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All-IP Core Network Multimedia Domain

IP Multimedia Subsystem - Accounting Information Flows and Protocol

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IP Multimedia Subsystem - Accounting Information Flows and Protocol

Contents

Foreword

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Revision History

REVISION HISTORY		
Revision	***Content changes.***	***Date***
0, v1.0	Initial Publication	December 2003
1, v2.0	Version 2.0	July 2005

1 Scope

The present document covers 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 [2].

The IMS charging architecture details, requirements, definitions and principles are listed in [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 3GPP2 document a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] Void

[2] 3GPP2 X.S0013-007-0: “IP Multimedia Subsystem, Charging Architecture”

[3] IETF RFC 3588: "Diameter Base Protocol"

[4] 3GPP2 S.R0086-0: “3GPP2 IMS Security Framework”

[5] 3GPP2 X.S0013-003-0: "IP Multimedia (IM) session handling; IM call model; Stage 2"

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

[7] 3GPP2 X.S0011-C: “cdma2000 Wireless IP Network Standard”

[8] Void

[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)"~~Void

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

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

[12] Void

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[13] Void

[14] 3GPP2 X.S0013-004-0: "IP Multimedia Call Control Protocol based on SIP and SDP; Stage 3"

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

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

[17] IETF RFC 2327: "SDP: Session Description Protocol"

[17a] IETF RFC 3266: "Support for IPv6 in Session Description Protocol"

[18] 3GPP2 X.S0013-002-0: "IP Multimedia Subsystem (IMS); Stage 2"

[19] 3GPP2 X.S0013-006-0: "Cx Interface based on the Diameter protocol; Protocol Details"

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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

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

3.2 Symbols

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

~~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 AAA
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 [2] and the following apply:

AAA	Authentication, Authorization, and Accounting
ABNF	Augmented Backus-Naur Form
ACA	Accounting-Answer
ACR	Accounting-Request
AIR	Accounting Information Record
ANM	Answer Message
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
CSCF	Call Session Control Function (I-Interrogating; P-Proxy; and S-Serving)

ECF	Event Charging Function
ECUR	Event Charging with Unit Reservation
IAM	Initial Address Message
ICN-BCP	IP Connectivity Network – Bearer Control Point
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
REL	Release Message
SCCF	Subscriber Content Charging Function
SDP	Session Description Protocol
SIP	Session Initiation Protocol
UE	User Equipment
UUS-Data	User to User Data

4 Offline and Online Charging

4.1 Implementation of Offline and Online Charging

The IMS charging architecture, described in [2], specifies that for offline charging all communications between the IMS network entities and the AAA 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 AAA or on the Ro interface to the ECF (or to use both). The decision of which interface to use is based on the information (AAA 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 AAA 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 AAA 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 AAA address. The AAA 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 AAA address as received via SIP signaling or the locally configured AAA 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.

4.2 Diameter Protocol Basic Principles and Use

The present document defines an 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 Authentication, Authorization, and Accounting Entity (AAA). The AAA uses this information to construct and format AIRs.
- For online charging, the AS and MRFC in the IMS network report credit control 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.~~

A configurable timer is supported in the AAA to supervise the reception of the ACR [Interim] and/or ACR [Stop]. An instance of the 'Timer' is started at the beginning of the accounting session, reset on the receipt of an ACR [Interim] and stopped at the reception of the ACR [Stop]. Upon expiration of the timer, the AAA stops the accounting session with the appropriate error indication. For Offline Charging, the client implements the state machine described in [3]. The server (AAA) 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

Specific support for online charging is not provided in this version of this specification.

4.2.2.3 Security Considerations

Diameter security is addressed in the base protocol [3]. Network security is specified in [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 AAA.

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 or SIP UPDATE [e.g. change in media components]	Configurable
	Expiration of AVP [Acct-Interim-Interval]	Configurable
ACR [Stop]	SIP BYE message (both normal and abnormal session termination cases)	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.

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 AAA during session establishment originated by a UE.

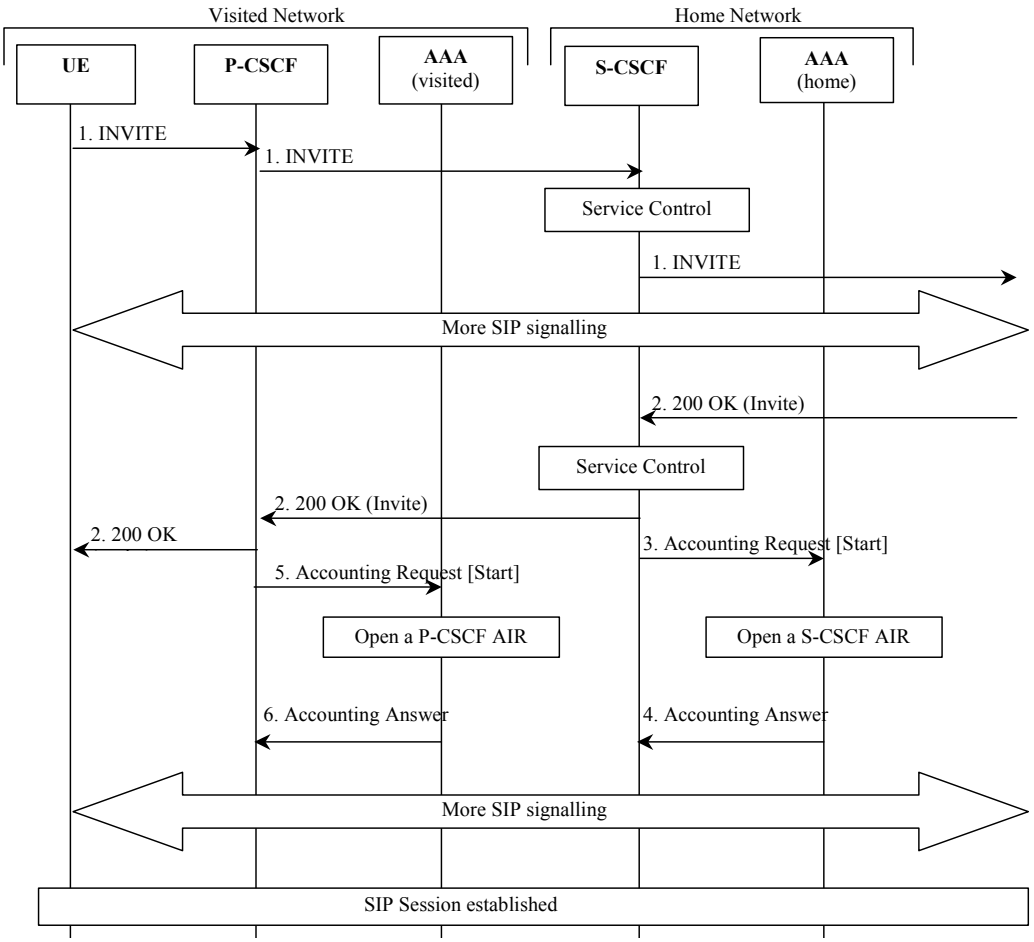

Figure 5.1: Message Sequence Chart for Session Establishment (Mobile Origination)

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 AIR.
4. The AAA opens a S-CSCF AIR and acknowledges the reception of the data .
5. Same as 3, but for P-CSCF.
6. Same as 4, but creating a P-CSCF AIR.

5.1.2.1.1.2 Session Establishment - Mobile Termination

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

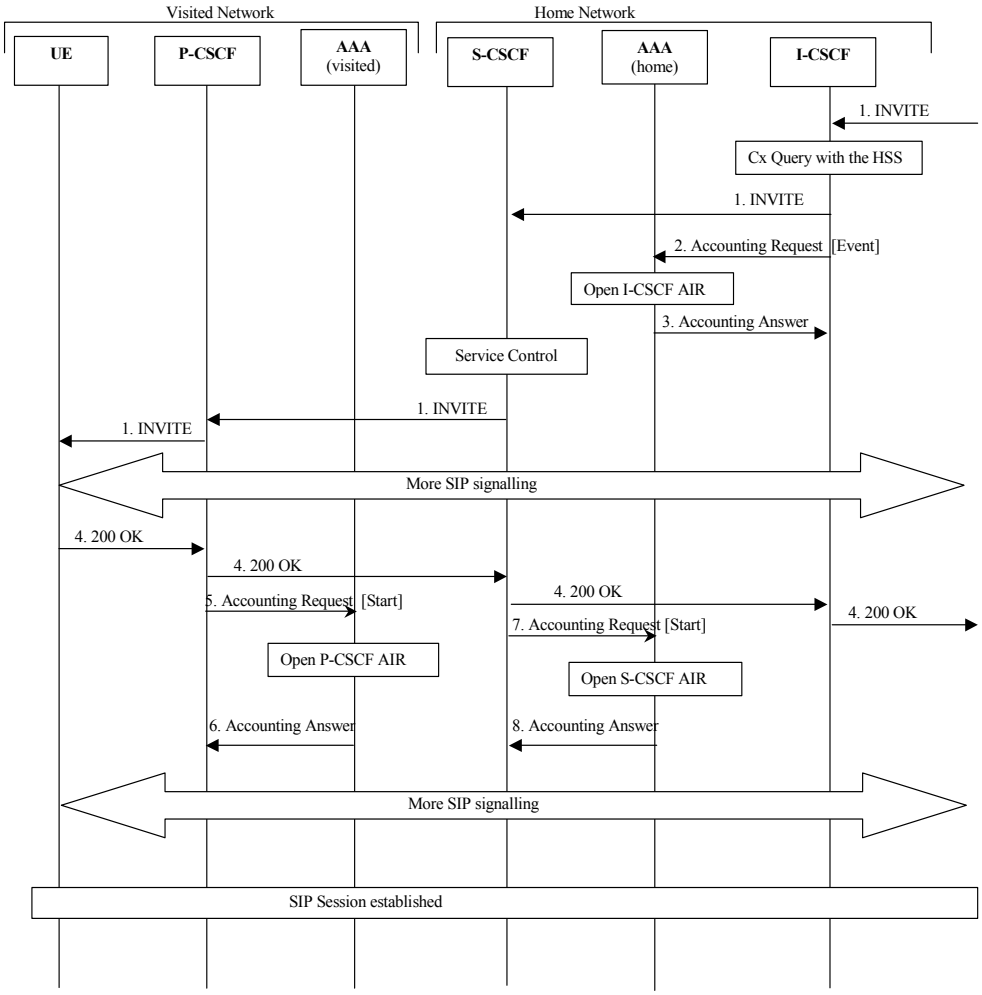

Figure 5.2: Message Sequence Chart for Session Establishment (Mobile Termination)

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 AAA opens an I-CSCF AIR and acknowledges the data received .
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 AAA when a UE generates a SIP (Re-)INVITE or SIP UPDATE in mid-session, e.g. in order to modify media component(s), or when the hold and resume procedure is executed.

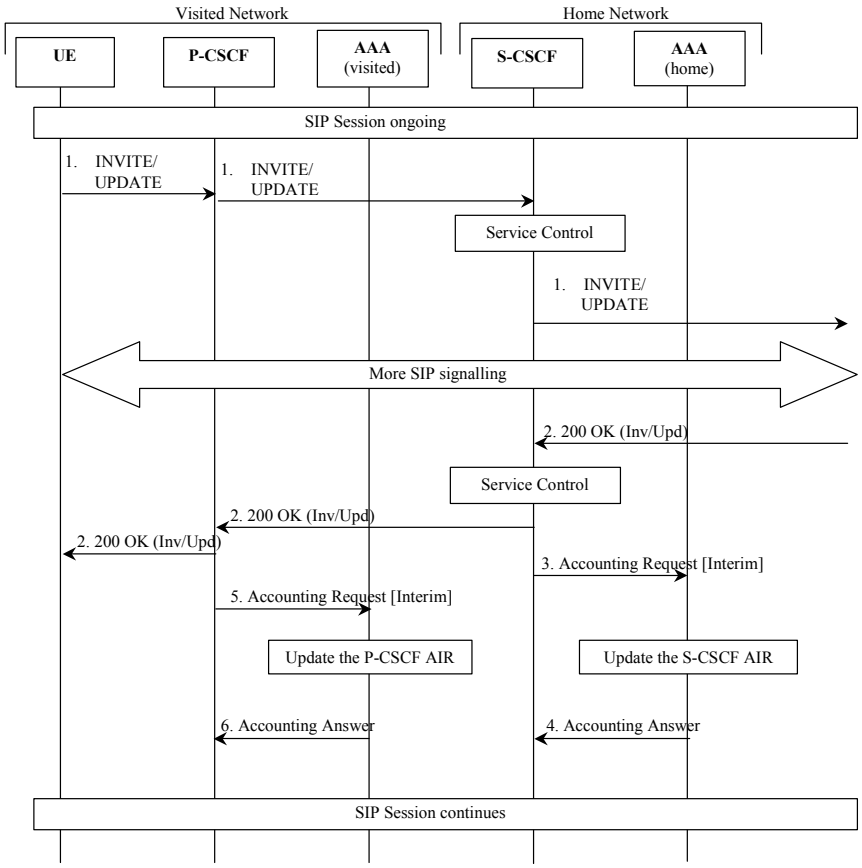

Figure 5.3: Message Sequence Chart for Media Modification

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 AIR.
4. The AAA updates the S-CSCF AIR and acknowledges the reception of the data.
5. Same as 3, but for P-CSCF.
6. Same as 4, updating the P-CSCF AIR.

5.1.2.1.1.4 Session Release - Mobile Initiated

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

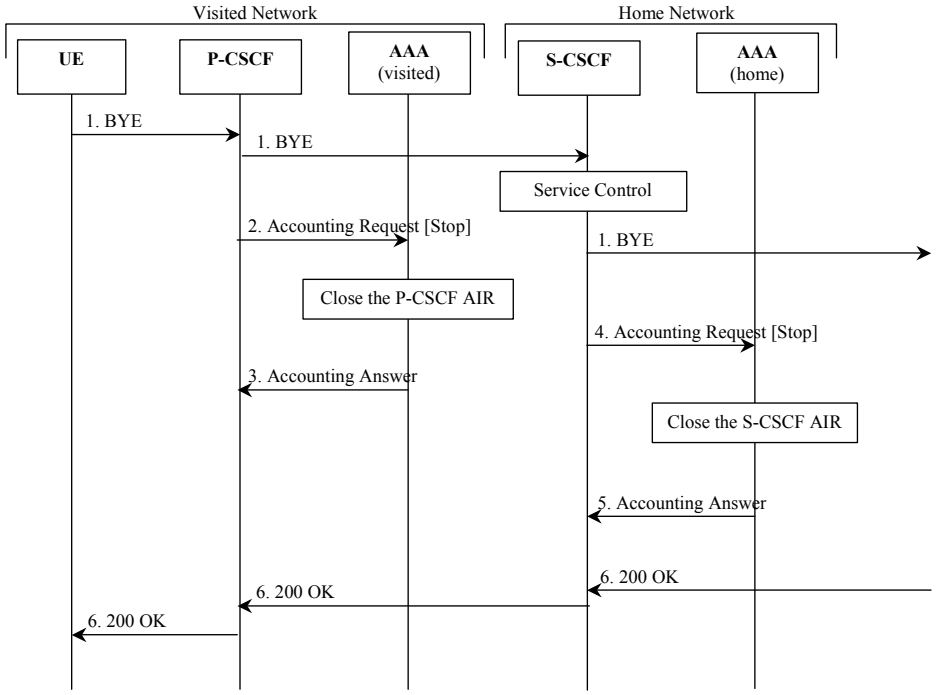

Figure 5.4: Message Sequence Chart for Session Release

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 AIR.
3. The AAA closes the P-CSCF AIR and acknowledges the reception of the data.
4. Same as 2, but for S-CSCF.
5. Same as 3, closing the S-CSCF AIR.
6. The release is acknowledged.

5.1.2.1.1.5 Session Release - Network Initiated

In the case of network initiated session release the IMS node sends a SIP BYE message which is replied to by the UE with a SIP 200 OK message. The charging message flow for this case is identical to the mobile initiated session release described in subclause 5.1.2.1.1.4.

5.1.2.1.1.6 Session Release - AAA initiated and performed by S-CSCF

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 AAA and external functions that convey that request to the AAA is not in the scope of the present document.

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

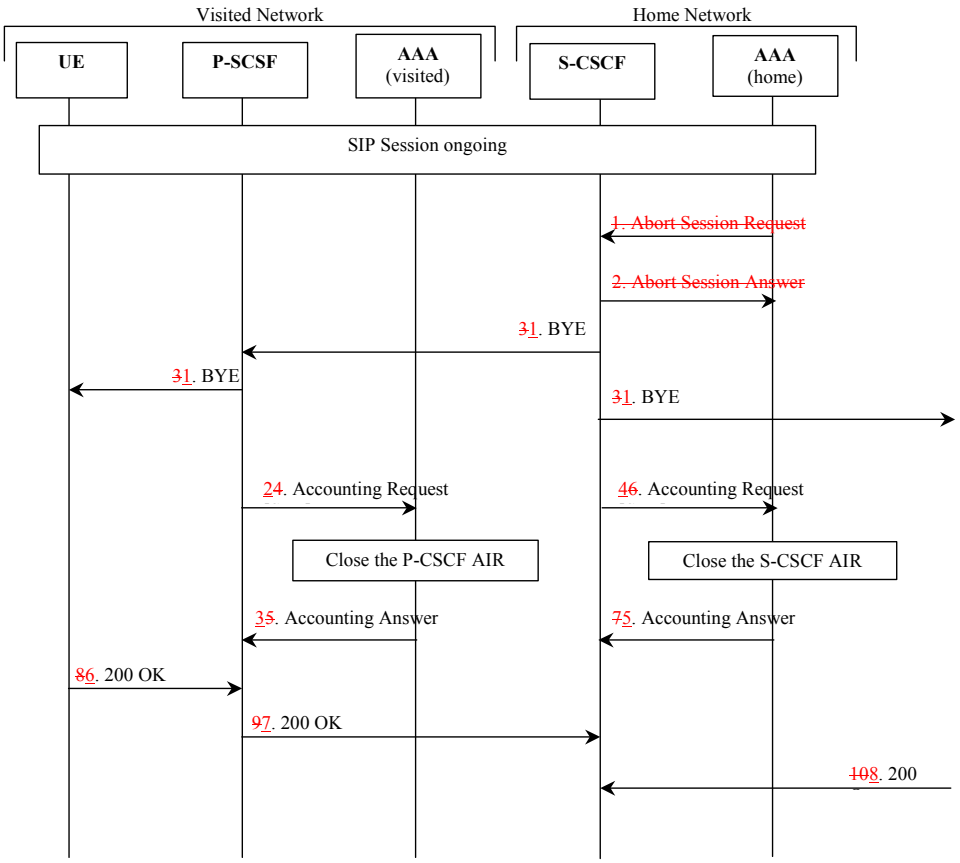

Figure 5.5: Message Sequence Chart for AAA Initiated Session Release done by S-CSCF

1. The AAA 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 AAA. Upon receiving the *Abort-Session-Answer*, the AAA closes the AIR. The record closure time in the AIR is the time when the *Abort-Session-Answer* message has been received.
31. The S-CSCF initiates the SIP session release by sending SIP BYE request to both the originating and the terminating parties, as specified in [5].
42. 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 AIR.
53. The AAA closes the P-CSCF AIR and acknowledges the reception of the data.
64. Same as 4, but for S-CSCF.
75. Same as 5, but for S-CSCF AIR.
86-810. The S-CSCF receives the 200 OK responses from originating and terminating parties.

~~The S-CSCF should not be restricted to receiving *Abort-Session-Requests* only from a AAA, 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 AAA for session-unrelated IMS procedures, i.e. those that relate to the Diameter ACR [Event], as listed in table 5.1.

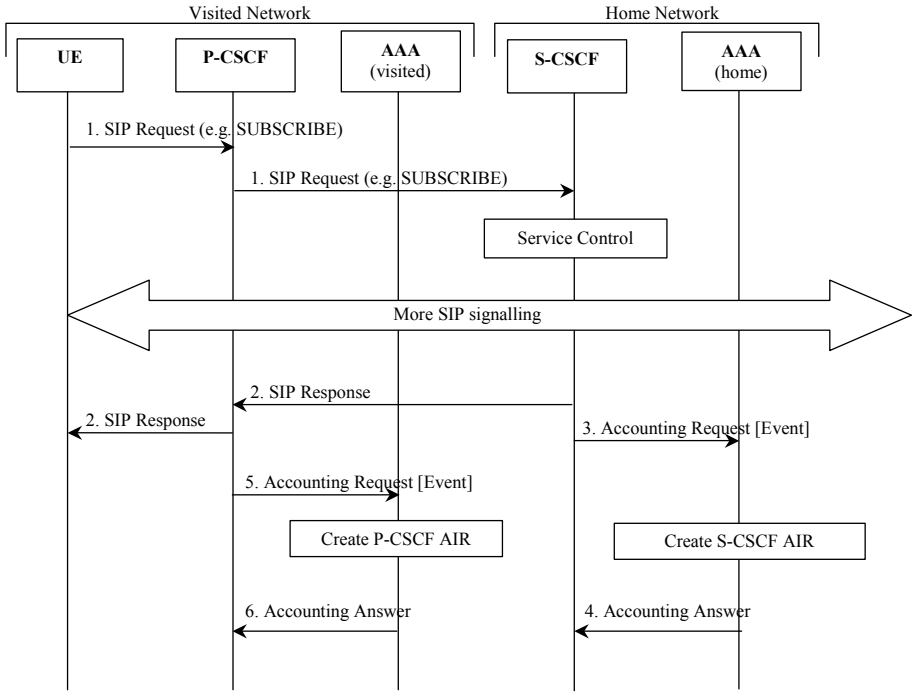

Figure 5.6: Message Sequence Chart for Session-Unrelated Procedure

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 AIR.
4. The AAA produces an S-CSCF AIR and acknowledges the reception of the data.
5. Same as 3, but for P-CSCF.
6. Same as 4, creating a P-CSCF AIR.

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 AAA during session establishment initiated from the PSTN side.

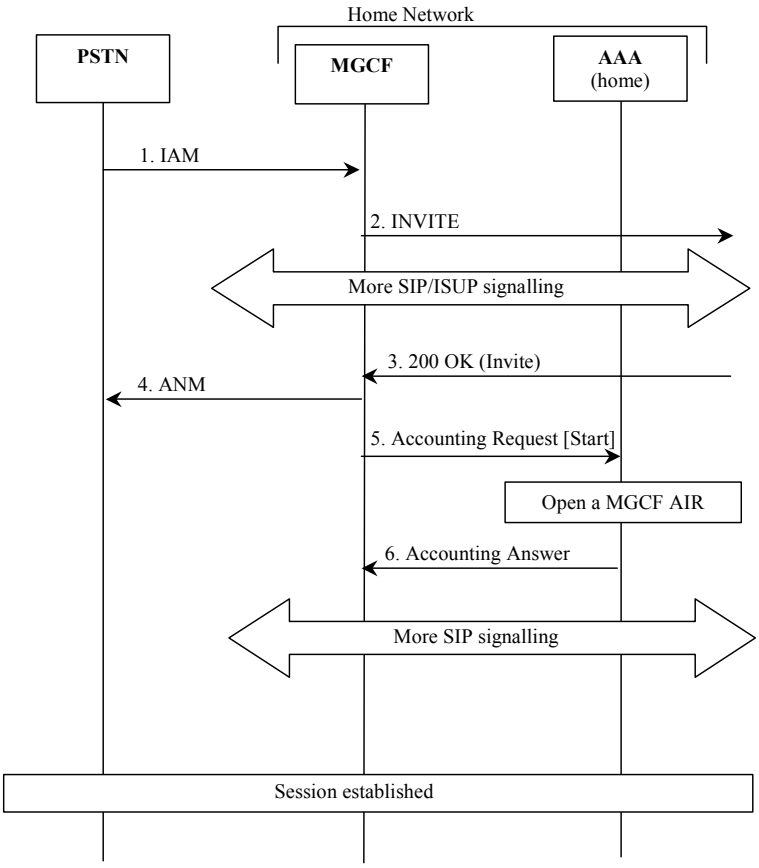

Figure 5.7: Message Sequence Chart for Session Establishment (PSTN Initiated)

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 AIR.
6. The AAA opens a MGCF AIR and acknowledges the reception of the data.

5.1.2.1.3.2 Session Establishment - IMS Initiated

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

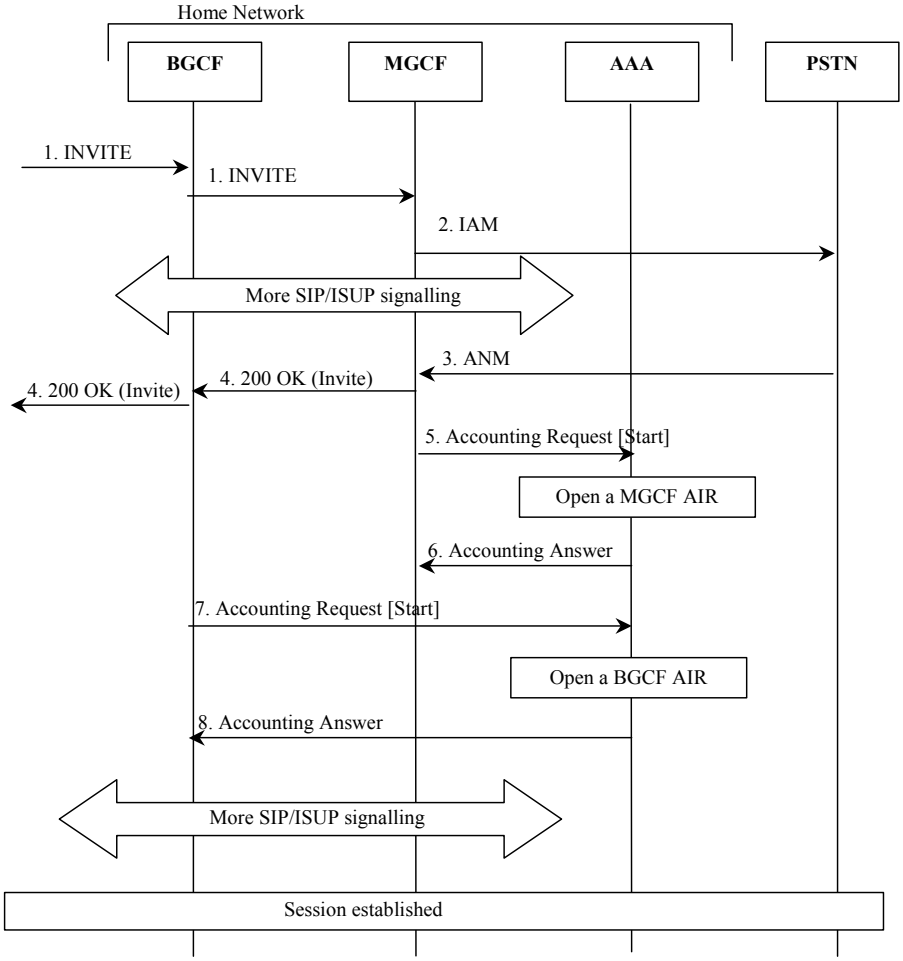

Figure 5.8: Message Sequence Chart for Session Establishment (IMS Initiated)

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 AIR.
6. The AAA opens a MGCF AIR and acknowledges the reception of the data.
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 AIR.
8. The AAA opens a BGCF AIR and acknowledges the reception of the data.

5.1.2.1.3.3 Session Release - PSTN Initiated

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

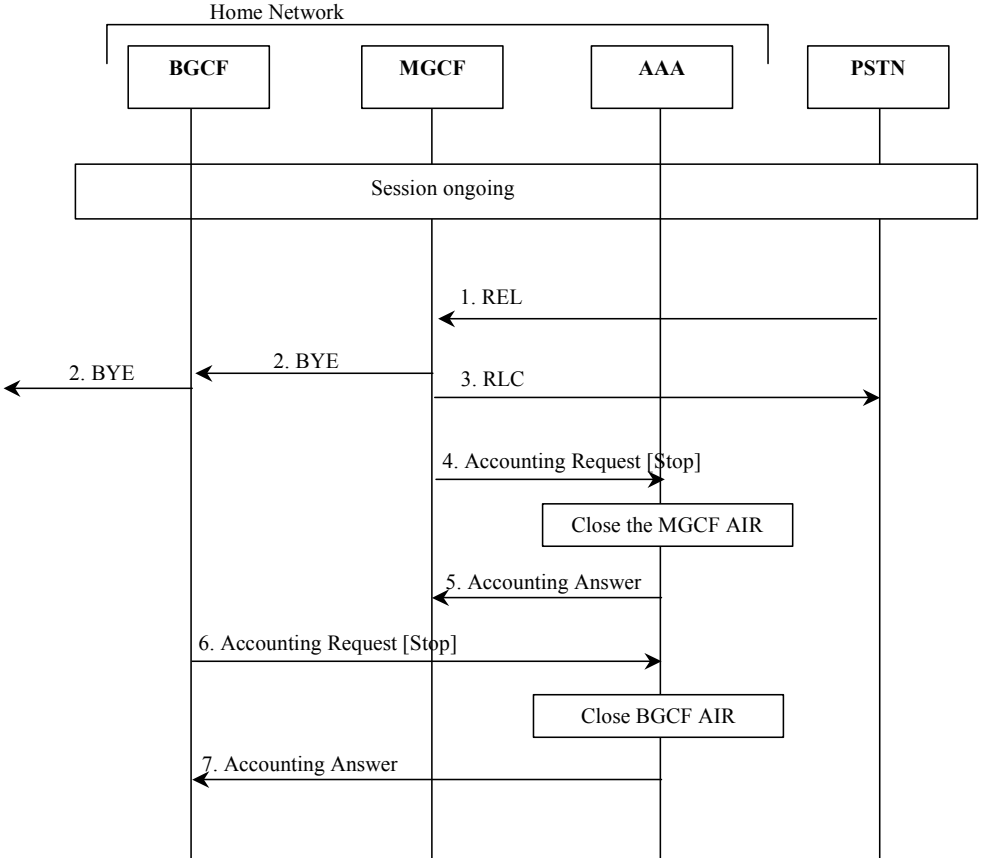

Figure 5.9: Message Sequence Chart for Session Release (PSTN initiated)

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 AIR.
5. The AAA closes the MGCF AIR and acknowledges the reception of the data.
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 AAA during an IMS initiated session release.

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

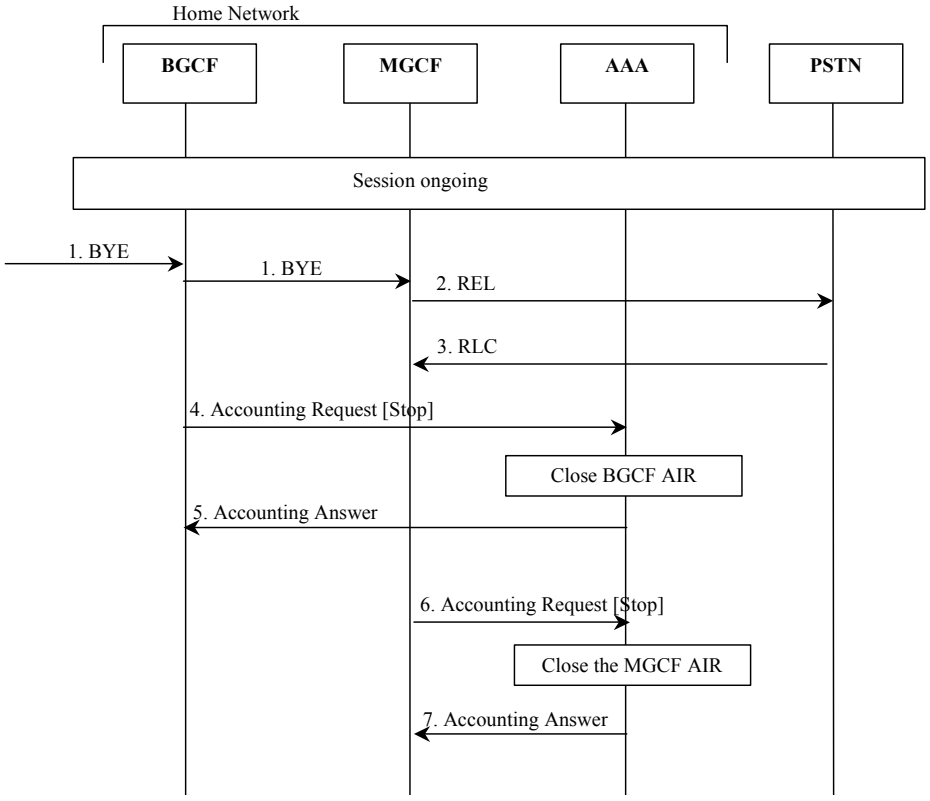

Figure 5.10: Message Sequence Chart for Session Release (IMS initiated)

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 AIR.
5. The AAA closes the BGCF AIR and acknowledges the reception of the data.
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.

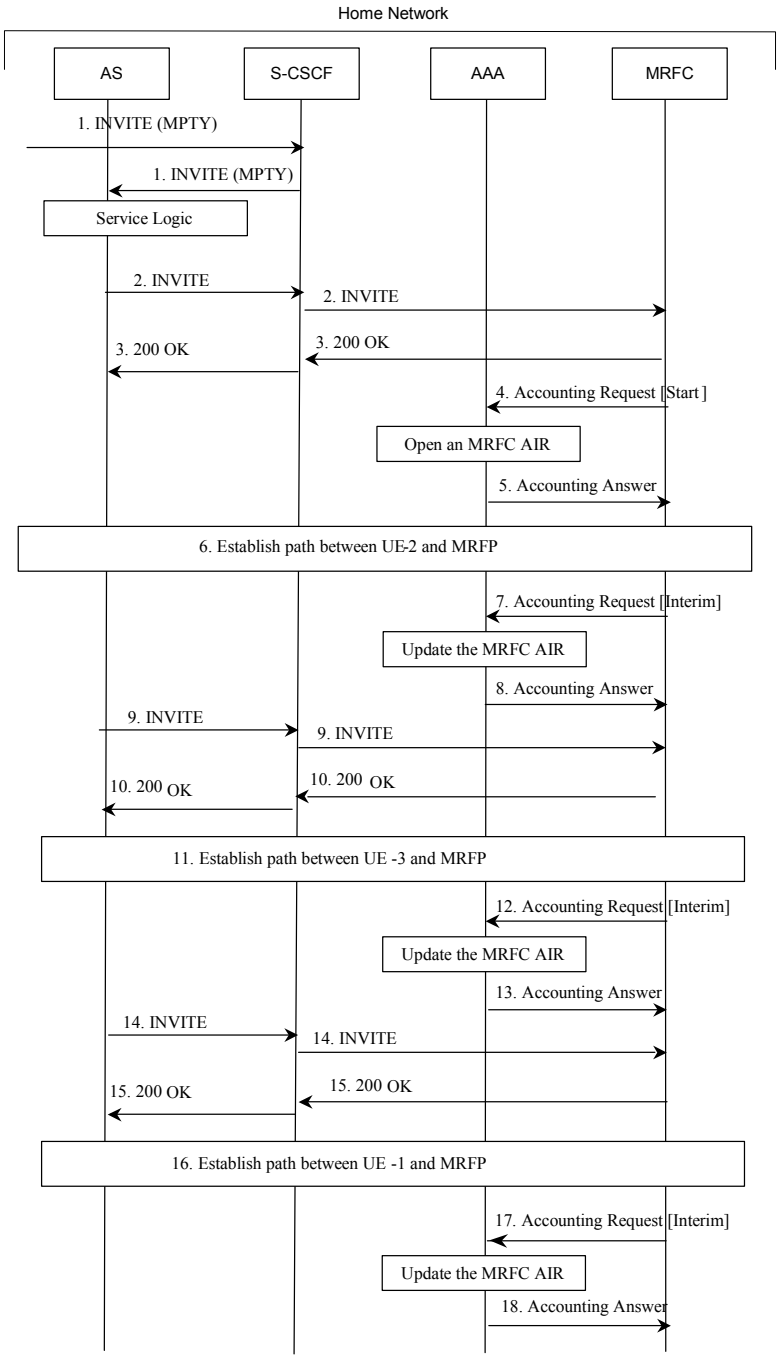

Figure 5.11: Message Sequence Chart for Multi-Party Call Establishment in MRFC

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 AIR
5. The AAA opens the MRFC AIR and acknowledges the reception of the data.
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 AAA updates the MRFC AIR and acknowledges the reception of the data.
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 AAA updates the MRFC AIR and acknowledges the reception of the data.
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 AAA updates the MRFC AIR and acknowledges the reception of the data.

5.1.2.1.5 AS Related Procedures

Application servers may support a multitude of services which are not specified in 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.

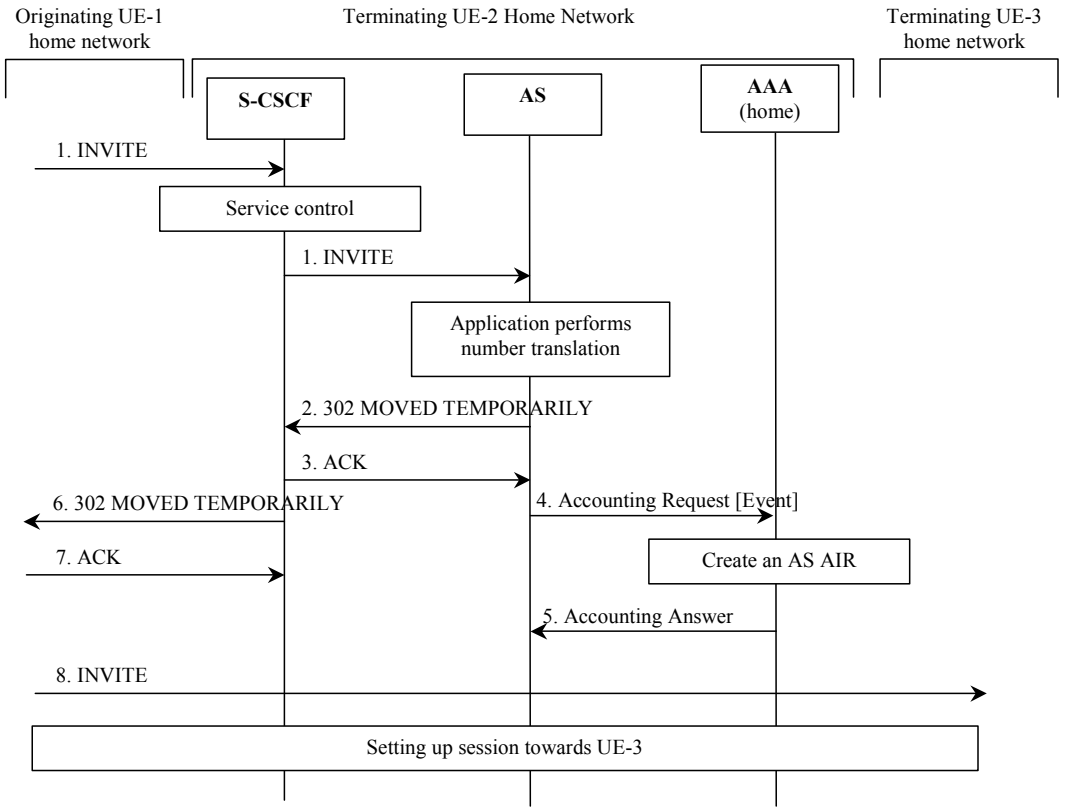

Figure 5.12: Message Sequence Chart for AS Acting as a Redirect Server

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 AIR.
5. The AAA creates the AS AIR and acknowledges the reception of the data.
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.

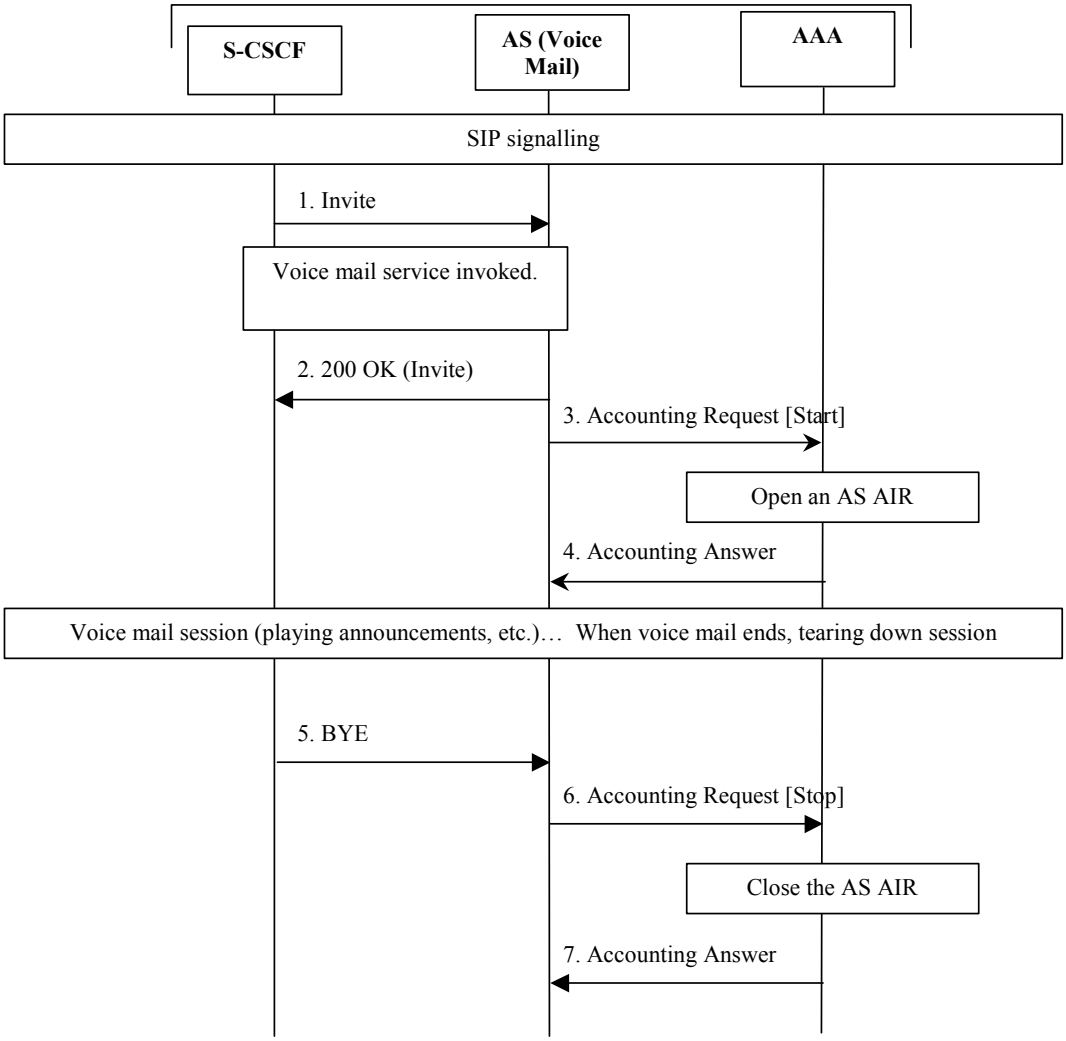

Figure 5.13: Message Sequence Chart for AS Acting as a Mail Server

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 AAA opens an AS AIR and acknowledges the reception of the *Accounting-Request* with *Accounting-Record-Type* indicating START_RECORD.
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 AIR.
7. The AAA closes the AS AIR and acknowledges the reception of the data.

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

For error terminations, a SIP session is closed by the reception of a BYE message indicating the reason for such termination.

In this case, an ACR [Stop] message that includes an appropriate error indication is sent from the IMS nodes to AAA.

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 AAA. 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 200 OK, or a SIP error message. If the latter occurs, i.e. there is a failure in the procedure, the ACR [Event] sent towards the AAA includes an appropriate error indication.

5.1.2.2.3 Error Cases - Diameter procedures

5.1.2.2.3.1 AAA Connection Failure

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

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

5.1.2.2.3.2 No Reply from AAA

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 AAA connection failure procedure as specified above.

If retransmitted ACRs are sent, they are marked with the T-flag as described in [3], in order to allow duplicate detection in the AAA, 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 T-flag as described in [3].

If the AAA 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's the information in the marked message that is taken into account when generating the AIR. The AIRs are marked if information from duplicated message(s) is used.

5.1.2.2.3.4 AAA Detected Failure

The AAA closes a AIR 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 AAA 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 AAA. For this purpose, the IMS Charging application employs the *Accounting-Request* and *Accounting-Answer* messages from the base Diameter protocol.

~~The AAA 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	AAA	ACR
Accounting-Answer	AAA	S-CSCF, I-CSCF, P-CSCF, MRFC, MGCF, BGCF, AS	ACA
~~Abort-Session-Request~~	~~AAA~~	~~S-CSCF~~	~~ASR~~
~~Abort-Session-Answer~~	~~S-CSCF~~	~~AAA~~	~~ASA~~

~~The S-CSCF should not be restricted to receiving *Abort-Session-Requests* only from a AAA, 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 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 AAA to construct AIRs.

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
Vendor Specific 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-Information]	Only for S-CSCF/MRFC
~~*[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
[ICN-BCP-Address]	Yes
[Served-Party-IP-Address]	Only for P-CSCF and 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
[Cause]	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 AAA 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]		-	-	-	-	-	-	-
Vendor Specific 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-Information] (see note 1)		SISE	-	-	SIS-	-	-	-
~~*[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
[ICN-BCP-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
[Cause]		--SE	--SE	E	--S	--SE	--SE	--SE

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~~2: Present only if user-to-user data is included in the SIP message that triggered the ACR.

5.2 Accounting Information Record Description

5.2.1 Void

5.2.2 AIR Triggers

5.2.2.1 Session Related AIRs

Reflecting the usage of multimedia sessions IMS AIRs are generated by the AAA 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 AIRs 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 AAA using Diameter ACR Start, Interim and Stop messages. A session AIR is opened in the AAA upon reception of a Diameter ACR [Start] message. Session AIRs are updated, or partial AIRs generated, upon reception of a Diameter ACR [Interim] message. The AAA closes the final session AIR 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 AIRs are specified in [2].

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

5.2.2.2 Session-unrelated AIRs

To reflect chargeable events not directly related to a session the AAA may generate AIRs 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 AAA using Diameter ACR [Event] messages. Session-unrelated AIRs are created in the AAA in a "one-off" action based on the information contained in the Diameter ACR [Event] message. One session-unrelated AIR is created in the AAA for each Diameter ACR [Event] message received, whereas the creation of partial AIRs is not applicable for session-unrelated AIRs. 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 AIRs are specified in [2].

6 Online Charging

Specific support for online charging is not provided in this version of this specification.

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

7.1.1 Acct-Application-Id AVP

The *Acct-Application-Id* AVP (AVP code 259), as part of the *Vendor-Specific-Application-Id* grouped AVP, shall contain the value of 1 ie. the same application id as used by the Cx interface protocol as defined in [19].

7.1.2~~1~~ Void

7.1.3~~2~~ User-Name AVP

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

7.1.4~~3~~ Vendor-Specific-Application-Id AVP

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

7.2 Additional AVPs

For the purpose of IMS charging additional AVPs are used in ACR and ACA for offline charging. The use of these AVPs are described in subclause 5.1.3. 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 is provided in table 7.2 and the detailed description is not repeated.

Table 7.2: Use Of accounting AVPs for IMS

AVP Name	AVP Code	Clause Defined	Value Type	AVP Flag rules				
				Must	May	Should not	Must not	May Encr.
Vendor Specific Diameter Accounting AVPs								
[Event-Type]	~~223~~823	7.2.16	Grouped	M, V				No
[SIP-Method]	~~224~~824	7.2.34	UTF8String	M, V				No
[Event]	~~225~~825	7.2.15	UTF8String	M, V				No
[Content-Type]	~~226~~826	7.2.12	UTF8String	M, V				No
[Content-Length]	~~227~~827	7.2.11	UTF8String	M, V				No
[Content-Disposition]	~~228~~828	7.2.10	UTF8String	M, V				No
[Role-of-Node]	~~229~~829	7.2.27	Enumerated	M, V				No
[User Session Id]	~~230~~830	7.2.45	UTF8String	M, V				No
[Calling-Party-Address]	~~231~~831	7.2.7	UTF8String	M, V				No
[Called-Party-Address]	~~232~~832	7.2.6	UTF8String	M, V				No
[Time-stamps]	~~233~~833	7.2.39	Grouped	M, V				No
[SIP-Request-Timestamp]	~~234~~834	7.2.35	UTF8String	M, V				No
[SIP-Response-Timestamp]	~~235~~835	7.2.36	UTF8String	M, V				No
*[Application-server-Information]	863	7.2.2a	Grouped	M,V				
[Application-server]	~~236~~836	7.2.3	UTF8String	M, V				No
[Application-provided-called-party-address]	~~237~~837	7.2.2	UTF8String	M, V				No
*[Inter-Operator-Identifier]	~~238~~838	7.2.22	Grouped	M, V				No
[Originating-IOI]	~~239~~839	7.2.25	UTF8String	M, V				No
[Terminating-IOI]	~~240~~840	7.2.38	UTF8String	M, V				No
[IMS-Charging-Identifier]	~~241~~841	7.2.20	UTF8String	M, V				No
*[SDP-Session-Description]	~~242~~842	7.2.31	UTF8String	M, V				No
*[SDP-Media-component]	~~243~~843	7.2.28	Grouped	M, V				No
[SDP-Media-Name]	~~244~~844	7.2.30	UTF8String	M, V				No
*[SDP-Media-Description]	~~245~~845	7.2.29	UTF8String	M, V				No
[ITS-Charging-Id]	~~246~~846	7.2.18	UTF8String	M, V				No
[ICN-BCP-Address]	~~247~~847	7.2.17	IPAddress	M, V				No
[Served-Party-IP-Address]	~~248~~848	7.2.32	IPAddress	M, V				No
[Authorized-QoS]	~~249~~849	7.2.4	UTF8String	M, V				No
[Server-Capabilities]	~~250~~850	[19]		M, V				No
[Trunk-Group-Id]	~~251~~851	7.2.40	Grouped	M, V				No
[Incoming-Trunk-Group-Id]	~~252~~852	7.2.21	UTF8String	M, V				No
[Outgoing-Trunk-Group-Id]	~~253~~853	7.2.26	UTF8String	M, V				No
[Bearer-Service]	~~254~~854	7.2.5	OctetString	M, V				No
[Service-Id]	~~255~~855	7.2. 33	UTF8String	M, V				No
[UUS-Data]	~~256~~856	7.2.46	Grouped	M, V				No
[Amount-of-UUS-data]	~~257~~857	7.2.1	UTF8String	M, V				No
[Mime-type]	~~258~~858	7.2.23	UTF8String	M, V				No
[Direction]	~~259~~859	7.2.14	Enumerated	M, V				No
[Cause]	~~260~~860	7.2.8	Grouped	M, V				No
{Cause-Code}	~~261~~861	7.2.9	Enumerated	M, V				No
{Node-Functionality}	~~262~~862	7.2.24	Enumerated	M, V				No

7.2.1 Amount-of-UUS-Data AVP

The *Amount-Of-UUS-Data* AVP (AVP code ~~257~~857) 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 ~~237~~837) is of type UTF8String and holds the called party number (SIP URL, E.164), if it is determined by an application server.

7.2.2a Application-Server-Information AVP

The *Application-Server-Information* AVP (AVP code 863) is of type Grouped and holds the Application-Server and multiple Application-Provided-Called-Party-Address.

It has the following ABNF grammar:

< Application-Server-Information >::=<AVP Header: 863 >

[Application-Server]

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

7.2.3 Application-Server AVP

The *Application-Server* AVP (AVP code ~~236~~836) 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 ~~249~~849) is of type UTF8String and holds the Authorised QoS as defined in [7] and applied via the Go interface.

7.2.5 Bearer-Service AVP

The *Bearer-Service* AVP (AVP code ~~254~~854) 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 ~~232~~832) is of type UTF8String and holds the address (Public User ID: SIP URL, E.164, etc.) of the party to whom a session is established.

7.2.7 Calling-Party-Address AVP

The *Calling-Party-Address* AVP (AVP code ~~231~~831) is of type UTF8String and holds the address (Public User ID: SIP URL, E.164, etc.) of the party initiating a session.

7.2.8 Cause AVP

The Cause AVP (AVP code ~~260~~860) is of type Grouped. The Cause AVP includes the *Cause-Code* AVP that contains the cause value and the *Node-Functionality* AVP that contains the function of the node where the cause code was generated.

Cause has the following ABNF grammar:

<Cause>::=<AVP Header: ~~260~~860>

{Cause-Code}

{Node-Functionality}

7.2.9 Cause-Code AVP

The *Cause-Code* AVP (AVP code ~~261~~861) is of type Enumerated and includes the cause code value from IMS node. It is used in *Accounting-Request*[stop] and/or *Accounting-Request*[event] messages.

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

Successful cause code values.

"Normal end of session" 0

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

"Successful transaction" -1

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

"End of SUBSCRIBE dialog" -2

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

"3xx Redirection" -3xx

The cause "3xx Redirection" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 3xx response [16].

Failure cause code values.

"Unspecified error" 1

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

" 4xx Request failure" 4xx

The cause "4xx Request failure" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 4xx error response [16].

"5xx Server failure" 5xx

The cause "5xx Server failure" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 5xx error response [16].

"6xx Global failure" 6xx

The cause "6xx Global failure" is used when the SIP transaction is terminated due to an IMS node receiving/initiating a 6xx error response [16].

"Unsuccessful session setup" 2

The cause "Unsuccessful session setup" is used in the *Accounting-Request*[stop] when the SIP session has not been successfully established (i.e. Timer H expires and SIP ACK is not received or SIP BYE is received after reception of the 200 OK final response and SIP ACK is not received) [14] [16].

"Internal error" 3

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

7.2.10 Content-Disposition AVP

The *Content-Disposition* AVP (AVP code ~~228~~828) is of type UTF8String and indicates how the message body or a message body part is to be interpreted (e.g. session, render), as described in [17] and [17a].

7.2.11 Content-Length AVP

The *Content-Length* AVP (AVP code ~~82~~27) is of type UTF8String and holds the size of the of the message-body, as described in [17] and [17a].

7.2.12 Content-Type AVP

The *Content-Type* AVP (AVP code ~~218~~826) is of type UTF8String and holds the media type (e.g. application/sdp, text/html) of the message-body, as described in [17] and [17a].

7.2.13 Void

7.2.14 Direction AVP

The *Direction* AVP (AVP code ~~259~~859) 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

7.2.15 Event AVP

The *Event* AVP (AVP code ~~225~~825) is of type UTF8String and holds the content of the "Event" header used in SUBSCRIBE and NOTIFY messages.

7.2.16 Event-Type AVP

The *Event-Type* AVP (AVP code ~~223~~823) is of type Grouped and contains information about the type of chargeable telecommunication service/event for which the accounting-request message is generated.

It has the following ABNF grammar:

<Event-Type>::=<AVP Header: ~~223~~ 823 >

[SIP-Method]

[Event]

[Content-Type]

[Content-Length]

[Content-Disposition]

7.2.17 ICN-BCP-Address AVP

The *ICN-BCP-Address* AVP (AVP code ~~247~~847) is of type IPAddress and holds the IP-address of the ICN-BCP that generated the ITS Charging ID, as described in [2].

7.2.18 ITS-Charging-ID AVP

The *ITS-Charging-ID* AVP (AVP code ~~246~~846) is of type UTF8String and holds a sequence number generated by the ICN-BCP at ITS Channel activation, as described in [2].

7.2.19 Void

7.2.20 IMS-Charging-Identifier AVP

The *IMS-Charging-Identifier* AVP (AVP code ~~241~~841) is of type UTF8String and holds the IMS Charging Identifier (ICID) as generated by a IMS node for a SIP session and described in ~~subclause 5.2.4.10~~[14].

7.2.21 Incoming-Trunk-Group-ID AVP

The *Incoming-Trunk-Group-ID* AVP (AVP code ~~252~~852) is of type UTF8String and identifies the incoming PSTN leg.

7.2.22 Inter-Operator-Identifier AVP

The *Inter-Operator-Identifier* AVP (AVP code ~~238~~838) 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: ~~238~~ 838 >

[Originating-IOI]

[Terminating-IOI]

7.2.23 Mime-Type AVP

The *Mime-Type* AVP (AVP code ~~258~~858) is of type UTF8String and holds the Mime type of the User-To-User data.

7.2.24 Node-Functionality AVP

The *Node-Functionality*AVP (AVP code ~~262~~862) is of type Enumerated and includes the *functionality* identifier of the *node* where the cause code was generated.

The functionality identifier can be one of the following:

S-CSCF 0

P-CSCF 1

I-CSCF 2

MRFC 3

MGCF 4

BGCF 5

AS 6

UE 7

7.2.25 Originating-IOI AVP

The *Originating-IOI* AVP (AVP code ~~239~~839) 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].

7.2.26 Outgoing-Trunk-Group-ID AVP

The *Outgoing-Trunk-Group-ID* AVP (AVP code ~~253~~853) is of type UTF8String and identifies the outgoing PSTN leg.

7.2.27 Role-of-Node AVP

The *Role-Of-Node* AVP (AVP code ~~229~~829) is of type Enumerated and specifies the role of the AS/CSCF.

The identifier can be one of the following:

ORIGINATING_ROLE 0

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

TERMINATING_ROLE 1

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

PROXY ROLE 2
The AS is applying a proxy role.

B2BUA_ROLE 3
The AS is applying a B2BUA role.

7.2.28 SDP-Media-Component AVP

The *SDP- Media-Component* AVP (AVP code ~~243~~843) is of type Grouped and contains information about media used for a IMS session.

It has the following ABNF grammar:

<SDP-Media-Component>::=<AVP Header: ~~243~~ 843 >

[SDP-Media-Name]

*[SDP-Media-Description]

[ITS-Charging-Id]

7.2.29 SDP-Media-Description AVP

The *SDP-Media-Description* AVP (AVP code ~~245~~845) 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] and [17a]. The attributes are specifying the media described in the *SDP-Media-Name* AVP.

7.2.30 SDP-Media-Name AVP

The *SDP-Media-Name* AVP (AVP code ~~244~~844) is of type UTF8String and holds the content of a "m=" line in the SDP data.

7.2.31 SDP-Session-Description AVP

The *SDP-Media-Description* AVP (AVP code ~~242~~842) is of type UTF8String and holds the content of an "attribute-line" (i=, c=, b=, k=, a=) related to a session, as described in [17] and [17a].

7.2.32 Served-Party-IP-Address AVP

The *Served-Party-IP-Address* AVP (AVP code ~~248~~848) is of type IPAddress and holds the IP address of either the calling or called party, depending on whether the P-CSCF is in touch with the calling or the called party. This AVP is only provided by the P-CSCF and S-CSCF.

7.2.33 Service-ID AVP

The *Service-ID* AVP (AVP code ~~255~~855) is of type UTF8String and identifies the service the MRFC is hosting. For conferences the conference ID is used as the value of this parameter.

7.2.34 SIP-Method AVP

The *SIP-Method* AVP (AVP code ~~224~~824) is of type UTF8String and holds the name of the SIP Method (INVITE, UPDATE etc.) causing an accounting request to be sent to the AAA.

7.2.35 SIP-Request-Timestamp AVP

The *SIP-Request-Timestamp* AVP (AVP code ~~234~~834) is of type UTF8String and holds the time in UTC format of the initial SIP request (e.g. Invite).

7.2.36 SIP-Response-Timestamp AVP

The *SIP-Response-Timestamp* AVP (AVP code ~~235~~835) is of type UTF8String and holds the time in UTC format of the response to the initial SIP request (e.g. 200 OK).

7.2.37 Void

7.2.38 Terminating-IOI AVP

The *Terminating-IOI* AVP (AVP code ~~240~~840) 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].

7.2.39 Time-Stamps AVP

The *Time-Stamps* AVP (AVP code ~~233~~833) is of type Grouped and holds the time of the initial SIP request and the time of the response to the initial SIP Request.

It has the following ABNF grammar:

<Time-Stamps>::=< AVP Header: ~~233~~ 833 >

[SIP-Request-Timestamp]

[SIP-Response-Timestamp]

7.2.40 Trunk-Group-ID AVP

The *Trunk-Group-ID* AVP (AVP code ~~251~~851) is of type Grouped and identifies the incoming and outgoing PSTN legs.

It has the following ABNF grammar:

<Trunk-Group-ID>::=<AVP Header: ~~251~~851>

[Incoming-Trunk-Group-ID]

[Outgoing-Trunk-Group-ID]

7.2.41 Void

7.2.42 Void

7.3.43 Void

7.2.44 Void

7.2.45 User-Session-ID AVP

The *User-Session-Id* AVP (AVP code ~~230~~830) is of type UTF8String and holds the session identifier. For a SIP session the *Session-ID* contains the SIP Call ID, as defined in [16].

7.2.46 UUS-Data AVP

The *UUS-Data* AVP (AVP Code ~~256~~856) is of type Grouped AVP and holds information about the sent User-To-User data.

It has the following ABNF grammar:

<UUS-Data>::=< AVP Header: ~~256~~ 856 >

[Amount-of-UUS-Data]

[Mime-Type]

[Direction]