release.

The BGCF is only involved if the session had been initiated from the IMS side.

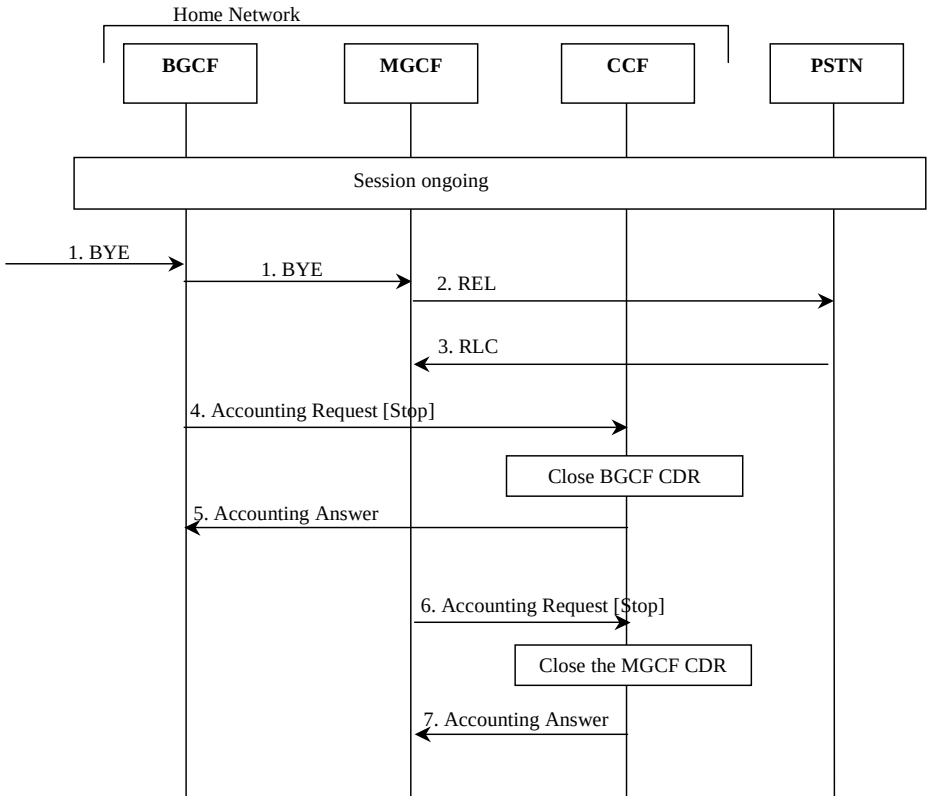


Figure 5.10: Message Sequence Chart for Session Release (IMS initiated)

1. The session release is initiated from the IMS side.
2. A release message is sent towards PSTN.
3. The acknowledgement of the release message is received from PSTN.
4. Upon reception of the BYE message, the BGCF sends an *Accounting-Request* with *Accounting-Record-Type* indicating STOP_RECORD to record stop of a session in the BGCF CDR.
5. The CCF acknowledges the reception of the data and closes the BGCF CDR.
6. Same as 4, but for MGCF.
7. Same as 5, but for MGCF.

5.1.2.1.4 MRFC Related Procedures

5.1.2.1.4.1 Multi-Party Call

Figure 5.11 shows the establishment of an ad hoc conference (multiparty call). An AS (acting as B2BUA) performs third party call control with the MRFC, where the S-CSCF is in the signalling path. The Application Server that is in control of the ad hoc conference is aware of the MRFC capabilities.

NOTE: Only accounting information sent from the MRFC is shown in detail in the figure. The SIP messages are for illustrative purpose only.

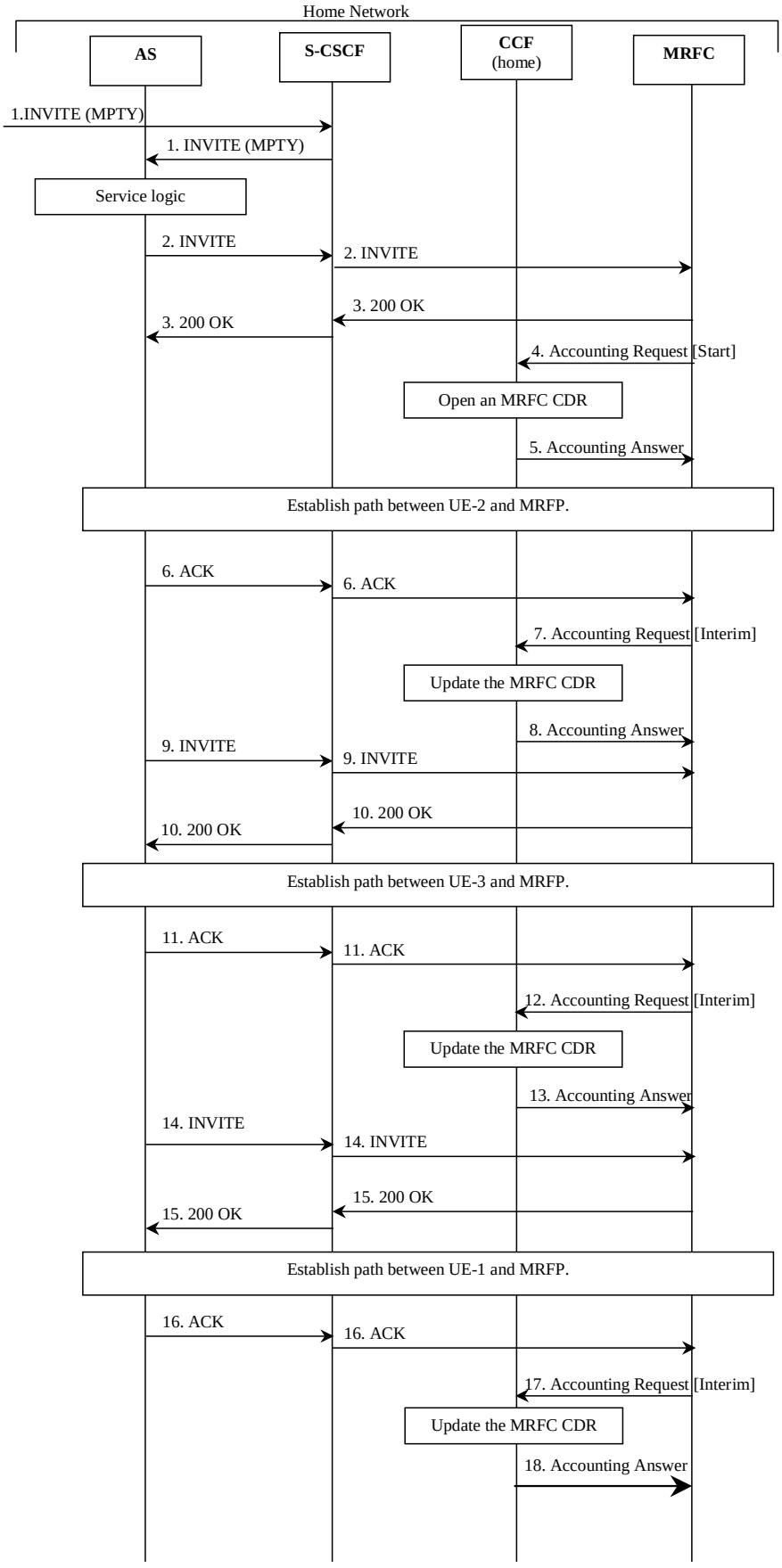


Figure 5.11: Message Sequence Chart for Multi-Party Call Establishment in MRFC

1. Sessions exist between UE-1 and UE-2, and between UE-1 and UE-3. A request is received from UE-1for putting all parties together to a multi-party call.
2. - 3. Request and acknowledgement to initiate multi-party call.
4. At session establishment the MRFC sends an *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD to record start of multi-party call in the MRFC CDR
5. The CCF acknowledges the reception of the data and creates the MRFC CDR.
6. Dialog between UE-2 and MRFP has been established.
7. The MRFC may send an *Accounting-Request* with *Accounting-Record-Type* indicating INTERIM_RECORD to report that UE-2 has been connected to the multi-party call.
8. The CCF acknowledges the reception of the data and updates the MRFC CDR.
9. New request sent to MRFC to prepare dialog for UE-3.
10. Request acknowledged.
11. Dialog between UE-3 and MRFP has been established.
12. The MRFC may send an *Accounting-Request* with *Accounting-Record-Type* indicating INTERIM_RECORD to report that UE-3 has been connected to the multi-party call.
13. The CCF acknowledges the reception of the data and updates the MRFC CDR.
14. New request sent to MRFC to prepare dialog for UE-1.
15. Request acknowledged.
16. Dialog between UE-1 and MRFP has been established.
17. The MRFC may send an *Accounting-Request* with *Accounting-Record-Type* indicating INTERIM_RECORD to report that UE-1 has been connected to the multi-party call.
18. The CCF acknowledges the reception of the data and updates the MRFC CDR.

5.1.2.1.5 AS Related Procedures

Application servers may support a multitude of services which are not specified in 3GPP standards. Therefore it is not possible to standardise charging flows and procedures for those services. However, for all such services, the AS may apply either Event Charging, where ACR [Event] messages are generated, or Session Charging, using ACR [Start, Stop and Interim]. The following subclauses depict one example for each of the two scenarios. The first procedure, AS acting as a Redirect Server, depicts the "event" case, while the second procedure, AS acting as a Voice Mail Server, depicts the "session" case.

5.1.2.1.5.1 AS Acting as a Redirect Server

Figure 5.12 shows the case where an Application Server acts as a Redirect Server. In the figure below, UE-1 sets up a session towards UE-2 but due to Call Forwarding functionality located in the AS, a new number (to UE-3) is returned to UE-1. Finally UE-1 sets up the session towards UE-3.

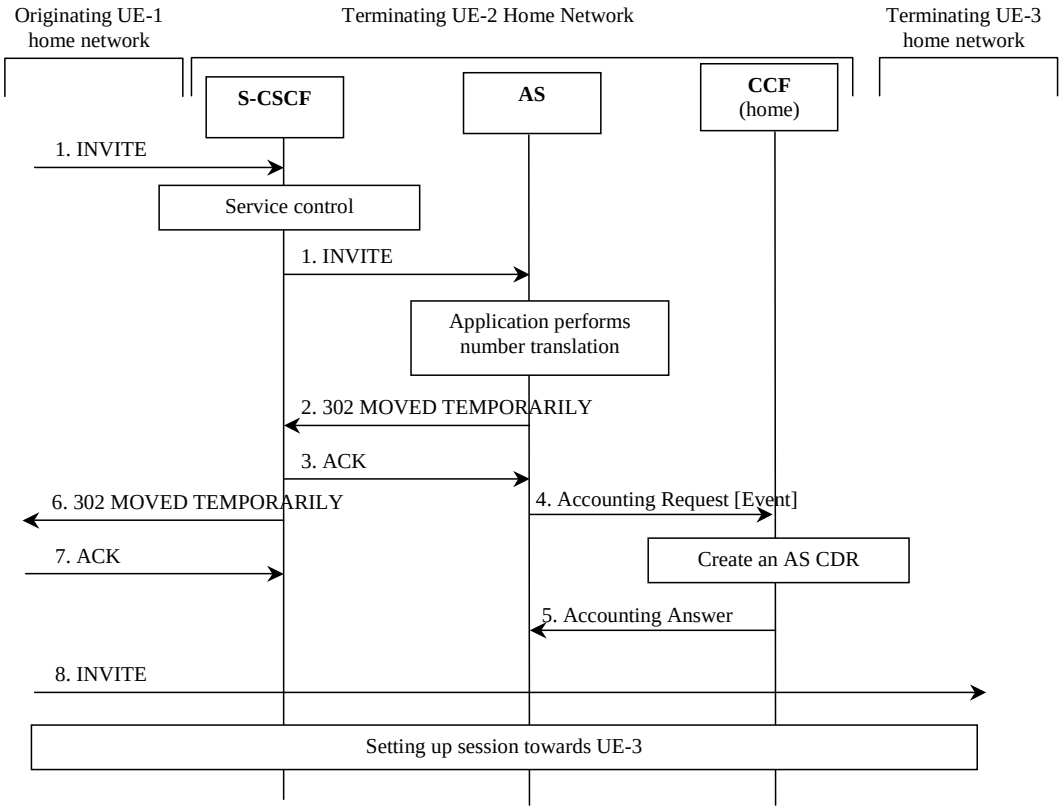


Figure 5.12: Message Sequence Chart for AS Acting as a Redirect Server

1. Sessions initiated by UE-1 towards UE-2.
2. - 3. Response indicating that session should be redirected towards another number (UE-3).
4. After successful service execution, the AS sends *Accounting-Request* with *Accounting-Record-Type* indicating EVENT_RECORD to record service specific information in the AS CDR.
5. The CCF acknowledges the reception of the data and creates the AS CDR.
6-7. Response indicating that session should be redirected towards another number (UE-3).
8. Session is initiated by UE-1 towards UE-3.

5.1.2.1.5.2 AS Acting as a Voice Mail Server

Figure 5.13 shows the case where an Application Server acts as a Voice Mail Server. S-CSCF invokes the AS acting as Voice Mail Server according to procedure as defined in TS 23.218 [5].

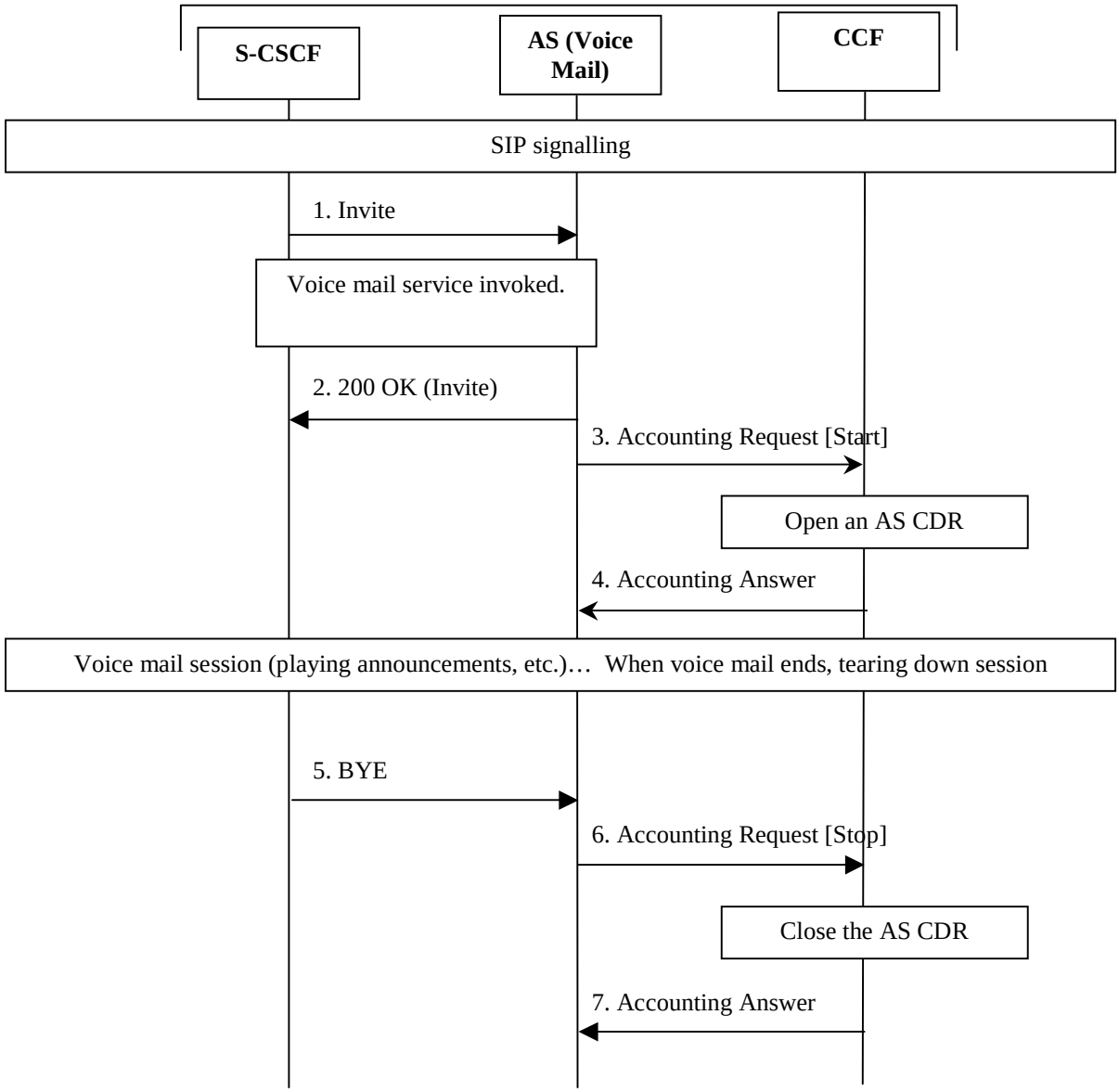


Figure 5.13: Message Sequence Chart for AS Acting as a Mail Server

1. AS receives the INVITE from the S-CSCF.
2. AS acknowledges the initiated Voice Mail session by issuing a 200 OK in response to the INVITE.
3. AS sends *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD to record start of a voice mail session.
4. The CCF acknowledges the reception of the *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD and opens a AS CDR.
5. Voice mail session release is initiated.
6. Upon reception of release message AS sends an *Accounting-Request* with *Accounting-Record-Type* indicating STOP_RECORD to record stop of a session in the AS CDR.
7. The CCF acknowledges the reception of the data and closes the AS CDR.

5.1.2.2 Message Flows - Error Cases and Scenarios

This subclause describes various error cases and how these should be handled. The error cases are grouped into the following categories:

- Failure in SIP Related Procedures:
  - Session Related Error Scenarios;
  - Session Unrelated Error Scenarios.
- Errors in Diameter (Accounting) Related Procedures.

5.1.2.2.1 Error Cases - Session Related SIP Procedures

5.1.2.2.1.1 Reception of SIP error messages

Normally a SIP session is closed by the reception of the BYE message. There are, however, a few cases when no BYE message is received and the ACR [Stop] message must be triggered by the reception of other messages.

ACR [Stop] can also be triggered by the reception of a SIP Final Response with error codes 4xx, 5xx or 6xx, indicating termination of an ongoing session as described in [16].

NOTE: This also covers the error handling in originating procedures, as a CANCEL request sent by the originating party to cancel a session invitation will trigger the terminating party to reply with a 487 final response to the INVITE.

The ACR [Stop] message includes an appropriate error indication.

5.1.2.2.1.2 SIP session failure

All nodes involved in the SIP session are expected to exercise some kind of session supervision. In case a node detects an error in the SIP session, such as a timeout or the occurrence of an invalid SIP message that results in the inability to maintain the session, this IMS node will generate a BYE message towards both ends of the connection.

The node that sent the BYE to trigger session termination identifies the cause of the failure in the ACR [Stop] towards the CCF. All other nodes, i.e. those that receive the BYE, are not aware of an error, and therefore they treat this situation as any normal SIP session termination.

5.1.2.2.2 Error Cases - Session Unrelated SIP procedures

As described in subclause 5.1.2.1.2, a session unrelated SIP procedure may either be completed with the reception of a 200OK, or a SIP error message. If the latter occurs, i.e. there is a failure in the procedure, the ACR [Event] sent towards the CCF includes an appropriate error indication.

5.1.2.2.3 Error Cases - Diameter procedures

5.1.2.2.3.1 CCF Connection Failure

When the connection towards the primary CCF is broken, the process of sending accounting information should continue towards a secondary CCF (if such a CCF is configured). For further CCF connection failure functionality, see subclause "*Transport Failure Detection*" in [3].

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

5.1.2.2.3.2 No Reply from CCF

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

If retransmitted ACRs are sent, they are marked with the *Re-Transmission* AVP, in order to allow duplicate detection in the CCF, as specified in the next subclause.

5.1.2.2.3.3 Duplicate Detection

A Diameter client marks possible duplicate request messages (e.g. retransmission due to the link failover process) with the *Re-Transmission* AVP.

If the CCF 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.

5.1.2.2.3.4 CCF Detected Failure

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

5.1.3 Message Formats

5.1.3.1 Summary of Offline Charging Message Formats

The IMS nodes generate accounting information that can be transferred from the nodes to the CCF. For this purpose, the IMS Charging application employs the *Accounting-Request* and *Accounting-Answer* messages from the base Diameter protocol.

The CCF may send an unsolicited message indicating to the S-CSCF to release the ongoing SIP session due for example to fraud detection. For this purpose the IMS Charging application employs the *Abort-Session-Request* and *Abort-Session-Answer* messages from the base Diameter protocol.

Table 5.3 describes the use of these messages for offline charging.

Table 5.3: Offline Charging Messages Reference Table

Command-Name	Source	Destination	Abbreviation
Accounting-Request	S-CSCF, I-CSCF, P-CSCF, MRFC, MGCF, BGCF, AS	CCF	ACR
Accounting-Answer	CCF	S-CSCF, I-CSCF, P-CSCF, MRFC, MGCF, BGCF, AS	ACA
Abort-Session-Request	CCF	S-CSCF	ASR
Abort-Session-Answer	S-CSCF	CCF	ASA

The S-CSCF should not be restricted to receiving *Abort Session Requests* only from a CCF, since such requests may be sent to an S-CSCF from other (i.e. non-IMS) sources, e.g. an operator's fraud detection system.

5.1.3.2 Structure for the Accounting- and Abort-Session Message Formats

The following is the basic structure shared by all offline charging messages. This is based directly on the format of the *Accounting-Request, Accounting-Answer, Abort-Session-Request* and *Abort-Session-Answer* messages defined in the base Diameter protocol specification [3]. Detailed description of the AVPs and their use for offline and online charging are provided in clause 7.

Those Diameter AVPs that are used for offline charging are marked "Yes" in tables 5.4 to 5.7. Those Diameter AVPs that are not used for offline charging are marked "No" in tables 5.4 to 5.7. This implies that their content can (Yes) or can not (No) be used by the CCF to construct CDRs.

The following symbols (adopted from [3]) are used in the tables:

- <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 are possible.

5.1.3.2.1 Accounting-Request Message

Table 5.4 illustrates the basic structure of a Diameter *Accounting-Request* message as used for offline charging. The use of the AVPs is specified in subclause 5.1.3.3 per IMS node and ACR type.

Table 5.4: Accounting-Request (ACR) Message Contents for Offline Charging

Diameter base protocol AVPs	
AVP	**Used in offline ACR**
<Diameter-Header:271,REQ,PXY>	Yes
<Session-Id> -- Diameter Session Id	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
{Destination-Realm}	Yes
{Accounting-Record-Type}	Yes
{Accounting-Record-Number}	Yes
[Acct-Application-Id]	No
[Vendor-Specific-Application-Id]	Yes
[User-Name]	Yes
[Accounting-Sub-Session-Id]	No
[Accounting-RADIUS-Session-Id]	No
[Acct-Multi-Session-Id]	No
[Acct-Interim-Interval]	Yes
[Accounting-Realtime-Required]	No
[Origin-State-Id]	Yes
[Event-Timestamp]	Yes
*[Proxy-Info]	No
*[Route-Record]	No
*[AVP]	No
Diameter Credit Control AVP	
[Subscription-Id]	No
[Requested-Action]	No
*[Requested-Service-Unit]	No
*[Used-Service-Unit]	No
*[Service-Parameter-Info]	No
[Abnormal-Termination-Reason]	No
*[Accounting-Correlation-Id]	No
[Credit-Control-Failure-Handling]	No
[Direct-Debiting-Failure-Handling]	No
[Re-Transmission]	Yes
3GPP Diameter accounting AVPs	
[Event-Type]	Yes
[Role-of-node]	Yes
[User-Session-ID]	Yes
[Calling-Party-Address]	Yes
[Called-Party-Address]	Yes
[Time-stamps]	Yes
*[Application-Server]	Only for S-CSCF
*[Application-provided-Called-Party-Address]	Only for S-CSCF
*[Inter-Operator-Identifier]	Yes
[IMS-Charging-Identifier]	Yes
*[SDP-Session-Description]	Yes
*[SDP-Media-Component]	Yes
[GGSN-Address]	Yes
[Served-Party-IP-Address]	Only for S-CSCF
[Authorised-QoS]	Only for P-CSCF
[Server-Capabilities]	Only for I-CSCF
[Trunk-Group-ID]	Only for MGCF
[Bearer-Service]	Only for MGCF
[Service-ID]	Only for MRFC
[UUS-Data]	Yes

NOTE: For AVP of type "Grouped" only the group AVP is listed in table 5.4. Detailed descriptions of the AVPs is provided in clause 7.

5.1.3.2.2 Accounting-Answer Message

Table 5.5 illustrates the basic structure of a Diameter *Accounting-Answer* message as used for IMS charging. This message is always used by the CCF as specified below, regardless of the IMS node it is received from and the ACR record type that is being replied to.

Table 5.5: Accounting-Answer (ACA) Message Contents for Offline Charging

Diameter base protocol AVPs	
AVP	**Used in Offline ACA**
<Diameter-Header:271,PXY>	Yes
<Session-Id>	Yes
{Result-Code}	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
{Accounting-Record-Type}	Yes
{Accounting-Record-Number}	Yes
[Acct-Application-Id]	No
[Vendor-Specific-Application-Id]	Yes
[User-Name]	Yes
[Accounting-Sub-Session-Id]	No
[Accounting-RADIUS-Session-Id]	No
[Acct-Multi-Session-Id]	No
[Error-Reporting-Host]	No
[Acct-Interim-Interval]	Yes
[Accounting-Realtime-Required]	No
[Origin-State-Id]	Yes
[Event-Timestamp]	Yes
*[Proxy-Info]	No
*[AVP]	No

5.1.3.2.3 Abort-Session-Request

Table 5.6 illustrates the basic structure of a Diameter *Abort-Session-Request* message as used for IMS charging.

Table 5.6: Abort Session Request (ASR) Message Contents

Diameter base protocol AVPs	
AVP	**Used in ASR**
<Diameter-Header:-274,REQ,-PXY>	Yes
<Session-Id> -- Diameter Session Id	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
{Destination-Realm}	Yes
{Destination-Host}	Yes
{Auth-Application-Id}	Yes
[User-Name]	Yes
[Origin-State-Id]	No
*[Proxy-Info]	No
*[Route-Record]	No
*[AVP]	No

5.1.3.2.4 Abort-Session-Answer

Table 5.7 illustrate the basic structure of a Diameter *Abort-Session-Answer* message as used for IMS charging.

Table 5.7: Abort Session Answer (ASA) Message Contents

Diameter base protocol AVPs	
AVP	**Used in ASA**
<Diameter-Header:-274,-PXY>	Yes
<Session-Id>	Yes
{Result-Code}	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
[User-Name]	Yes
[Origin-State-Id]	No
[Error-Message]	Yes
[Error-Reporting-Host]	No
*[Failed-AVP]	No
*[Redirected-Host]	No
[Redirected-Host-Usage]	No
[Redirected-Max-Cache-Time]	No
*[Proxy-Info]	No
*[AVP]	No

5.1.3.3 Detailed Message Formats

Following the base protocol specification, the following "types" of accounting data may be sent:

- Start session accounting data.
- Interim session accounting data.
- Stop session accounting data.
- Event accounting data.

ACR types Start, Interim and Stop are used for accounting data related to successful SIP sessions. In contrast, Event accounting data is unrelated accounting data, such as a simple registration or interrogation and successful service event triggered by an AS. In addition, Event accounting data are also used for unsuccessful SIP session establishment attempts.

The following table specifies per ACR type the accounting data that are sent by each of the IMS network elements:

- S-CSCF.
- P-CSCF.
- I-CSCF.
- MRFC.
- MGCF.
- BGCF.
- AS.

The ACR types in the table are listed in the following order: S (start)/I (interim)/S (stop)/E (event). Therefore, when all ACR types are possible it is marked as SISE. If only some ACR types are allowed for a node, only the appropriate letters are used (i.e. SIS or E) as indicated in the table heading. The omission of an ACR type for a particular AVP is marked with "-" (i.e. SI-E). Also, when an entire AVP is not allowed in a node the entire cell is marked as "-".

Note that not for all Grouped AVPs the individual AVP members are listed in the table. See clause 7 for a detailed list of the AVP group members and for the description of the AVPs.

For the ACA the same details listed in table 5.8 applies with the addition that *Error-Reporting-Host* AVP is supported in all ACAs in a similar manner as most other base protocol AVPs (e.g. in the same manner as *Origin-State-Id* AVP).

Table 5.8: Detailed Diameter ACR Message Contents for Offline Charging

AVP name	Node Type	S-CSCF	P-CSCF	I-CSCF	MRFC	MGCF	BGCF	AS
	Supported ACRs	S/I/S/E	S/I/S/E	E	S/I/S	S/I/S/E	S/I/S/E	S/I/S/E
AVPs from the Diameter base protocol								
<Session-Id>		SISE	SISE	E	SIS	SISE	SISE	SISE
{Origin-Host}		SISE	SISE	E	SIS	SISE	SISE	SISE
{Origin-Realm}		SISE	SISE	E	SIS	SISE	SISE	SISE
{Destination-Realm}		SISE	SISE	E	SIS	SISE	SISE	SISE
{Accounting-Record-Type}		SISE	SISE	E	SIS	SISE	SISE	SISE
{Accounting-Record-Number}		SISE	SISE	E	SIS	SISE	SISE	SISE
[Vendor-Specific-Application-Id]		SISE	SISE	E	SIS	SISE	SISE	SISE
[Acct-Application-Id]		-	-	-	-	-	-	-
[User-Name] (see note 1)		SISE	SISE	E	SIS	SISE	SISE	SISE
[Accounting-Sub-Session-Id]		-	-	-	-	-	-	-
[Accounting-RADIUS-Session-Id]		-	-	-	-	-	-	-
[Acct-Multi-Session-Id]		-	-	-	-	-	-	-
[Acct-Interim-Interval]		SIS-	SIS-	-	SIS-	SIS-	SIS-	SIS-
[Accounting-Realtime-Required]		-	-	-	-	-	-	-
[Origin-State-Id]		SISE	SISE	E	SIS	SISE	SISE	SISE
[Event-Timestamp]		SISE	SISE	E	SIS	SISE	SISE	SISE
*[Proxy-Info]		-	-	-	-	-	-	-
*[Route-Record]		-	-	-	-	-	-	-
*[AVP]		-	-	-	-	-	-	-
Diameter Credit Control AVP								
[Subscription-Id]		-	-	-	-	-	-	-
[Requested-Action]		-	-	-	-	-	-	-
*[Requested-Service-Unit]		-	-	-	-	-	-	-
*[Used-Service-Unit]		-	-	-	-	-	-	-
*[Service-Parameter-Info]		-	-	-	-	-	-	-
[Abnormal-Termination-Reason]		-	-	-	-	-	-	-
*[Accounting-Correlation-Id]		-	-	-	-	-	-	-
[Credit-Control-Failure-Handling]		-	-	-	-	-	-	-
[Direct-Debiting-Failure-Handling]		-	-	-	-	-	-	-
[Re-Transmission]		SISE	SISE	E	SIS	SISE	SISE	SISE
3GPP Diameter accounting AVPs								
[Event-Type]		SISE	SISE	E	SIS	SISE	SISE	SISE
[Role-of-Node]		SISE	SISE	E	SIS	SISE	SISE	SISE
[User-Session-Id]		SISE	SISE	E	SIS	SISE	SISE	SISE
[Calling-Party-Address]		SISE	SISE	E	SIS	SISE	SISE	SISE
[Called-Party-Address]		SISE	SISE	E	SIS	SISE	SISE	SISE
[Time-stamps]		SISE	SISE	E	SIS	SISE	SISE	SISE
*[Application-server] (see note 1)		SISE	-	-	-	-	-	-
*[Application-Provided-Called-Party-Address] (see note 1)		SISE	-	-	-	-	-	-
[Inter-Operator-Identifiers] (see note 1)		SISE	SISE	E	SIS	SISE	SISE	SISE
[IMS-Charging-Identifier]		SISE	SISE	E	SIS	SISE	SISE	SISE
*[SDP-Session-Description] (see note 2)		SI-E	SI-E	-	SI-	SI-E	SI-E	SI-E
*[SDP-Media-component] (see note 2)		SI-E	SI-E		SI-	SI-E	SI-E	SI-E
[GGSN-Address]		SI-E	SI-E		SI-	SI-E	SI-E	SI-E
[Served-Party-IP-Address] (see note 1)		-	SISE	-	-	-	-	-

AVP name	Node Type	S-CSCF	P-CSCF	I-CSCF	MRFC	MGCF	BGCF	AS
	Supported ACRs	S/I/S/E	S/I/S/E	E	S/I/S	S/I/S/E	S/I/S/E	S/I/S/E
[Authorized-QoS] (see note 1)		-	SISE	-	-	-	-	-
[Server-Capabilities]		-	-	E	-	-	-	-
[Trunk-Group-ID]		-	-	-	-	SISE	-	-
[Bearer-Service]		-	-	-	-	SISE	-	-
[Service-Id]		-	-	-	SIS	-	-	-
[UUS-Data] (see note 3)		SISE	SISE					SISE

NOTE 1: Only present if available in the IMS node.
NOTE 2: Present in Interim and Event ACRs only if the SIP transactions that triggered the ACR contained SDP.
NOTE 3: Present only if user-to-user data is included in the SIP message that triggered the ACR.

5.2 CDR Description on the Bi Interface

5.2.1 CDR Field Types

The following Standard CDR content and format are considered:

S-CSCF-CDR generated based on information from the S-CSCF.

I-CSCF-CDR generated based on information from the I-CSCF.

P-CSCF-CDR generated based on information from the P-CSCF.

BGCF-CDR generated based on information from the BGCF.

MGCF-CDR generated based on information from the MGCF.

MRFC-CDR generated based on information from the MRFC.

AS-CDR generated based on information from the AS.

The content of each CDR type is defined in the tables that are part of this subclause. For each CDR type the field definition includes the field name, description and category.

Equipment vendors shall be able to provide all of the fields listed in the CDR content tables in order to claim compliance with the present document. However, since CDR processing and transport consume network resources, operators may opt to eliminate some of the fields that are not essential for their operation. This operator provisionable reduction is specified by the field category.

A field category can have one of two primary values:

M This field is **M**andatory and shall always be present in the CDR.

C This field shall be present in the CDR only when certain **C**onditions are met. These Conditions are specified as part of the field definition.

Some of these fields are designated as Operator provisionable. Using TMN management functions or specific tools provided by an equipment vendor, operators may choose if they wish to include or omit the field from the CDR. Once omitted, this field is not generated in a CDR. To avoid any potential ambiguity, a CDR generating element MUST be able to provide all these fields. Only an operator can choose whether or not these fields should be generated in their system.

Those fields that the operator may configure to be present or absent are further qualified with the "Operator provisionable" subscript as follows:

M_o This is a field that, if provisioned by the operator to be present, shall always be included in the CDRs. In other words, an M_o parameter that is provisioned to be present is a mandatory parameter.

C_o This is a field that, if provisioned by the operator to be present, shall be included in the CDRs when the required conditions are met. In other words, a C_o parameter that is configured to be present is a conditional parameter.

The CCF provides the CDRs at the Bi interface in the format and encoding described in the present document. Additional CDR formats and contents may be available at the interface to the billing system to meet the requirements of the billing system, these are outside of the scope of 3GPP standardisation.

5.2.2 CDR Triggers

5.2.2.1 Session Related CDRs

Reflecting the usage of multimedia sessions IMS CDRs are generated by the CCF on a per session level. In the scope of the present document the term "session" refers always to a SIP session. The coherent media components are reflected inside the session CDRs with a media component container comprising of all the information necessary for the description of a media component.

Accounting information for SIP sessions is transferred from the IMS nodes involved in the session to the CCF using Diameter ACR Start, Interim and Stop messages. A session CDR is opened in the CCF upon reception of a Diameter ACR [Start] message. Session CDRs are updated, or partial CDRs generated, upon reception of a Diameter ACR [Interim] message. The CCF closes the final session CDR upon reception of a Diameter ACR [Stop] message, which indicates that the SIP session is terminated. Further details on triggers for the generation of IMS CDRs are specified in [2].

Accounting information for unsuccessful session set-up attempts may be sent by the IMS node to the CCF employing the Diameter ACR [Event] message. The behaviour of the CCF upon receiving ACR [Event] messages is specified in subclause 5.2.2.2.

5.2.2.2 Session Unrelated CDRs

To reflect chargeable events not directly related to a session the CCF may generate CDRs upon the occurrence of session unrelated SIP procedures, such as registration respectively de-registration events. Accounting information for SIP session-unrelated procedures is transferred from the IMS nodes involved in the procedure to the CCF using Diameter ACR [Event] messages. Session unrelated CDRs are created in the CCF in a "one-off" action based on the information contained in the Diameter ACR [Event] message. One session unrelated CDR is created in the CCF for each Diameter ACR [Event] message received, whereas the creation of partial CDRs is not applicable for session unrelated CDRs. The cases for which the IMS nodes send ACR [Event] messages are listed per SIP procedure in tables 5.1 and 5.2.

Further details on triggers for the generation of IMS CDRs are specified in [2].

5.2.3 CDR Content

5.2.3.1 Charging Data in S-CSCF (S-CSCF-CDR)

Table 5.9: S-CSCF Charging Data (S-CSCF-CDR)

Field	Category	Description
Record Type	M	Identifies the type of record: S-CSCF-CDR.
Retransmission	C_O	This parameter, when present, indicates that information from retransmitted Diameter ACRs has been used in this CDR.
Event Type	M_O	Reflects the type of chargeable telecommunication service/event for which the CDR is generated, such as: "session", "register", "subscribe".
Role of Node	M_O	Specifies the role of the CSCF if relevant for the chargeable telecommunication service/event, which is either: Originating role (serving A) Terminating role (serving B)
Node Address	M_O	The address of the S-CSCF providing the information for the CDR.
Session ID	M_O	The Session identification. For a SIP session the Session ID contains the SIP Call ID as defined in the Session Initiation Protocol.
Calling Party Address (Public User ID)	M_O	The address of the party initiating a session (SIP URL, E.164 …)
Called Party Address (Public User ID)	M_O	The address of the party to whom a session is established (SIP URL, E.164 …)

Field	Category	Description
Private User ID (served party)	M_O	Holds the used Network Access Identifier according to RFC2486 [6]. This parameter corresponds to the *User-Name* AVP.
Record Opening Time	M_O	A time stamp reflecting the time the CCF opened this record.
Record Closure Time	M_O	A Time stamp reflecting the time the CCF closed the record.
List of AS Involved	C_O	Holds a list of ASs (if any) identified by the SIP URLs
List of AS Provided Called Party Addresses	C_O	Holds a list of the Called Party Address(es), if the address(es) are determined by an AS (SIP URL, E.164…).
Inter Operator Identifier(s)	C_O	Holds the identification of the network neighbours (originating and terminating) if exchanged via SIP signalling.
Local Record Sequence Number	M_O	Contains a unique record number created by this CCF.
Partial Record Sequence Number	C_O	The partial record number, if partial records are generated.
Cause for Record Closure	M_O	Identifies the reason for CDR closure, such as: time limit, service change (e.g. change in media components), network internal reasons, end of session, tariff time change.
IMS Charging Identifier (ICID)	M_O	Holds the ICID as received from the S-CSCF.
SDP Session Description	Co	Holds the Session Description if exchanged between the User Agents.
List of Session Modifications	M_O	List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps.
SIP Request Timestamp	C_O	This parameter contains the time of the initial SIP Request (usually a (Re)Invite), as provided by the S-CSCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SIP Response Timestamp	C_O	This parameter contains the time of the response to the initial SIP Request (usually a 200 OK), as provided by the S-CSCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SDP Media Component	C_O	Holds the media components if specified in the SDP data.
Media Initiator Flag	C_O	This is a flag that is present only if the called party requested the session modification.
GPRS Charging ID	C_O	If IMS is accessed via GPRS, the GPRS charging ID generated by the GGSN whose address is contained in the parameter "GGSN Address".
GGSN Address	C_O	Holds the IP-address of the GGSN that was used for the SIP session, if IMS is accessed via GPRS.
Cause	M_O	A more specific reason for the closure of the CDR. The possible values of this parameter depend on the "Cause for Record Closure".
User-to-User Data	C_O	This parameter describes the user-to-user data, if carried in the SIP signaling.
Record Extensions	C_O	A set of operator/manufacturer specific extensions to the record, conditioned upon existence of an extension.

5.2.3.2 Charging Data in P-CSCF (P-CSCF-CDR)

Table 5.10: P-CSCF Charging Data (P-CSCF-CDR)

Field	Category	Description
Record Type	M_O	Identifies the type of record: P-CSCF-CDR.
Event Type	M_O	Reflects the type of chargeable telecommunication service/event for which the CDR is generated, such as: "session", "register", "subscribe".
Role of Node	M_O	Specifies the role of the CSCF if relevant for the chargeable telecommunication service/event, which is either: Originating role (serving A) Terminating role (serving B)
Node Address	M_O	The address of the node providing the information for the CDR.
Session ID	M_O	The Session identification. For a SIP session the Session ID contains the SIP Call ID as defined in the Session Initiating Protocol.
Calling Party Address (Public User ID)	M_O	The address of the party initiating a session (SIP URL, E.164 …)
Called Party Address (Public User ID)	M_O	The address of the party to whom a session is established (SIP URL, E.164 …)
Served party IP Address	M_O	Holds the IP address of either the calling or called party, depending on whether the proxy is in touch with the calling or the called party
Record Opening Time	M_O	A time stamp reflecting the time the CCF opened this record.
Record Closure Time	M_O	A Time stamp reflecting the time the CCF closed the record.
Inter Operator Identifier(s)	C_O	Holds the identification of the network neighbours (originating and terminating) if exchanged via SIP signalling.
Local Record Sequence Number	M_O	Contains a unique record number created by this CCF.
Partial Record Sequence Number	C_O	The partial record number, if partial records are generated.
Cause for Record Closure	M_O	Identifies the reason for CDR closure, such as: time limit, service change (e.g. change in media components), network internal reasons, end of session, tariff time change.
IMS Charging Identifier (ICID)	M_O	Holds the ICID as received from the P-CSCF.
List of Session Modifications	M_O	List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps.
SIP Request Timestamp	C_O	This parameter contains the time of the initial SIP Request (usually a (Re)Invite), as provided by the P-CSCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SIP Response Timestamp	C_O	This parameter contains the time of the response to the initial SIP Request (usually a 200 OK), as provided by the P-CSCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SDP Media Component	C_O	Holds the media components if specified in the SDP data.
Media Initiator Flag	C_O	This is a flag that is present only if the called party requested the session modification.
Authorised QoS	C_O	Authorised QoS as defined in TS 23.207 7] / TS 29.207 [8] and applied via the Go interface
GPRS Charging ID	C_O	If IMS is accessed via GPRS, the GPRS charging ID generated by the GGSN whose address is contained in the parameter "GGSN Address".
GGSN Address	C_O	Holds the IP-address of the GGSN that was used for the SIP session, if IMS is accessed via GPRS.
Cause	M_O	A more specific reason for the closure of the CDR. The possible values of this parameter depend on the "Cause for Record Closure".
User-to-User Data	C_O	This parameter will describe the user-to-user data, if carried in the SIP signaling.
Record Extensions	C_O	A set of operator/manufacturer specific extensions to the record, conditioned upon existence of an extension.

5.2.3.3 Charging Data in I-CSCF (I-CSCF-CDR)

Table 5.11: I-CSCF Charging Data (I-CSCF-CDR)

Field	Category	Description
Record Type	M_O	Identifies the type of record: I-CSCF-CDR.
Event Type	M_O	Reflects the type of chargeable telecommunication service/event for which the CDR is generated, such as: "session", "register", "subscribe".
Node Address	M_O	The address of the node providing the information for the CDR.
Session ID	M_O	The Session identification. For a SIP session the Session ID contains the SIP Call ID as defined in the Session Initiating Protocol.
Calling Party Address (Public User ID)	M_O	The address of the party initiating a session (SIP URL, E.164 …)
Called Party Address (Public User ID)	M_O	The address of the party to whom a session is established (SIP URL, E.164 …)
Transaction time stamp	M_O	Time stamp reflecting the time for transaction termination (Upon receiving/generating the final response for the SIP request)
Inter Operator Identifier(s)	C_O	Holds the identification of the network neighbours (originating and terminating) if exchanged via SIP signalling.
Local Record Sequence Number	M_O	Contains a unique record number created by this node.
S-CSCF information	C_O	Information related to the serving CSCF, e.g. the S-CSCF capabilities upon registration event or the S-CSCF address upon the session establishment event.
IMS Charging Identifier (ICID)	M_O	Holds the ICID as received from the MRFC.
Record Extensions	C_O	A set of operator/manufacturer specific extensions to the record, conditioned upon existence of an extension.

5.2.3.4 Charging Data in MRFC (MRFC-CDR)

Table 5.12: MRFC Charging Data (MRFC-CDR)

Field	Category	Description
Record Type	M_O	Identifies the type of record: MRFC-CDR.
Node Address	M_O	The address of the node providing the information for the CDR.
Session ID	M_O	The Session identification. For a SIP session the Session ID contains the SIP Call ID as defined in the Session Initiating Protocol.
Service ID	M_O	Identifies the service the MRFC is hosting. For conferences the conference ID is used here.
Calling Party Address (Public User ID)	M_O	The address of the party initiating a session (SIP URL, E.164 …)
Called Party Address (Public User ID)	M_O	The address of the party to whom a session is established (SIP URL, E.164 …)
Record Opening Time	M_O	A time stamp reflecting the time the CCF opened this record.
Record Closure Time	M_O	A Time stamp reflecting the time the CCF closed the record.
Inter Operator Identifier(s)	C_O	Holds the identification of the network neighbours (originating and terminating) if exchanged via SIP signalling.
Local Record Sequence Number	M_O	Contains a unique record number created by this CCF.
Partial Record Sequence Number	C_O	The partial record number, if partial records are generated.
Cause for Record Closure	M_O	Identifies the reason for CDR closure, such as: time limit, service change (e.g. change in media components), network internal reasons, end of session, tariff time change.
IMS Charging Identifier (ICID)	M_O	Holds the ICID as received from the MRFC.
List of session Modifications	M_O	List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps.
SIP Request Timestamp	C_O	This parameter contains the time of the initial SIP Request (usually a (Re)Invite), as provided by the MRFC. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SIP Response Timestamp	C_O	This parameter contains the time of the response to the initial SIP Request (usually a 200 OK), as provided by the MRFC. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
Media Initiator Flag	C_O	This is a flag that is present only if the called party requested the session modification.
GPRS Charging ID	C_O	If IMS is accessed via GPRS, the GPRS charging id generated by the GGSN whose address is contained in the parameter "GGSN Address".
GGSN Address	C_O	Holds the IP-address of the GGSN that was used for the SIP session, if IMS is accessed via GPRS.
Cause	M_O	A more specific reason for the closure of the CDR. The possible values of this parameter depend on the "Cause for Record Closure".
Record Extensions	C_O	A set of operator/manufacturer specific extensions to the record, conditioned upon existence of an extension.

5.2.3.5 Charging Data in MGCF (MGCF-CDR)

Table 5.13: MGCF Charging Data (MGCF-CDR)

Field	Category	Description
Record Type	M_O	Identifies the type of record: MGCF-CDR.
Role of node	M_O	Specifies the role of the CSCF if relevant for the chargeable telecommunication service/event, which is either: Originating role (serving A) Terminating role (serving B)
Node Address	M_O	The address of the node providing the information for the CDR.
Session ID	M_O	The Session identification. For a SIP session the Session ID contains the SIP Call ID as defined in the Session Initiating Protocol.
Calling Party Address (Public User ID)	M_O	The address of the party initiating a session (SIP URL, E.164 …)
Called Party Address (Public User ID)	M_O	The address of the party to whom a session is established (SIP URL, E.164 …)
Record Opening Time	M_O	A time stamp reflecting the time the CCF opened this record.
Record Closure Time	M_O	A Time stamp reflecting the time the CCF closed the record.
Inter Operator Identifier(s)	C_O	Holds the identification of the network neighbours (originating and terminating) if exchanged via SIP signalling.
Local Record Sequence Number	M_O	Contains a unique record number created by this CCF.
Partial Record Sequence Number	C_O	The partial record number, if partial records are generated.
Cause for Record Closure	M_O	Identifies the reason for CDR closure, such as: time limit, service change (e.g. change in media components), network internal reasons, end of session, tariff time change.
IMS Charging Identifier (ICID)	M_O	Holds the ICID as received from the MGCF.
List of Session Modifications	M_O	List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps.
SIP Request Timestamp	M_O	This parameter contains the time of the initial SIP Request (usually a (Re)Invite), as provided by the MGCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SIP Response Timestamp	M_O	This parameter contains the time of the response to the initial SIP Request (usually a 200 OK), as provided by the MGCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
List of Session Modifications	M_O	List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps.
Media Initiator Flag	C_O	This is a flag that is present only if the called party requested the session modification.
GPRS Charging ID	C_O	If IMS is accessed via GPRS, the GPRS charging id generated by the GGSN whose address is contained in the parameter "GGSN Address".
GGSN address	C_O	Holds the IP-address of the GGSN that was used for the SIP session, if IMS is accessed via GPRS.
Cause	M_O	A more specific reason for the closure of the CDR. The possible values of this parameter depend on the "Cause for Record Closure".
Trunk Group ID Incoming/Outgoing	M_O	PSTN leg: Contains the outgoing trunk group ID for an outgoing session/call Contains the incoming trunk group ID for an incoming session/call
Bearer Service	M_O	Holds the used bearer service for the PSTN leg
Record Extensions	C_O	A set of operator/manufacturer specific extensions to the record, conditioned upon existence of an extension.

5.2.3.6 Charging Data in BGCF (BGCF-CDR)

Table 5.14: BGCF Charging Data (BGCF-CDR)

Field	Category	Description
Record Type	M_O	Identifies the type of record: BGCF-CDR.
Node Address	M_O	The address of the node providing the information for the CDR
Session ID	M_O	The Session identification. For a SIP session the Session ID contains the SIP Call ID as defined in the Session Initiating Protocol.
Calling Party Address (Public User ID)	M_O	The address of the party initiating a session (SIP URL, E.164 …)
Called Party Address (Public User ID)	M_O	The address of the party to whom a session is established (SIP URL, E.164 …)
Record Opening Time	M_O	A time stamp reflecting the time the CCF opened this record.
Record Closure Time	M_O	A Time stamp reflecting the time the CCF closed the record.
Inter Operator Identifier(s)	C_O	Holds the identification of the network neighbours (originating and terminating) if exchanged via SIP signalling.
Local Record Sequence Number	M_O	Contains a unique record number created by this CCF.
Partial Record Sequence Number	C_O	The partial record number, if partial records are generated.
Cause for Record Closure	M_O	Identifies the reason for CDR output, such as: time limit, service change (e.g. change in media components), network internal reasons, last CDR, tariff time change.
IMS Charging Identifier (ICID)	M_O	Holds the ICID as received from the BGCF.
List of Session Modifications	M_O	List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps.
SIP Request Timestamp	C_O	This parameter contains the time of the initial SIP Request (usually a (Re)Invite), as provided by the BGCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SIP Response Timestamp	C_O	This parameter contains the time of the response to the initial SIP Request (usually a 200 OK), as provided by the BGCF. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SDP Media Component	C_O	Holds the media components if specified in the SDP data.
Media Initiator Flag	C_O	This is a flag that is present only if the called party requested the session modification.
GPRS Charging ID	C_O	If IMS is accessed via GPRS, the GPRS charging id generated by the GGSN whose address is contained in the parameter "GGSN Address".
GGSN address	C_O	Holds the IP-address of the GGSN that was used for the SIP session, if IMS is accessed via GPRS.
Cause	M_O	A more specific reason for the closure of the CDR. The possible values of this parameter depend on the "Cause for Record Closure".
Record Extensions	C_O	A set of operator/manufacturer specific extensions to the record, conditioned upon existence of an extension.

5.2.3.7 Charging Data in AS (AS-CDR)

Table 5.15: AS Charging Data (AS-CDR)

Field	Category	Description
Record Type	M_O	Identifies the type of record: AS-CDR.
Node Address	M_O	The address of the node providing the information for the CDR
Session ID	M_O	The Session identification. For a SIP session the Session ID contains the SIP Call ID as defined in the Session Initiating Protocol.
Calling Party Address (Public User ID)	M_O	The address of the party initiating a session (SIP URL, E.164 …)
Called Party Address (Public User ID)	M_O	The address of the party to whom a session is established (SIP URL, E.164 …)
Record opening time	M_O	A time stamp reflecting the time the CCF opened this record.
Record closure time	M_O	A Time stamp reflecting the time the CCF closed the record.
Inter Operator Identifier(s)	C_O	Holds the identification of the network neighbours (originating and terminating) if exchanged via SIP signalling.
Local Record Sequence Number	M_O	Contains a unique record number created by this CCF.
Partial Record Sequence Number	C_O	The partial record number, if partial records are generated.
Cause for Record Closure	M_O	Identifies the reason for CDR closure, such as: time limit, service change (e.g. change in media components), network internal reasons, end of session, tariff time change.
IMS Charging Identifier (ICID)	M_O	Holds the ICID as received from the MGCF.
List of Session Modifications	M_O	List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps.
SIP Request Timestamp	M_O	This parameter contains the time of the initial SIP Request (usually a (Re)Invite), as provided by theAS. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SIP Response Timestamp	M_O	This parameter contains the time of the response to the initial SIP Request (usually a 200 OK), as provided by theAS. Only present if the CDR is opened by the reception of an ACR containing the time stamp.
SDP Media Component	C_O	Holds the media components if specified in the SDP data.
Media Initiator Flag	C_O	This is a flag that is present only if the called party requested the session modification.
GPRS Charging ID	C_O	If IMS is accessed via GPRS, the GPRS charging id generated by the GGSN whose address is contained in the parameter "GGSN Address".
GGSN Address	C_O	Holds the IP-address of the GGSN that was used for the SIP session, if IMS is accessed via GPRS.
Cause	M_O	A more specific reason for the closure of the CDR. The possible values of this parameter depend on the "Cause for Record Closure".
Service Specific Data	C_O	Contains service specific data if present.
User-to-User Data	C_O	This parameter will describe the user-to-user data if carried in the SIP signaling.
Record Extensions	C_O	A set of operator/manufacturer specific extensions to the record, conditioned upon existence of an extension.

5.2.4 CDR Parameter Description

Void.

5.2.4.1 Authorised QoS

Void.

5.2.4.2 Bearer Service

Void.

5.2.4.3 Called Party Address (Public User ID)

Void.

5.2.4.4 Calling Party Address (Public User ID)

Void.

5.2.4.5 Cause

Void.

5.2.4.6 Cause for Record Closure

Void.

5.2.4.7 Event Type

Void.

5.2.4.8 GGSN Address

This parameter holds the IP address of the GGSN that handles on or more media component(s) of a IMS session. If GPRS is used to access the IMS, the GGSN address is used together with the GPRS charging ID as the access part of the charging correlation vector. The charging correlation vector is comprised of an access part and an IMS part, which is the IMS Charging Identifier. For further information regarding the composition of the charging correlation vector refer to the appropriate clause in TS 32.200 [2].

5.2.4.9 GPRS Charging ID

This parameter holds the GPRS charging ID (GCID) as generated by the GGSN for a GPRS PDP context. There is a 1:1 relationship between the GCID and the PDP context. If GPRS is used to access the IMS, the GCID is used together with the GGSN address as the access part of the charging correlation vector that is comprised of an access part and an IMS part, which is the IMS Charging Identifier.

For further information regarding the composition of the charging correlation vector refer to the appropriate clause in TS 32.200 [2].

5.2.4.10 IMS Charging Identifier (ICID)

This parameter holds the IMS charging identifier (ICID) as generated by the IMS node for the SIP session. There is a 1:1 relationship between the ICID and the session ID. The ICID is part of the charging correlation vector and coded as US-ASCII (as are all SIP messages). The charging correlation vector contains an IMS part (ICID - a unique number plus an IP address) and an access part (GPRS Charging ID and GGSN address). For further information regarding the composition and usage of the charging correlation vector refer to TS 32.200 [2] and TS 24.229 [14].

The ICID is composed of a 4 octet unique number and the IP address of the network node generating the ICID. This is inserted in the CDRs as shown in figures 5.13 and 5.14 below. Since IPv4 and IPv6 addresses are supported simultaneously, an ICID may either be composed of an IPv4 or IPv6 compliant source address.

	Bits							
Octets	8	7	6	5	4	3	2	1
1	Unique value (1st Octet)							
2	Unique value (2nd Octet)							
3	Unique value (3rd Octet)							
4	Unique value (4th Octet)							
5	IPv6 address (1st Octet)							
6	IPv6 address (2nd Octet)							
...	...							
20	IPv6 address (16th Octet)							

Figure 5.13: ICID layout with IPv6

	Bits							
Octets	8	7	6	5	4	3	2	1
1	Unique value (1st octet)							
2	Unique value (2nd octet)							
3	Unique value (3rd octet)							
4	Unique value (4th octet)							
5	IPv4 address (1st Octet)							
6	IPv4 address (2nd Octet)							
7	IPv4 address (3rd Octet)							
8	IPv4 address (4th octet)							

Figure 5.14: ICID layout with IPv4

The Unique Value consists of a 32-bit integer, coded as an unsigned integer. Bit 8 of the lowest numbered octet (5 for IPv4/17 for IPv6) is the most significant bit and bit 1 of the highest numbered octet (8 for IPv4/20 for IPv6) is the least significant bit.

The IP-address is encoded using binary coding, where each octet in ICID represents one octet in the IP-address. Bit 8 of octet 1 is the most significant bit and bit 1 of the highest numbered octet (4 for IPv4/16 for IPv6) is the least significant bit.

The following example, shown in figure 5.15, describes the content of ICID when the unique value of 15409 (H'3C31) was generated by a node with the IPv6-address of 255.5.0.0.0.0.0.0.0.0.0.0.0.0.0.179 (FF05::B3):

	Bits								
Octets	8	7	6	5	4	3	2	1	Meaning
1	0	0	1	1	1	1	0	0	H'3C
2	0	0	1	1	0	0	0	1	H'31
3	1	1	1	1	1	1	1	1	255
4	0	0	0	0	0	1	0	1	5
5-17	0	0	0	0	0	0	0	0	0
18	1	0	1	1	0	0	1	1	179
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0

Figure 5.15: ICID layout with IPv6

5.2.4.11 Inter Operator Identifier(s)

Void.

5.2.4.12 List of AS Involved

Void.

5.2.4.13 List of AS Provided Called Party Address

Void.

5.2.4.14 List of Session Modifications

List of session information exchanged via SIP signalling by the user agent(s) and the related timestamps. Each entry in the list is comprised of the SIP request and response timestamps and media component information as provided in the ACR received from the IMS node. New entries are added to the list each time an ACR that includes the SIP request and response timestamps is received.

This implies that the list is not updated when receiving ACRs that are generated by the IMS node due to expiration of the *Acct-Interim-Interval* timer.

Charging data for media components associated with a session are handled inside the Session CDRs as follows:

A new media component container is added into a session CDR each time a media component is added to a session. A media component container is closed once the related media component is removed from a session. Figure 5.16 illustrates this principle.

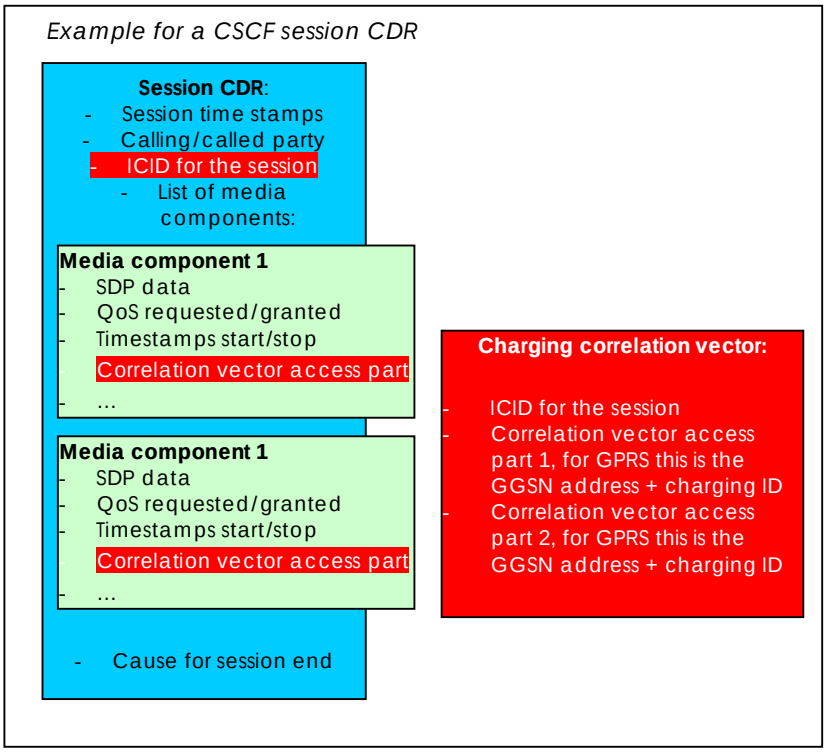


Figure 5.16: Charging Data Record Structure

A media component container is added into the session CDR when the associated SIP 200 OK message (the one corresponding to the appropriate SIP INVITE message) is received in the node generating the CDR. An appropriate media component start time stamp reflects the start of this media component. A media component is supposed to be removed from a session once either the SIP BYE message or a SIP 200 OK message (corresponding to the SIP INVITE message removing a media) is received in the node generating the ACR. The removal of a media component (either due to session release or due to a SIP INVITE/200 OK message pair during a session) is reflected with an appropriate time stamp inside the media components. If a media component is removed from an ongoing session, the related media component container is not carried forward to subsequent partial CDRs (if any).

5.2.4.15 Local Record Sequence Number

Void.

5.2.4.16 Media Initiator Flag

This field indicates if the called party has requested the session modification and it is present only if the initiator was the called party.

5.2.4.17 Node Address

Void.

5.2.4.18 Partial Record Sequence Number

Void.

5.2.4.19 Private User ID (served party)

This field identifies the served party's private User ID that is received in the *User-Name* AVP in the *Accounting Request* message. The served party could be either the calling or called party.

5.2.4.20 Record Closure Time

Void.

5.2.4.21 Record Extensions

Void.

5.2.4.22 Record Opening Time

Void.

5.2.4.23 Record Type

Void.

5.2.4.24 Retransmission

Void.

5.2.4.25 Role of Node

Void.

5.2.4.26 SDP Media Component

Void.

5.2.4.27 SDP Session Description

Void.

5.2.4.28 Service ID

This field identifies the service the MRFC is hosting. For conferences the conference ID is used here.

5.2.4.29 Service Specific Data

Void.

5.2.4.30 Session ID

Void.

5.2.4.31 Served party IP Address

Void.

5.2.4.32 SIP Request Timestamp

Void.

5.2.4.33 SIP Response Timestamp

Void.

5.2.4.34 S-CSCF Information

This field contains Information related to the serving CSCF, e.g. the S-CSCF capabilities upon registration event or the S-CSCF address upon the session establishment event.

5.2.4.35 Trunk Group ID Incoming/Outgoing

Void.

5.2.4.36 User-to-User Data

Void.

5.2.5 Bi interface Conventions

The present document gives several recommendations for the main protocol layers for the Bi interface protocol stack. These recommendations are not strictly specified features, since there are a lot of variations among the existing Billing Systems.

As a minimum, all implementations shall support a file based bulk interface for the transfer of CDRs from the CCF to the BS. The recommendation is FTP over TCP/IP.

5.2.6 Abstract Syntax Description

Void.

5.2.7 Data Encoding Rules

Data encoding rules are descried in [9] for BER, in [10] for PER, or in [11] for XER.

6 Online Charging

6.1 Diameter Description on the Ro Interface

6.1.1 Basic Principles

IMS online charging essentially uses the same protocol that is used for offline charging. However, for online charging the protocol may include additional Attribute-Value Pairs (AVPs) within the existing messages.

Two cases for online event charging are distinguished:

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

In the case of Immediate Event Charging (IEC), granting units to the AS is performed in a single operation that also includes the deduction of the corresponding monetary units from the subscriber's account. The charging process is controlled by the corresponding *Accounting-Record-Type* EVENT_RECORD which is sent with an ACR for a given accounting event.

In contrast, Event Charging with Unit Reservation (ECUR) also includes the process of requesting, reserving, releasing and returning unused units. The deduction of the corresponding monetary units then occurs upon conclusion of the ECUR transaction. In this case, the *Accounting-Record-Type* START / INTERIM / STOP_RECORD are used to control the accounting session. During a SIP session there can be repeated execution of unit reservation and debit operations as specified in TS 32.200 [2].

The AS/MRFC may apply either IEC, where ACR Event messages are generated, or ECUR, using ACR Start, Stop and Interim. 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 the IETF Credit Control Application, [13], is planned. However, this can only be accomplished when the current IETF draft receives an official RFC status.

6.1.2 Message Flows and Types

This subclause describes the message flows for the event charging procedures on the Ro interface.

6.1.2.1 Immediate Event Charging (IEC)

This subclause provides the details of the "Debit Units" operation specified in TS 32.200 [2].

6.1.2.1.1 Message Flows - Successful Cases and Scenarios

6.1.2.1.1.1 IEC - Debit Units Operation

Figure 6.1 shows the transactions that are required on the Ro interface in order to perform IEC with Debit Units operations. The Debit Units operation may alternatively be carried out prior to, concurrently with or after service/content delivery. The AS/MRFC must ensure that the requested service execution is successful, when this scenario is used.

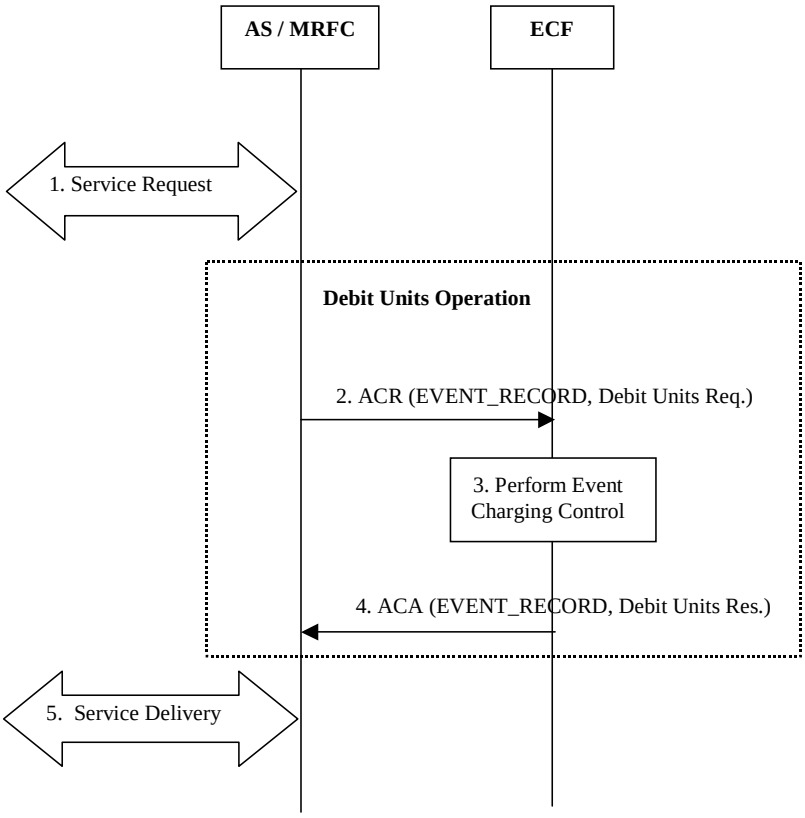


Figure 6.1: IEC - Debit Units Operation

1. The AS/MRFC receives a SIP related service request from S-CSCF.

The Debit Units Operation is performed as described in TS 32.200 [2].

2. The AS/MRFC performs IEC prior to service execution. AS/MRFC sends *Accounting-Request* with *Accounting-Record-Type* set to EVENT_RECORD to indicate service specific information to the ECF. The *Requested-Action* is set to DIRECT_DEBITING. If known, the AS/MRFC may include *Requested-Service-Unit* (monetary or non monetary units) in the request message.

3. If the service cost information is not received by the ECF, the ECF determines the price of the service according to the service specific information received by issuing a rating request to the Rating Function. The ECF then deducts the corresponding monetary amount. If the cost of the service is included in the request received from the AS/MRFC, the ECF directly deducts the specified monetary amount from the user's account.
4. The ECF returns *Accounting-Answer* message with *Accounting-Record-Type* set to EVENT_RECORD to the AS/MRFC in order to authorize the service execution (*Granted-Service-Unit* and possibly *Cost-Information* indicating the cost of the service are included in the *Accounting-Answer* message). The *Accounting-Answer* message has to be checked by the AS/MRFC accordingly and the requested service is controlled concurrently with service delivery.
5. Service is being delivered.

6.1.2.1.2 Message Flows - Error Cases and Scenarios

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

The failure handling behavior is locally configurable in the AS/MRFC. If the *Direct-Debiting-Failure-Handling* AVP is not used, the locally configured values are used instead.

6.1.2.1.2.1 Reception of SIP Error Messages

If SIP errors occur during service delivery, as defined in [5] and [12], it is up to the AS/MRFC to determine to what extent the service was delivered before the error occurred and act appropriately with respect to charging. This may imply that no units at all (or no more units) are debited.

6.1.2.1.2.2 Debit Unit Operation Failure

This case comprises of ECF connection failure and/or receiving error responses from the ECF.

The AS/MRFC detects an ECF connection failure when the timer Tx expires [13] or a transport failure is detected as defined in [3]. The ECF should indicate the cause of failure by setting the appropriate result code as defined in [3] and [13]. In any case, the failure handling of AS/MRFC and ECF complies with the failure procedures for "Direct Debiting" scenario described in "draft-hakala-diameter-credit-control-03", [13].

6.1.2.1.2.3 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 (within a reasonable time window) by the receiver entity.

The AS/MRFC mark the request messages that are retransmitted after a link failover as possible duplicates with the *Re-Transmission* AVP. For optimized performance, uniqueness checking against other received requests is only necessary for those records marked with the *Re-Transmission* AVP received within a reasonable time window. This focused check is based on the inspection of the *Session-Id* and *Accounting-Record-Number* AVP pairs.

Note that for IEC the duplicate detection is performed in the Correlation Function that is part of the OCS. The ECF that receives the possible duplicate request should mark as possible duplicate the corresponding request that is sent over the Rc interface.

6.1.2.2 Event Charging with Unit Reservation (ECUR)

This subclause provides the details of the "Reserve Units" and "Debit Units" operations specified in TS 32.200 [2].

6.1.2.2.1 Message Flows - Successful Cases and Scenarios

6.1.2.2.1.1 ECUR - Reserve Units and Debit Units Operations

Figure 6.2 shows the transactions that are required on the Ro interface in order to perform ECUR with Reserve Units and Debit Units operations. Multiple replications of both of these operations are possible.

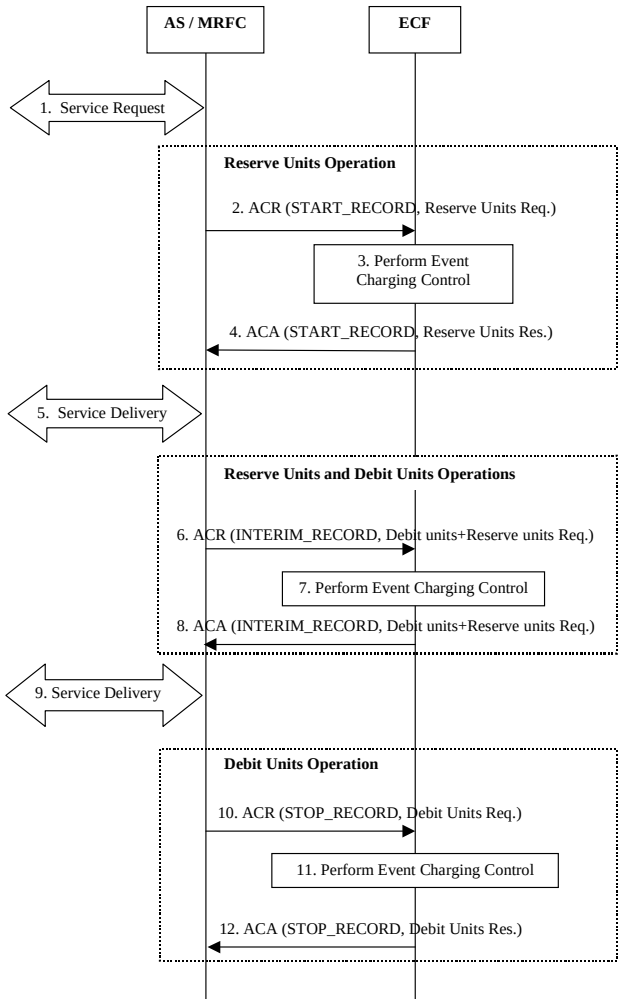


Figure 6.2: ECUR - Reserve Units and Debit Units Operations

1. The AS/MRFC receives a SIP related service request from S-CSCF. The service request may be initiated by either the user or an AS/MRFC.

The Reserve Units Operation is performed as described in TS 32.200 [2].

2. In order to perform Reserve Units operation for a number of units (monetary or non-monetary units), the AS/MRFC sends an ACR with *Accounting-Record-Type* set to START_RECORD to the ECF. If known, the AS/MRFC may include *Requested-Service-Unit* (monetary or non monetary units) in the request message.
3. If the service cost information is not received by the ECF, the ECF 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 ECF directly reserves the specified monetary amount. If the credit balance is sufficient, the ECF reserves the corresponding amount from the users account.
4. Once the reservation has been made, the ECF returns *Accounting-Answer* message with *Accounting-Record-Type* set to START_RECORD to the AS/MRFC in order to authorize the service execution (*Granted-Service-Unit* and possibly *Cost-Information* indicating the cost of the service are included in the *Accounting-Answer* message).
5. Content/service delivery starts and the reserved units are concurrently controlled.

The Reserve Units and Debit Units Operations are performed as described in TS 32.200 [2].

6. During content/service delivery, in order to perform Debit Units and subsequent Reserve Units operations, the AS/MRFC sends an ACR with *Accounting-Record-Type* set to INTERIM_RECORD, to report the units used and request additional units, respectively. If known, the AS/MRFC may include *Requested-Service-Unit* (monetary or non monetary units) in the request message.
7. The ECF deducts the amount used from the account. If the service cost information is not received by the ECF, the ECF 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 ECF directly reserves the specified monetary amount. If the credit balance is sufficient, the ECF reserves the corresponding amount from the users account.
8. Once the deduction and reservation have been made, the ECF returns *Accounting-Answer* message with *Accounting-Record-Type* set to INTERIM_RECORD to the AS/MRFC, in order to allow the content/service delivery to continue (new *Granted-Service-Unit* and possibly *Cost-Information* indicating the cumulative cost of the service are included in the *Accounting-Answer* message). The ECF may include in the ACA the *Final-Unit-Indication* to indicate the final granted units.
9. Content/service delivery continues and the reserved units are concurrently controlled.

The Debit Units Operation is performed as described in TS 32.200 [2].

10. When content/service delivery is completed or the final granted units have been consumed, the AS/MRFC sends *ACR* with *Accounting-Record-Type* set to STOP_RECORD to terminate the active accounting session and report the used units.
11. The ECF deducts the amount used from the account. Unused reserved units are released, if applicable.
12. The ECF acknowledges the reception of the ACR message by sending *ACA* message with *Accounting-Record-Type* indicating STOP_RECORD (possibly *Cost-Information* indicating the cumulative cost of the service is included in the *Accounting-Answer* message).

6.1.2.2.1.2 Support of Tariff Switch

Changes to the tariffs pertaining to the service may be handled in the following ways.

- Tariff Changes handled using Acct-Interim-Interval AVP; or
- Tariff changes handled using the Tariff Switch Time AVP.

6.1.2.2.1.2.1 Tariff Changes handled using Acct-Interim-Interval AVP

The tariff change for online charging can be achieved by setting the value of the *Acct-Interim-Interval* AVP (ECF controlled) in a manner that it matches the desired tariff switch time.

6.1.2.2.1.2.2 Tariff changes handled using the Tariff Switch Time AVP

To indicate a change of tariff to the AS/MRFC, the ECF can include the Tariff Switch Time (*Tariff-Switch-Definition* AVP), i.e. a timer value referring to the change of tariff, in the *Accounting-Answer*. The Tariff Switch Time is evaluated by the AS/MRFC relative to the time stamp of the *Accounting-Request* (*Accounting-Record-Type* START_RECORD or INTERIM_RECORD). By that it is possible to eliminate any delays of the signalling between AS/MRFC and ECF.

Together with the Tariff Switch Time the ECF also provides the granted service units. These units can be provided in one portion or in two, referring to the granted service units before and after the tariff switch.

If a Tariff Switch Time is received, the AS/MRFC starts the tariff switch timer and use the granted service units for usage metering. If both, granted service units before and after the tariff switch have been provided, the AS/MRFC uses the units granted before the tariff switch (pre-switch quota).

If the pre-switch quota is exhausted, the AS/MRFC sends an *Accounting-Request* to the ECF. The *Accounting-Request* contains the amount of service units used from the beginning of the connection only. The value of the tariff switch timer is discarded in the AS/MRFC and it is the responsibility of the ECF to provide a new Tariff Switch Time in the *Accounting-Answer*.

If the tariff switch timer expired, the AS/MRFC further continues usage metering using the post-switch quota, if provided, but no *Accounting-Request* is sent. If no specific units were granted to after tariff switch time, the AS/MRFC continues usage metering with the remaining units granted.

If the post switch quota is exhausted, the AS/MRFC sends an *Accounting-Request* to the ECF, containing the service units used before the last tariff switch, the service units used after the last tariff switch and the tariff switch time.

If the granted units - provided in one portion - are exhausted, an *Accounting-Request* is sent. If a tariff switch has occurred in this time, the *Accounting-Request* contains the service units used before the tariff switch, the service units used after the tariff switch and the time of the tariff switch. Otherwise, if no tariff switch has occurred, the *Accounting-Request* contains the overall amount of used service units.

There may be some AS/MRFCs that do no support tariff switching. In this case, the AS/MRFC ignores the AVPs associated with this feature (i.e. *Tariff-Switch-Definition* and *Unit-Value-After-Tariff-Switch* AVPs). The *Granted-Service-Unit, Unit-Value* and *Used-Service-Unit* AVPs are treated as if the Tariff Switch feature does not exist.

Figure 6.3 shows the messages exchanged on the Ro interface for ECUR for a tariff change. This scenario covers a tariff switch where the granted service units are provided in two portions, before and after the tariff switch. No additional Acc*ounting-Request* takes place, as the granted service units were not exhausted.

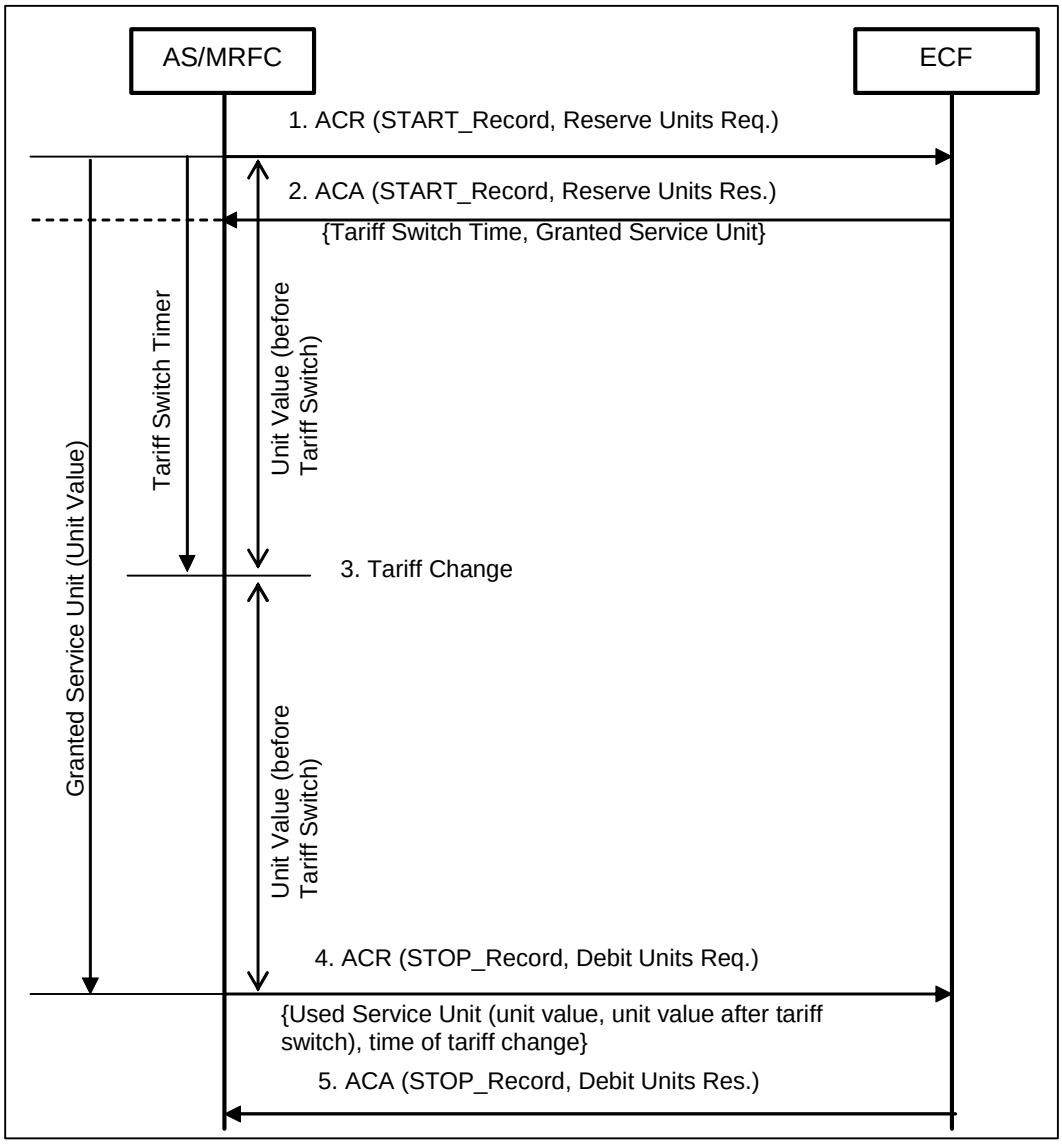


Figure 6.3: Tariff Change in the AS/MRFC

1. In order to perform credit control with reservation of an amount of units (monetary or non-monetary units) the AS/MRFC sends an ACR with *Accounting-Record-Type* set to START_RECORD to ECF. The *Requested-Action* is set to RESERVE_UNITS.
2. Once the reservation has been made, ECF returns an ACA with *Accounting-Record-Type* set to START_RECORD to the AS/MRFC in order to authorize the content/service delivery. The ACA includes the Tariff Switch Time, the service units granted before the tariff switch and the service units granted after the tariff switch.
   Upon receipt of the ACA, the AS/MRFC evaluates the tariff switch time relative to the timestamp of the ACR, starts the tariff switch timer and monitors service usage based on the service units granted before the tariff switch.
3. The Tariff Switch Timer expires. The AS/MRFC now monitors service usage based on the service units granted after the tariff switch.
4. The AS/MRFC sends ACR with *Accounting-Record-Type* set to STOP_RECORD to terminate the active accounting session. The message includes the amount of service units used before the tariff switch, the amount of service units used after the tariff switch and the time of the tariff change.
5. An *Accounting-Answer* is sent from the ECF back to the AS/MRFC as an acknowledgment of the successful debit process and to finalize the transaction.

6.1.2.2.1.3 Expiration of Reservation Validity

This subclause defines how reserved units are returned, if not used, within a reasonable time. It should be possible that both the reservation and SIP sessions are cancelled or only the reservation is cancelled without removing the SIP session. Work on this is ongoing in IETF Credit Control Draft [13]. Alignment with [13] is planned.

6.1.2.2.2 Message Flows - Error Cases and Scenarios

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

The failure handling behavior is locally configurable in the AS/MRFC. If *Credit-Control-Failure-Handling* AVP is not used, the locally configured values are used instead.

6.1.2.2.2.1 Reception of SIP Error Messages

If SIP errors occur during service delivery, as defined in [5] and [12], it is up to the AS/MRFC to determine to what extent the service was delivered before the error occurred and act appropriately with respect to charging. This may imply that no units at all (or no more units) are reserved or debited.

6.1.2.2.2.2 Reserve Units and Debit Units Operation Failure

This case comprises of ECF connection failure, and/or receiving error responses from the ECF.

The AS/MRFC detects an ECF connection failure when the timer Tx expires [13] or a transport failure is detected as defined in [3]. The ECF also has the capability to detect failures when the timer Ts [3] expires. The ECF should indicate the cause of failure by setting the appropriate result code as defined in [3] and [13]. In any case, the failure handling of AS/MRFC and ECF complies with the failure procedures for "Session Based Credit Control" scenario described in "draft-hakala-diameter-credit-control-03", [13].

6.1.2.2.2.3 Duplicate Detection

For credit control duplicate detection is performed only for possible duplicate event requests related to IEC as mentioned in subclause 6.1.2.1.2.3,as retransmission of ECUR related accounting requests is not allowed.

6.1.3 Message Formats

6.1.3.1 Summary of Online Charging Message Formats

The existing Diameter credit control extension internet-draft [13] proposes an approach based on a series of "interrogations":

- Initial interrogation (extending the start-session accounting report message).
- Zero, one or more interim interrogations (extending the interim accounting report message).
- Final interrogation (extending the stop-session accounting report message).

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 make use of the same *Accounting-Request* and *Accounting-Answer* messages in the base Diameter protocol as for the offline charging. Additional AVPs are specified for the purposes of online charging. These additional AVPs include all the AVPs listed in [13] and the *Tariff-Switch-Definition* AVP as specified in clause 7.

The *Accounting-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.

Such an approach has the benefit of a common basic message structure, and accounting data reporting mechanism for both offline and online charging.

Table 6.1 describes the use of these messages for online charging.

Table 6.1: Online Charging Messages Reference Table

Command-Name	Source	Destination	Abbreviation
Accounting-Request	MRFC, AS	ECF	ACR
Accounting-Answer	ECF	MRFC, AS	ACA

6.1.3.2 Structure for the Accounting Message Formats

The following is the basic structure shared by all online charging messages. This is based directly on the format of the *Accounting-Request* and *Accounting-Answer* messages defined in the base Diameter protocol specification [3] with the extensions defined in [13].

Those Diameter AVPs that are used for offline charging are marked "Yes" in tables 6.2 to 6.3. Those Diameter AVPs that are not used for online charging are marked "No" in tables 6.2 to 6.3. This implies that their content can (Yes) or can not (No) be used by the ECF for charging purposes.

The following symbols are used in the tables:

- <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.

6.1.3.2.1 Accounting-Request Message

Table 6.2 illustrates the basic structure of a Diameter *Accounting-Request* message as used for IMS online charging.

Table 6.2: Accounting-Request (ACR) Message Contents for Online Charging

Diameter Base Protocol AVPs	
AVP	**Used in Online ACR**
<Diameter Header: 271, REQ, PXY>	Yes
<Session-Id>	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
{Destination-Realm }	Yes
{Accounting-Record-Type}	Yes
{Accounting-Record-Number}	Yes
[Acct-Application-Id]	No
[Vendor-Specific-Application-Id]	Yes
[User-Name]	Yes
[Accounting-Sub-Session-Id]	No
[Accounting-RADIUS-Session-Id]	No
[Acct-Multi-Session-Id]	No
[Acct-Interim-Interval]	Yes
[Accounting-Realtime-Required]	No
[Origin-State-Id]	Yes
[Event-Timestamp]	Yes
* [Proxy-Info]	No
* [Route-Record]	No
*[AVP]	No
Diameter Credit Control AVPs	
[Subscription-Id]	Yes
[Requested-Action]	Yes
*[Requested-Service-Unit]	Yes
*[Used-Service-Unit]	Yes
[Tariff-Switch-Definition]	Yes
*[Service-Parameter-Info]	Yes
[Abnormal-Termination-Reason]	Yes
*[Accounting-Correlation-Id]	No
[Credit-Control-Failure-Handling]	Yes
[Direct-Debiting-Failure-Handling]	Yes
[Re-Transmission]	Yes
3GPP Diameter accounting AVPs	
[Event-Type]	Yes
[Role-of-node]	Yes
[User-Session-ID]	Yes
[Calling-Party-Address]	Yes
[Called-Party-Address]	Yes
[Time-stamps]	Yes
*[Application-Server]	No
*[Application-Provided-Called-Party-Address]	No
*[Inter-Operator-Identifier]	Yes
[IMS-Charging-Identifier]	Yes
*[SDP-Session-Description]	Yes
*[SDP-Media-Component]	Yes
[GGSN-Address]	Yes
[Served-Party-IP-Address]	No
[Authorised QoS]	No
[Server-Capabilities]	No
[Trunk-Group-ID]	No
[Bearer-Service]	No
[UUS-Data]	Yes

The detailed use of the AVPs for MRFC/AS and for each ACR record type (start/interim/stop/event) is specified in subclause 6.1.3.3.

6.1.3.2.2 Accounting-Answer Message

Table 6.3 illustrates the basic structure of a Diameter *Accounting-Answer* message as used for IMS charging. This message is always used by the ECF as specified below, independent of the receiving IMS node and the ACR record type that is being replied to.

Table 6.3: Accounting Answer (ACA) Message Contents for Online Charging

Diameter base protocol AVPs	
AVP	**Used in online ACA**
<Diameter Header: 271, PXY>	Yes
<Session-Id>	Yes
{Result-Code}	Yes
{Origin-Host}	Yes
{Origin-Realm}	Yes
{Accounting-Record-Type}	Yes
{Accounting-Record-Number}	Yes
[Acct-Application-Id]	No
[Vendor-Specific-Application-Id]	Yes
[User-Name]	Yes
[Accounting-Sub-Session-Id]	Yes
[Accounting-RADIUS-Session-Id]	No
[Acct-Multi-Session-Id]	No
[Error-Reporting-Host]	No
[Acct-Interim-Interval]	Yes
[Accounting-Realtime-Required]	No
[Origin-State-Id]	Yes
[Event-Timestamp]	Yes
* [Proxy-Info]	No
*[AVP]	No
Diameter Credit Control AVPs	
[Subscription-Id]	Yes
*[Granted-Service-Unit]	Yes
[Tariff-Switch-Definition]	Yes
[Cost-Information]	Yes
[Final-Unit-Indication]	Yes
[Check-Balance-Result]	Yes
[Credit-Control-Failure-Handling]	Yes

6.1.3.3 Detailed Message Formats

Following the protocol specifications, the following "types" of accounting data may be sent:

- Start session accounting data.
- Interim session accounting data.
- Stop session accounting data.
- Event accounting data.

ACR types start, interim and stop are used for accounting data related to successful SIP sessions. In contrast, event accounting data is used for session-unrelated accounting data, such as a simple registration or interrogation, and for accounting data related to unsuccessful SIP session establishment attempts.

The following table specifies per ACR type the accounting data that are sent by MRFC and AS.

Tables 6.4 and 6.5 are the basic structure for online charging messages via Ro Interface. This is based directly on the *Accounting-Request* and *Accounting-Answer* messages defined in the Diameter protocol specifications [3] and [13].

Table 6.4: Detailed Diameter ACR Message Contents for online Charging

AVP name	Node Type	MGCF	AS
	Supported ACRs	S/I/S/E	S/I/S/E
AVPs from Diameter Base Protocol			
<Session-ID>		SISE	SISE
{Origin-Host}		SISE	SISE
{Origin-Realm}		SISE	SISE
{Destination-Realm}		SISE	SISE
{Accounting-Record-Type}		SISE	SISE
{Accounting-Record-Number}		SISE	SISE
[Acct-Application-ID]		-	-
[Vendor-Specific-Application-ID]		SISE	SISE
[User-Name]		SISE	SISE
[Accounting-Sub-Session-ID]		-	-
[Accounting-RADIUS-Session-ID]		-	-
[Acct-Multi-Session-ID]		-	-
[Acct-Interim-Interval]		SIS-	SIS-
[Accounting-Realtime-Required]		-	-
[Origin-State-ID]		SISE	SISE
[Event-Timestamp]		SISE	SISE
*[Proxy-Info]		-	-
*[Route-Record]		-	-
*[AVP]		-	-
Diameter Credit-Control AVP			
[Subscription-Id]		SISE	SISE
[Requested-Action]		SISE	SISE
*[Requested-Service-Unit]		SISE	SISE
*[Used-Service-Unit]		SISE	SISE
[Tariff-Switch-Definition]		SISE	SISE
*[Service-Parameter-Info]		SISE	SISE
[Abnormal-Termination-Reason]		SISE	SISE
*[Accounting-Correlation-Id]		SISE	SISE
[Credit-Control-Failure-Handling]		SISE	SISE
[Direct-Debiting-Failure-Handling]		SISE	SISE
*[Granted-Service-Unit]		-	-
[Cost-Information]		-	-
[Final-Unit-Indication]		-	-
[Check-Balance-Result]		-	-
[Re-Transmission]		SISE	SISE
3GPP Diameter Accounting AVPs			
[Event-Type]		SISE	SISE
[Role-of-Node]		SISE	SISE
[User-Session-ID]		SISE	SISE
[Calling-Party-Address]		SISE	SISE
[Called-Party-Address]		SISE	SISE
[Time-stamps]		SISE	SISE
[Application-server]		-	-
[Application-provided-called-party-address]		-	-
[Inter-Operator-Identifiers]		SISE	SISE
[IMS-Charging-Identifier]		SISE	SISE
*[SDP-Session-Description]		SI-E	SI-E
*[SDP-Media-component]		SI-E	SI-E
[SDP-Media-Name]		SI-E	SI-E
[GGSN-Address]		SI-E	SI-E
GPRS-Charging-Id]		SI-E	SI-E
[Served-Party-IP-Address]		-	-
[Authorized-QoS]		-	-
[Server-Capabilities]		-	-
[Trunk-Group-ID]		-	-
[Bearer-Service]		-	-
[Service-Id]		-	-
[UUS-Data]		SISE	SISE

Table 6.5: Detailed Diameter ACA Message Contents for Online Charging

AVP name	Node Type Supported ACAs	ECF S/I/S/E
AVPs from Diameter Base Protocol		
<Session-ID>		SISE
{Result Code}		SISE
{Origin-Host}		SISE
{Origin-Realm}		SISE
{Accounting-Record-Type}		SISE
{Accounting-Record-Number}		SISE
[Acct-Application-ID]		-
[Vendor-Specific-Application-ID]		SISE
[User-Name]		-
[Accounting-Sub-Session-ID]		-
[Accounting-RADIUS-Session-ID]		-
[Acct-Multi-Session-ID]		-
[Error-Reporting-Host]		-
[Acct-Interim-Interval]		SIS-
[Accounting-Realtime-Required]		-
[Origin-State-ID]		SISE
[Event-Timestamp]		SISE
*[Proxy-Info]		-
*[Route-Record]		-
AVPs from Diameter Credit Control		
[Subscription-Id]		SISE
[Requested-Action]		-
*[Requested-Service-Unit]		-
*[Used-Service-Unit]		-
[Tariff-Switch-Definition]		SISE
*[Service-Parameter-Info]		-
[Abnormal-Termination-Reason]		-
*[Accounting-Correlation-Id]		-
[Credit-Control-Failure-Handling]		-
[Direct-Debiting-Failure-Handling]		-
*[Granted-Service-Unit]		SISE
[Cost-Information)		SISE
[Final-Unit-Indication]		SISE
[Check-Balance-Result]		SISE
[Credit-Control-Failure-Handling]		SISE

7 AVPs Used for Offline and Online Charging

7.1 Diameter Base Protocol AVPs

The use of the Attribute Value Pairs (AVPs) that are defined in the Diameter Base Protocol [3] is specified in subclause 5.1.3 for offline charging and in subclause 6.1.3 for online charging. The information is summarized in table 7.1 with the base protocol AVPs listed in alphabetical order. Detailed specification of these AVPs is available in the base protocol specifications.

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

Those Diameter AVPs that are used for IMS charging are marked "Yes" in table 7.1. Those Diameter AVPs that are not used for IMS charging are marked "No" in table 7.1. This implies that their content can (Yes) or can not (No) be used by the CCF or ECF for charging purposes.

The following symbols (adopted from [3]) are used in the tables:

- <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 are possible.

Table 7.1: Use Of Diameter Base Protocol AVPs in IMS

AVP name	Mechanism	Offline				Online	
	Type	ACR	ACA	ASR	ASA	ACR	ACA
	Table #	5.4	5.5	5.6	5.7	6.2	6.3
[Accounting-Multi-Session-Id]		No	No	-	-	No	No
[Accounting-RADIUS-Session-Id]		No	No	-	-	No	No
[Accounting-Realtime-Required]		No	No	-	-	No	No
{Accounting-Record-Number}		Yes	Yes	-	-	Yes	Yes
{Accounting-Record-Type}		Yes	Yes	-	-	Yes	Yes
[Accounting-Sub-Session-Id]		No	No	-	-	No	No
[Acct-Application-Id]		No	No	-	-	No	No
[Acct-Interim-Interval]		Yes	Yes	-	-	Yes	Yes
{Auth-Application-Id}		-	-	Yes	-	-	-
<Diameter-Header:271,REQ,PXY>		Yes	Yes	Yes	Yes	Yes	Yes
{Destination-Host}		-	-	Yes	Yes	-	-
{Destination-Realm}		Yes	-	Yes	Yes	Yes	-
[Error-Message]		-	-	-	Yes	-	-
[Error-Reporting-Host]		-	No	-	No	-	No
[Event-Timestamp]		Yes	Yes	-	-	Yes	Yes
*[Failed-AVP]		-	-	-	No	-	-
*[Proxy-Info]		No	No	No	No	No	No
{Origin-Host}		Yes	Yes	Yes	Yes	Yes	Yes
{Origin-Realm}		Yes	Yes	Yes	Yes	Yes	Yes
[Origin-State-Id]		Yes	Yes	No	No	Yes	Yes
*[Redirected-Host]		-	-	-	No	-	-
[Redirected-Host-Usage]		-	-	-	No	-	-
[Redirected-Max-Cache-Time]		-	-	-	No	-	-
{Result-Code}		-	Yes	-	Yes	-	Yes
*[Route-Record]		No	-	No	-	No	-
<Session-Id>		Yes	Yes	Yes	Yes	Yes	Yes
[User-Name]		Yes	Yes	Yes	Yes	Yes	Yes
[Vendor-Specific-Application-Id]		Yes	Yes	-	-	Yes	Yes

NOTE: *Result-Code* AVP is defined in Diameter Base Protocol [3]. However new values are used in IMS charging applications. These additional values are defined below.

7.1.1 Result-Code AVP

This subclause defines new *Result-Code* AVP (Diameter Base Protocol [3]) values that must be supported by all Diameter implementations that conform to the present document.

The *Accounting-Answer* message includes the *Result-Code* AVP, which may indicate that an error was present in the *Accounting-Request* message. A rejected *Accounting-Request* message should cause the user's session to be terminated.

Errors that fall within the transient failures category are used to inform a peer that the request could not be satisfied at the time it was received, but MAY be able to satisfy the request in the future.

DIAMETER_END_USER_SERVICE_DENIED 40XX

The ECF denies the service request due to service restrictions 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 40XX

The credit control server 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).

Errors that fall within permanent failure category are used to inform the peer that the request failed, and should not be attempted again.

DIAMETER_END_USER_NOT_FOUND 50XX

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

7.1.2 User-Name AVP

The *User-Name* AVP contains the Private User Identity [18], if available in the node.

7.1.3 Vendor-Specific-Application-Id AVP

7.2 Additional AVPs

For the purpose of IMS charging additional AVPs are used in ACR and ACA for both online and offline charging. The use of these AVPs are described in subclause 5.1.3 for offline charging and in subclause 6.1.3 for online charging. The information is summarized in table 7.2 along with the AVP flag rules.

Detailed descriptions of AVPs that are used specifically for IMS charging are provided in the subclauses below the table. However, for AVPs that are just borrowed from other applications only the reference (e.g. [13]), is provided in table 7.2 and the detailed description is not repeated.

Table 7.2: Use Of Diameter Credit Control and 3GPP accounting AVPs for IMS

AVP Name	AVP Code	Clause Defined	Value Type	AVP Flag rules				
				Must	May	Should not	Must not	May Encr.
AVPs from Diameter Credit Control								
[Subscription-Id]		[13]						
[Requested-Action]		[13]						
*[Requested-Service-Unit]		[13]						
*[Used-Service-Unit]		7.2.41	Grouped					
{Unit-Type}		7.2.38						
{Unit-Value}		7.2.39						
{Unit-Value-After-Tariff-Switch}		7.3.40	Float64					
[Currency-Code]		[13]						
[Tariff-Switch-Definition]		7.2.34	OctetString					
*[Service-Parameter-Info]		[13]						
[Abnormal-Termination-Reason]		[13]						
*[Accounting-Correlation-Id]		[13]						
[Credit-Control-Failure-Handling]		[13]						
[Direct-Debiting-Failure-Handling]		[13]						
*[Granted-Service-Unit]		7.2.17	Grouped					
{Unit-Type}		7.2.38						
{Unit-Value}		7.2.39						
[Unit-Value-After-Tariff-Switch]		7.3.40	Float64					
[Currency-Code]		[13]						
[Cost-Information]		7.2.11	Grouped					

AVP Name	AVP Code	Clause Defined	Value Type	AVP Flag rules				
				Must	May	Should not	Must not	May Encr.
{Cost}		[13]						
{Currency-Code}		[13]						
[Final-Unit-Indication]		[13]						
[Check-Balance-Result]		[13]						
[Re-Transmission]		[13]						
3GPP Diameter Accounting AVPs								
[Event-Type]		7.2.14	Grouped					
[SIP-Method]		7.2.31	UTF8String					
[Event]		7.2.13	UTF8String					
[Content-Type]		7.2.10	UTF8String					
[Content-Length]		7.2.9	UTF8String					
[Content-Disposition]		7.2.8	UTF8String					
[Role-of-Node]		7.2.24	Enumerated					
[User Session Id]		7.2.42	UTF8String					
[Calling-Party-Address]		7.2.7	UTF8String					
[Called-Party-Address]		7.2.6	UTF8String					
[Time-stamps]		7.2.36	Grouped					
[SIP-Request-Timestamp]		7.2.32	UTF8String					
[SIP-Response-Timestamp]		7.2.33	UTF8String					
[Application-server]		7.2.3	UTF8String					
[Application-provided-called-party-address]		7.2.2	UTF8String					
[Inter-Operator-Identifier]		7.2.20	Grouped					
[Originating-IOI]		7.2.22	UTF8String					
[Terminating-IOI]		7.2.35	UTF8String					
[IMS-Charging-Identifier]		7.2.18	UTF8String					
*[SDP-Session-Description]		7.2.28	UTF8String					
*[SDP-Media-component]		7.2.25	Grouped					
[SDP-Media-Name]		7.2.27	UTF8String					
*[SDP-Media-Description]		7.2.26	UTF8String					
[GPRS-Charging-Id]		7.2.16	UTF8String					
[GGSN-Address]		7.2.15	IPAddress					
[Served-Party-IP-Address]		7.2.29	IPAddress					
[Authorized-QoS]		7.2.4	TBD					
[Server-Capabilities]		[19]						
[Trunk-Group-Id]		7.2.37	Grouped					
[Incoming-Trunk-Group-Id]		7.2.19	UTF8String					
[Outgoing-Trunk-Group-Id]		7.2.23	UTF8String					
[Bearer-Service]		7.2.5	OctetString					
[Service-Id]		7.2. 30	UTF8String					
[UUS-Data]		7.2.43	Grouped					
[Amount-of-UUS-data]		7.2.1	UTF8String					
[Mime-type]		7.2.21	UTF8String					
[Direction]		7.2.12	Enumerated					

7.2.1 Amount-of-UUS-Data AVP

The *Amount-Of-UUS-Data* AVP (AVP code TBD) is of type UTF8String and holds the amount (in octets) of User-to-User data conveyed in the body of the SIP message with content-disposition header field equal to "render".

7.2.2 Application-Provided-Called-Party-Address AVP

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

7.2.3 Application-Server AVP

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

7.2.4 Authorised-QoS AVP

The *Authorised-QoS* AVP (AVP code TBD) is of type (TBD) and holds the Authorised QoS as defined in TS 23.207 [7] / TS 29.207 [8] and applied via the Go interface.

7.2.5 Bearer-Service AVP

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

7.2.6 Called-Party-Address AVP

The *Called-Party-Address* AVP (AVP code TBD) 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.

7.2.7 Calling-Party-Address AVP

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

7.2.8 Content-Disposition AVP

The *Content-Disposition* AVP (AVP code TBD) 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 [17].

7.2.9 Content-Length AVP

The *Content-Length* AVP (AVP code TBD) is of type UTF8String and holds the size of the of the message-body, as described in [17].

7.2.10 Content-Type AVP

The *Content-Type* AVP (AVP code TBD) is of type UTF8String and holds the media type (e.g. application/sdp, text/html) of the message-body, as described in [17].

7.2.11 Cost-Information AVP

The *Cost-Information* AVP (AVP Code TBD) is of type Grouped and is used to return the cost information of a service in the *Accounting- Answer* command. The included *Cost* AVP contains the cost of the service event and the *Currency-Code* specifies in which currency the cost was given.

When the *Requested-Action* AVP with value PRICE_ENQUIRY is included in the *Accounting-Request* command the *Cost-Information* AVP sent in the succeeding *Accounting-Answer* command contains the cost estimation of the requested service, without any reservation being made.

The *Cost-Information* AVP included in the *Accounting-Answer* command with the *Accounting-Record-Type* set to INTERIM_RECORD contains the accumulated cost for the session without taking any credit- reservation into account.

The *Cost-Information* AVP included in the *Accounting-Answer* command with the *Accounting-Record-Type* set to EVENT_RECORD or STOP_RECORD contains the total cost for the requested service. It has the following ABNF grammar.

When the Requested-Action AVP is set to RESERVE_UNITS in the *Accounting-Request* (ACR) and the Unit-Type in the *Requested-Service-Unit* AVP is set to SERVICE_CREDIT_MONEY, the *Cost-Information* AVP sent in the succeeding *Accounting Answer* (ACA) contains the requested cost information.

It has the following ABNF grammar:

<Cost-Information>: :=<AVP Header: TBD>

{ Cost }

{ Currency-Code }

7.2.12 Direction AVP

The Direction AVP (AVP code TBD) is of type Enumerated and indicates whether the UUS data travels in up-link or down-link direction. The following values are defined:

UPLINK 0

DOWNLINK 1

7.2.13 Event AVP

The Event AVP (AVP code TBD) is of type UTF8String and holds the content of the "Event" header used in SUBSCRIBE and NOTIFY messages.

7.2.14 Event-Type AVP

Reflects the type of chargeable telecommunication service/event for which the accounting-request message is generated, such as: "session", "register", "subscribe".

The *IMS-Event-Type* AVP (AVP code TBD) 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:

<IMS-Event-Type>::=<AVP Header: TBD >

[SIP-Method]

[Event]

[Content-Type]

[Content-Length]

[Content-Disposition]

7.2.15 GGSN-Address AVP

The *GGSN-Address* AVP (AVP code TBD) is of type IPAddress and holds the IP-address of the GGSN that generated the GPRS Charging ID, as described in [2].

7.2.16 GPRS-Charging-ID AVP

The *GPRS-Charging-ID* AVP (AVP code TBD) is of type UTF8String and holds a sequence number generated by the GGSN at PDP context activation, as described in [2].

7.2.17 Granted-Service-Unit AVP

If the ACA containing the *Granted-Service-Unit* AVP contains a *Tariff-Switch-Definition* AVP, *the Unit-Value-After-Tariff-Switch* AVP may be included. In this case the *Unit-Value* AVP contains the granted units before the tariff switch time and the *Unit-Value-After-Tariff-Switch* AVP gives the units granted after the tariff switch.

If the ACA containing the *Granted-Service-Unit* AVP contains a *Tariff-Switch-Definition* AVP but *no Unit-Value-After-Tariff-Switch* AVP is included, the granted *Unit-Value* is used before and after the tariff switch.

An ACA containing a *Granted-Service-Unit* AVP with *Unit-Value-After-Tariff-Switch* AVP MUST contain a *Tariff-Switch-Definition* AVP. If the *Tariff-Switch-Definition* AVP is missing, the *Unit-Value-After-Tariff-Switch* AVP is ignored and it is proceeded as without a tariff change.

It has the following ABNF grammar:

<Granted-Service-Unit>::=< AVP Header: TBD >

{ Unit-Type }

{ Unit-Value }

[Unit-Value-After-Tariff Switch]

[Currency-Code]

7.2.18 IMS-Charging-Identifier (ICID) AVP

The *IMS-Charging-Identifier* AVP (AVP code TBD) 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.

7.2.19 Incoming-Trunk-Group-ID AVP

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

7.2.20 Inter-Operator-Identifier (IOI) AVP

The *Inter-Operator-Identifier* AVP (AVP code TBD) is of type Grouped and holds the identification of the network neighbours (originating and terminating) as exchanged via SIP signalling and described in [15].

It has the following ABNF grammar:

<Inter-Operator-Identifier>::=< AVP Header: TBD >

[Originating-IOI]

[Terminating-IOI]

7.2.21 Mime-Type AVP

The *Mime-Type* AVP (AVP code TBD) is of type UTF8String and holds the Mime type of the User-To-User data.

7.2.22 Originating-IOI AVP

The *Originating-IOI* AVP (AVP code TBD) is of type UTF8String (alphanumeric string) and holds the Inter Operator Identifier for the originating network as generated by the S-CSCF in the home network of the originating end user [15].

7.2.23 Outgoing-Trunk-Group-ID AVP

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

7.2.24 Role-of-Node AVP

The *Role-Of-Node* AVP (AVP code TBD) is of type Enumerated and specifies the role of the CSCF, as relevant for the chargeable telecommunication service/event.

The identifier can be one of the following:

ORIGINATING_ROLE 0

The CSCF is applying a originating role, serving the calling subscriber.

TERMINATING_ROLE 1

The CSCF is applying a terminating role, serving the called subscriber.

7.2.25 SDP-Media-Component AVP

The *SDP- Media-Component* AVP (AVP code TBD) 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: TBD >

[SDP-Media-Name]

*[SDP-Media-Description]

[GPRS-Charging-Id]

7.2.26 SDP-Media-Description AVP

The *SDP-Media-Description* AVP (AVP code TBD) is of type UTF8String and holds the content of an "attribute-line" (i=, c=, b=, k=, a=) related to a media component, as described in [17]. The attributes are specifying the media described in the SDP-Media-Name AVP.

7.2.27 SDP-Media-Name AVP

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

7.2.28 SDP-Session-Description AVP

The *SDP-Media-Description* AVP (AVP code TBD) is of type UTF8String and holds the content of an "attribute-line" (i=, c=, b=, k=, a=) related to a media component, as described in [17].

7.2.29 Served-Party-IP-Address AVP

The *Served-Party-IP-Address* AVP (AVP code TBD) is of type IPAddress and holds the IP address of either the calling or called party, depending on whether the proxy is in touch with the calling or the called party.

7.2.30 Service-ID AVP

The *Service-ID* AVP (AVP code TBD) 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.

7.2.31 SIP-Method AVP

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

7.2.32 SIP-Request-Timestamp AVP

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

7.2.33 SIP-Response-Timestamp AVP

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

7.3.34 Tariff-Switch-Definition AVP

The *Tariff-Switch-Definition* AVP (AVP Code TBD) is of type OctetString and contains the tariff switch timer.

This AVP can be included in the *Accounting Answer* which is sent as a result of the previous *Accounting Request* with *Requested-Action* AVP set to RESERVE_UNITS. The tariff switch timer is evaluated relative to the timestamp of the preceding *Accounting Request* command. When the tariff switch timer expires, the AS/MRFC uses the *Unit-Value-After-Tariff-Switch*, if provided in the ACA, as granted units.

If a tariff switch has occurred, the *Tariff-Switch-Definition* AVP should be included in the next ACR together with the units used before the tariff switch (*Unit-Value* AVP) and the units used after the tariff switch (*Unit-Value-After-Tariff-Switch* AVP).

7.2.35 Terminating-IOI AVP

The *Terminating-IOI* AVP (AVP code TBD) is of type UTF8String (alphanumeric string) and holds the Inter Operator Identifier for the originating network as generated by the S-CSCF in the home network of the terminating end user [15].

7.2.36 Time-Stamps AVP

The *Time-Stamp* AVP (AVP code TBD) 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: TBD >

[SIP-Request-Timestamp]

[SIP-Response-Timestamp]

7.2.37 Trunk-Group-ID AVP

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

It has the following ABNF grammar:

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

[Incoming-Trunk-Group-ID]

[Outgoing-Trunk-Group-ID]

7.2.38 Unit-Type AVP

The *Unit-Type* AVP is of type Enumerated (AVP Code TBD) and contains the type of the unit. The unit type can be one of the following:

SERVICE_CREDIT_TIME 0

The unit is of type "time" and is given in seconds.

SERVICE_CREDIT_VOLUME 1

The unit is of type "volume" and is given in kB.

SERVICE_CREDIT_EVENT 2

The unit is of type "event" and is given as a number of events.

SERVICE_CREDIT_MONEY 3

The unit is of type "money" and is given as a monetary value, whose currency SHOULD be specified by the *Currency-Code* AVP.

SERVICE_CREDIT_SERVICE 4

The unit of type "service" and is given as a selected service.

7.2.39 Unit-Value AVP

The *Unit-Value* AVP is of type Float64 (AVP Code TBD) and contains the granted or used Unit-Value. The value can be time in seconds, volume in kB, number of events or monetary amount depending on the given *Unit-Type*.

If the *Unit-Type* AVP is set to "time" in the *Accounting-Answer* command, the *Unit Value* AVP specifies the granted time in seconds (measured from the moment when the services becomes active or from the previous Answer command) until a new *Accounting-Request* MUST be sent.

If the *Unit Type* AVP is set to "time" in the *Accounting-Request* command, the *Unit-Value* AVP specifies the used time since previous report or time requested by the service element (e.g. AS/MRFC).

If the *Unit-Type* AVP is set to "volume" in the *Accounting-Answer* command, the *Unit-Value* AVP specifies the granted volume in kB (measured from the moment when the services becomes active or from the previous Answer command) until a new *Accounting-Request* MUST be sent. If the *Unit-type* AVP is set to "volume" in the *Accounting-Request* command, the *Unit-Value* AVP specifies the used volume since previous report or volume requested by service element (e.g. AS/MRFC).

If the *Unit-Type* AVP is set to "event" in the *Accounting-Answer* command, the *Unit-Value* AVP specifies the granted number of events (measured from the moment when the service becomes active or from the previous Answer command) until a new *Accounting-Request* MUST be sent. If the *Unit-type* AVP is set to "event" in the *Accounting-Request* command, the *Unit-Value* AVP specifies the used number of events since previous report or number of events requested by the service element (e.g. AS/MRFC).

If the *Unit-Type* AVP is set to "money" in the *Accounting-Answer* command, the *Unit-Value* AVP specifies the granted monetary amount, which the end user can use until a new *Accounting-Request* MUST be sent. If the *Unit-Type* AVP is set to "money" in the *Accounting-Request* command, the *Unit-Value* AVP specifies the used monetary amount since previous report or the monetary amount requested by the service element (e.g. AS/MRFC).

If the *Accounting-Answer* command contains a *Tariff-Switch-Definition* AVP and a *Unit-Value-After-Tariff-Switch* AVP, the *Unit-Value* AVP in the *Accounting-Answer* contains the amount of units granted before the tariff change. In this case, the following holds:

- If the *Unit-Type* AVP is set to "time" in the *Accounting-Answer* command, the *Unit Value* AVP specifies the granted time before the tariff switch in seconds (measured from the moment when the services becomes active or from the previous Answer command) until the tariff switch occurs or a new *Accounting-Request* MUST be sent.

- If the *Unit-Type* AVP is set to "volume" in the *Accounting-Answer* command, the *Unit-Value* AVP specifies the granted volume before the tariff switch in kB (measured from the moment when the services becomes active or from the previous Answer command) until the tariff switch occurs or a new *Accounting-Request* MUST be sent.

- If the *Unit-Type* AVP is set to "event" in the *Accounting-Answer* command, the *Unit-Value* AVP specifies the granted number of events before the tariff switch (measured from the moment when the service becomes active or from the previous Answer command) until the tariff switch occurs or a new *Accounting-Request* MUST be sent.

- If the *Unit-Type* AVP is set to "money" in the *Accounting-Answer* command, the *Unit-Value* AVP specifies the granted monetary amount before the tariff switch, which the end user can use until the tariff switch occurs or a new *Accounting-Request* MUST be sent.

If the *Accounting-Answer* command contains a *Tariff-Switch-Definition* AVP but no *Unit-Value-After-Tariff-Switch* AVP, the *Unit-Value* AVP in the Accounting-Answer contains the total amount of units granted irrespective of the tariff change.

If the *Accounting-Answer* command contains a *Tariff-Switch-Definition* AVP and a tariff switch occurred, the next *Accounting-Request* contains the *Unit-Value* AVP and the *Unit-Value-After-Tariff-Switch* AVP. The *Unit-Value* AVP contains the service units used before the tariff switch.

7.3.40 Unit-Value-After-Tariff-Switch AVP

The *Unit-Value-After-Tariff-Switch* AVP is of type Float64 (AVP Code TBD) and contains the granted or used Unit-Value after a tariff switch. The value can be time in seconds, volume in kB, number of events or monetary amount depending on the given *Unit-Type*.

The *Unit-Value-After-Tariff-Switch* AVP can only occur in combination with a *Tariff-Switch-Definition* AVP.

If the *Unit-Type* AVP is set to "time" in the *Accounting-Answer* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the granted time in seconds (measured from the moment when the tariff change occurs) until a new *Accounting-Request* MUST be sent.

If the *Unit Type* AVP is set to "time" in the *Accounting-Request* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the used time after tariff switch.

If the *Unit-Type* AVP is set to "volume" in the *Accounting-Answer* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the granted volume in kB (measured from the moment when the tariff change occurs) until a new *Accounting-Request* MUST be sent. If the *Unit-type* AVP is set to "volume" in the *Accounting-Request* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the used volume after tariff switch.

If the *Unit-Type* AVP is set to "event" in the *Accounting-Answer* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the granted number of events (measured from the moment when the tariff change occurs) until a new *Accounting-Request* MUST be sent. If the *Unit-type* AVP is set to "event" in the *Accounting-Request* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the used number of events after tariff switch.

If the *Unit-Type* AVP is set to "money" in the *Accounting-Answer* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the granted monetary amount, which the end user can use (measured from the moment when the tariff change occurs) until a new *Accounting-Request* MUST be sent. If the *Unit-Type* AVP is set to "money" in the *Accounting-Request* command, the *Unit-Value-After-Tariff-Switch* AVP specifies the used monetary amount after tariff switch.

7.2.41 Used-Service-Unit AVP

The *Used-Service-Unit* AVP is of type Grouped AVP (AVP Code TBD) and contains the amount of used units since the previous *Accounting-Answer* command. The included *Unit-Type* AVP defines the type of the unit and the *Unit-Value* AVP contains the used amount. If the unit type is "money", a *Currency-Code* AVP SHOULD be included.

If the previous ACA contained a *Tariff-Switch-Definition* AVP, *the Unit-Value-After-Tariff-Switch* AVP must be included in the *Used-Service-Unit* AVP in the ACR, if the tariff switch was encountered. In this case the *Unit-Value* AVP contains the units used before the tariff switch and the *Unit-Value-After-Tariff-Switch* AVP gives the units used after the tariff switch.

It has the following ABNF grammar:

<Used-Service-Unit>::=< AVP Header: TBD >

{ Unit-Type }

{ Unit-Value }

{ Unit-Value-After-Tariff-Switch }

[Currency-Code]

7.2.42 User-Session-ID AVP

The *User-Session-Id* AVP (AVP code TBD) is of type UTF8String and holds the session identifier. For a SIP session the *Session-ID* contains the SIP Call ID, as defined in [16].

7.2.43 UUS-Data AVP

The *UUS-Data* AVP (AVP Code TBD) is of type Grouped AVP and holds information about the sent User-To-User data.

It has the following ABNF grammar:

<Used-Service-Unit>::=< AVP Header: TBD >

[Amount-of-UUS-Data]

[Mime-Type]

[Direction]

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
Mar 2002	S_15	SP-020033	--	--	Submitted to TSG SA #15 for Information	1.0.0	
Jun 2002	S_16	SP-020327	--	--	Submitted to TSG SA #16 for the 2nd time for Information	1.5.0	
Sep 2002	S_17	SP-020453	--	--	Submitted to TSG SA #17 for Approval	2.0.0	5.0.0
Dec 2002	S_18	SP-020739	001	--	Remove ambiguity of the CCF Session State	5.0.0	5.1.0
Dec 2002	S_18	SP-020739	002	--	Addition of Application Server (AS) acting as a Voice Mail Server	5.0.0	5.1.0
Dec 2002	S_18	SP-020739	003	--	Corrections of definitions and ambiguity	5.0.0	5.1.0

History

Document history		
V5.0.0	September 2002	Publication
V5.1.0	December 2002	Publication