Source:	**SA5 (Telecom Management)**
Title:	**3 Rel-5 CR 32.225 (Charging data description for IMS)**
Document for:	**Decision**
Agenda Item:	**7.5.3**

Doc-1st-	Spec	CR	R	Phas	Subject	Ca	Ver	Doc-2nd-	Workitem
SP-040278	32.225	026	-	Rel-5	Correction of reference to security specification	F	5.5.0	S5-044257	OAM-CH
SP-040278	32.225	027	-	Rel-5	Correction on CauseForRecordClosing	F	5.5.0	S5-044324	OAM-CH
SP-040278	32.225	028	-	Rel-5	Correction of Diameter credit control protocol reference - Align with RFC 3588	F	5.5.0	S5-044358	OAM-CH

CR-Form-v7

CHANGE REQUEST

| ⌘ | **32.225** CR **026** | ⌘ **rev** | **-** | ⌘ | Current version: | **5.5.0** | ⌘ |

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ ☐ ME ☐ Radio Access Network ☐ Core Network **X**

Title:	⌘	Correction of reference to security specification

Source:	⌘	**SA5 Ericsson** (patrik.teppo@ericsson.com)

Work item code: ⌘	OAM-CH	**Date:** ⌘	14/05/2004

Category:	⌘	**F**		**Release:** ⌘	Rel-5

Use *one* of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use *one* of the following releases:
2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
Rel-4 *(Release 4)*
Rel-5 *(Release 5)*
Rel-6 *(Release 6)*

Reason for change: ⌘	TS 32.225 referes to a non existing security TS.

Summary of change: ⌘	Change reference [4] from TS 33.201 to TS 33.210

Consequences if not approved:	⌘	Reference 4 is incorrect.

Clauses affected:	⌘	2 and 4.2.2.3

		Y	**N**		
Other specs affected:	⌘		X	Other core specifications	⌘
			X	Test specifications	
			X	O&M Specifications	

Other comments:	⌘	

Change in Clause 2

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-17.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 33.210~~1~~: "~~Access~~ Network 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". - Included in Annex A

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-02.txt or ftp://ftp.rfc-editor.org/in-notes/rfc3455.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-13.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".

[20]   IETF RFC 2806: "URLs for Telephone Calls".

End of Change in Clause 2

Change in Clause 4.2.2.3

4.2.2.3   Security Considerations

Diameter security is addressed in the base protocol [3]. Network security is specified in TS 33.210~~1~~ [4].

End of Change in Clause 4.2.2.3
End of Document

Annex B (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
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Mar 2003	S_19	SP-030057	005	--	Correction of the IMS Charging Identifier (ICID) definition	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	006	--	Correction of IMS-CDR definitions	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	007	--	Inclusion of IETF draft 'Hakala-diameter-credit-control' specification version 05	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	008	--	Removal of Re-Transmission Attribute Value Pair (AVP) in order to align duplicate detection procedure with the Diameter Base protocol	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	009	--	Correction of the accounting session supervision (Offline) - alignment with the Diameter Base protocol	5.1.0	5.2.0
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Mar 2003	S_19	SP-030057	011	--	Correction of the support of local file storage and use of FTP for transfer of Accounting Information	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	012	--	Correction of abnormal session termination procedure	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	013	--	Correction of network initiated session release procedure - alignment with SIP (IETF RFC 3261)	5.1.0	5.2.0
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Jun 2003	S_20	SP-030271	016	--	Correction of usage of Application-Provided-Called-Party-Address AVP	5.2.0	5.3.0
Jun 2003	S_20	SP-030271	017	--	Correction of "Cause" and "Service-ID"AVP	5.2.0	5.3.0
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Dec 2003	S_22	SP-030622	020	--	Correction of MRFC-CDR content definition for multi-party-call establishment	5.3.0	5.4.0
Dec 2003	S_22	SP-030622	021	--	Correction on ICID definition	5.3.0	5.4.0
Dec 2003	S_22	SP-030622	022	--	Removal of ASR and ASA	5.3.0	5.4.0
Mar 2004	S_23	SP-040143	023	--	Correction of AVP Codes and Diameter protocol specific details	5.4.0	5.5.0
Mar 2004	S_23	SP-040143	024	--	Corrections on the Session Description Protocol (SDP) parameters	5.4.0	5.5.0
Mar 2004	S_23	SP-040143	025	--	Correction of reference to diameter base protocol	5.4.0	5.5.0

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CHANGE REQUEST

| ⌘ | **32.225 CR 027** | ⌘ **rev** | **-** | ⌘ | Current version: | **5.5.0** | ⌘ |

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ ☐　　ME ☐　Radio Access Network ☐　Core Network **X**

Title: ⌘	Correction on CauseForRecordClosing	
Source: ⌘	**SA5** (gerald.goermer@siemens.com)	
Work item code: ⌘	OAM-CH	***Date:*** ⌘ 14/05/2004

Category: ⌘ **F**	***Release:*** ⌘ Rel-5

Use one of the following categories:
　F *(correction)*
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be found in 3GPP TR 21.900.

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　2　　　*(GSM Phase 2)*
　R96　　*(Release 1996)*
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　R98　　*(Release 1998)*
　R99　　*(Release 1999)*
　Rel-4　*(Release 4)*
　Rel-5　*(Release 5)*
　Rel-6　*(Release 6)*

Reason for change: ⌘	The descibed causes for record closing are not consistent with the defined ASN.1 structure.
Summary of change: ⌘	The missed cause for maximun number of charging conditions is added.
Consequences if not approved: ⌘	The generation of partial records is not possible for all causes.

Clauses affected: ⌘	5.2.6

	Y	N		
Other specs affected: ⌘		X	Other core specifications ⌘	
		X	Test specifications	
		X	O&M Specifications	

Other comments: ⌘	

Change in Clause 5.2.6

5.2.6   Abstract Syntax Description

```
TS32225-DataTypes {42} -- to be allocated, value "42" is used to allow compilation of the code

DEFINITIONS IMPLICIT TAGS ::=

BEGIN

-- Exports everything

IMPORTS

TimeStamp
FROM TS32205-DataTypes {itu-t (0) identified-organization (4) etsi(0) mobileDomain (0)
umts-Operation-Maintenance (3) ts-32-205 (205) informationModel (0) asn1Module (2) version1 (1)}

IMSRecord ::= SET
{
        -- Fields used by several multimedia Record types ("Common fields"):
        -- (which field is used in which record type is defined in section 5.2.3)
        recordType                      [0] CallEventRecordType,
        retransmission                  [1] NULL OPTIONAL,
        sIP-Method                      [2] SIP-Method OPTIONAL,
        role-of-Node                    [3] Role-of-Node OPTIONAL,
        nodeAddress                     [4] NodeAddress OPTIONAL,
        session-Id                      [5] Session-Id OPTIONAL,
        calling-Party-Address           [6] InvolvedParty OPTIONAL,
        called-Party-Address            [7] InvolvedParty OPTIONAL,
        privateUserID                   [8] GraphicString OPTIONAL,
        serviceRequestTimeStamp         [9] TimeStamp OPTIONAL,
        serviceDeliveryStartTimeStamp   [10] TimeStamp OPTIONAL,
        serviceDeliveryEndTimeStamp     [11] TimeStamp OPTIONAL,
        recordOpeningTime               [12] TimeStamp OPTIONAL,
        recordClosureTime               [13] TimeStamp OPTIONAL,
        interOperatorIdentifiers        [14] InterOperatorIdentifiers OPTIONAL,
        localRecordSequenceNumber       [15] LocalRecordSequenceNumber OPTIONAL,
        recordSequenceNumber            [16] INTEGER OPTIONAL,
        causeForRecordClosing           [17] CauseForRecordClosing OPTIONAL,
        incomplete-CDR-Indication       [18] Incomplete-CDR-Indication OPTIONAL
        iMS-Charging-Identifier         [19] IMS-Charging-Identifier OPTIONAL,
        sDP-Session-Description         [20] SEQUENCE OF Graphic STRING OPTIONAL,
        list-Of-SDP-Media-Components    [21] SEQUENCE OF Media-Components-List OPTIONAL,
        gGSNaddress                     [22] NodeAddress OPTIONAL,
        serviceDeliveryFailureReason    [23] ServiceDeliveryFailureReason OPTIONAL,
        list-Of-Message-Bodies          [24] SEQUENCE OF MessageBody OPTIONAL,
        recordExtensions                [25] RecordExtensions OPTIONAL,
        -- Space left for further "common fields"

        -- Fields particular used in the S-CSCF-recordType:
        applicationServersInformation   [40] SEQUENCE OF ApplicationServersInformation OPTIONAL,


        -- Fields particular used in the P-CSCF-recordType:
        servedPartyIPAress              [50] ServedPartyIPAddress OPTIONAL,
        -- < ServedPartyIPAddress to be defined >

        -- Fields particular used in the I-CSCF-recordType:
        transactionTimestamp            [60] TimeStamp OPTIONAL,
        s-CSCF-Information              [61] S-CSCF-Information OPTIONAL,
        -- < S-CSCF-Information to be defined >

        -- Fields particular used in the MRFC-recordType:
        service-Id                      [70] Service-Id OPTIONAL,
        -- <Service-Id to be defined>

        -- Fields particular used in the MGCF-recordType:
        trunkGroupID                    [80] TrunkGroupID OPTIONAL,
        bearerService                   [81] TransmissionMedium OPTIONAL,

        -- Fields particular used in the BGCF-RecordType (start with tag 90):
        -- <empty so far>
```

```
        -- Fields particular used in the AS-RecordType:
        serviceSpecificData             [100] OCTET STRING OPTIONAL
}


ACRInterimLost ::= ENUMERATED
{
        no (0),
        yes (1),
        unknown (2)
}

ApplicationServersInformation ::= SEQUENCE
{
        applicationServersInvolved      [0] NodeAddress OPTIONAL,
        applicationProvidedCalledParties [1] SEQUENCE OF InvolvedParty OPTIONAL
}

CauseForRecordClosing ::= ENUMERATED
{
        serviceDeliveryEndSuccessfully (0),
        unSuccessfulServiceDelivery    (1),
        timeLimit                      (3),
        serviceChange                  (4), -- e.g. change in media due to Re-Invite
        managementIntervention         (5),
        maxChangeCond                  (6)  -- e.g. number in 'List of Message Bodies' exceeeded
-- partial record generation reasons to be added
-- Additional codes are for further study
}

IMS-Charging-Identifier ::= OCTET STRING

Incomplete-CDR-Indication ::= SET
{
        aCRStartLost [0] BOOLEAN, -- TRUE if ACR[Start] was lost, FALSE otherwise
        aCRInterimLost [1] ACRInterimLost,
        aCRStopLost [2] BOOLEAN -- TRUE if ACR[Stop] was lost, FALSE otherwise
}

InterOperatorIdentifiers ::= SEQUENCE
{
        originatingIOI [0] GraphicString OPTIONAL,
        terminatingIOI [1] GraphicString OPTIONAL
}

InvolvedParty ::= CHOICE
{
        sIP-URL [0] GraphicString, -- refer to rfc3261
        tEL-URL [1] GraphicString  -- refer to rfc3261
}

IPAddress ::= CHOICE
{
        ipV4Addr [0] GraphicString, -- "dot" notation is used
        ipV6Addr [1] GraphicString  -- "dot" notation is used
}

LocalRecordSequenceNumber ::= INTEGER (0..+2147483647)
-- A unique number assigned by the CCF and supplied to all CDRs. The value range
-- limits the field to a maximum 4 octet INTEGER.

Media-Components-List ::= SEQUENCE
{
        sIP-Request-Timestamp  [0] TimeStamp OPTIONAL,
        sIP-Response-Timestamp [1] TimeStamp OPTIONAL,
        sDP-Media-Components   [2] SDP-Media-Components OPTIONAL,
        mediaInitiatorFlag     [3] NULL OPTIONAL,
        authorized-QoS         [3] GraphicString OPTIONAL
}

MessageBody ::= SEQUENCE
{
        Content-Type          [0] GraphicString OPTIONAL,
        Content-Disposition   [1] GraphicString OPTIONAL,
        Content-Length        [2] INTEGER OPTIONAL,
        Originator            [3] InvolvedParty OPTIONAL
}
```

```
NodeAddress ::= CHOICE
{
        iPAddress  [0] IPAddress,
        domainName [1] GraphicString
}

RecordExtensions ::= SEQUENCE
{
        -- ...
        -- operator specific record extensions
        -- ...
}

Role-of-Node ::= ENUMERATED
{
        originating (0),
        terminating (1),
        proxy       (2),
        b2bua       (3)
}

SDP-Media-Components ::= SEQUENCE
{
        sDP-Media-Name         [0] SEQUENCE OF GraphicString OPTIONAL,
        sDP-Media-Descriptions [1] SEQUENCE OF SDP-Media-Description OPTIONAL,
        gPRS-Charging-Id       [2] INTEGER OPTIONAL,
}

SDP-Media-Description ::= SEQUENCE OF GraphicString OPTIONAL,

ServiceDeliveryFailureReason ::= GraphicString
-- holds the SIP error code as received via a SIP Final response (4xx, 5xx or 6xx)

Session-Id ::= GraphicString
-- rfc3261: example for SIP Call-ID: f81d4fae-7dec-11d0-a765-00a0c91e6bf6@foo.bar.com

Sip-Method ::= GraphicString

TransmissionMedium ::= SEQUENCE {
        -- Transmission Medium Required, refer to ITU-T Q.763:
        tMR [0] OCTET STRING (SIZE (1)) OPTIONAL,
        -- Transmission Medium USED, refer to ITU-T Q.763:
        tMU [1] OCTET STRING (SIZE (1)) OPTIONAL
}

TrunkGroupID ::= CHOICE {
        incoming [0] GraphicString,
        outgoing [1] GraphicString
}

END
```

End of Change in Clause 5.2.6
End of Document

Annex B (informative):
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	
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Mar 2003	S_19	SP-030057	005	--	Correction of the IMS Charging Identifier (ICID) definition	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	006	--	Correction of IMS-CDR definitions	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	007	--	Inclusion of IETF draft 'Hakala-diameter-credit-control' specification version 05	5.1.0	5.2.0
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Mar 2003	S_19	SP-030057	009	--	Correction of the accounting session supervision (Offline) - alignment with the Diameter Base protocol	5.1.0	5.2.0
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Mar 2003	S_19	SP-030057	013	--	Correction of network initiated session release procedure - alignment with SIP (IETF RFC 3261)	5.1.0	5.2.0
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CHANGE REQUEST

⌘	**32.225** CR **028**	⌘**rev**	**-**	⌘	Current version:	**5.5.0**	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ ☐ ME ☐ Radio Access Network ☐ Core Network **X**

Title:	⌘	Correction of Diameter credit control protocol reference - Align with RFC 3588
Source:	⌘	SA5 (gerald.goermer@siemens.com)
Work item code: ⌘	OAM-CH	**Date:** ⌘ 14/05/2004
Category:	⌘ **F**	**Release:** ⌘ Rel-5

Use one of the following categories:
F (correction)
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R99   (Release 1999)
Rel-4 (Release 4)
Rel-5 (Release 5)
Rel-6 (Release 6)

Reason for change:	⌘	IMS Online Charging is dependent to an IETF draft that has been withdrawn and replaced by Diameter Credit Crontrol (DCC) application.
Summary of change: ⌘		All technical items and references in relation on the obsolete IETF specification has been replaced by an appropriate DCC content.
Consequences if not approved:	⌘	IMS online Charging is not consistent with the IETF specifications.

Clauses affected:	⌘	2, 3.3, 4.2.2.2, 5.1.3.2.1, 6, 7.1, 7.2 and Annex A

	Y	N		
Other specs affected: ⌘		X	Other core specifications	⌘
		X	Test specifications	
		X	O&M Specifications	

Other comments:	⌘	

2 References

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[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-ietf-aaa-diameter-cc-04.txt Included in Annex A

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-02.txt or ftp://ftp.rfc-editor.org/in-notes/rfc3455.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-13.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".

[20]   IETF RFC 2806: "URLs for Telephone Calls".

<div style="border:1px solid black; text-align:center; font-weight:bold;">End of Change in Clause 2</div>

<div style="border:1px solid black; text-align:center; font-weight:bold;">Change in Clause 3.3</div>

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
AVP	Attribute Value Pair
B2BUA	Back-to-Back User Agent
BGCF	Breakout Gateway Control Function
BS	Billing System
CCA	Credit Control Answer
CCF	Charging Collection Function
CCR	Credit Control Request
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)
IANA	Internet Assigned Numbers Authority
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

<div style="border:1px solid black; text-align:center; font-weight:bold;">End of Change in Clause 3.3</div>

<div style="border:1px solid black; text-align:center; font-weight:bold;">Change in Clause 4.2.2.2</div>

4.2.2.2   Online Specific Base Protocol Requirements

The usage and values of *Acct-Interim-Interval* AVP and the timer 'T$_x$s' are under the sole control of the credit control server (OCS) and determined by operator configuration of the OCS. There are no specific requirements on the client concerning the *Acct-Interim-Interval* AVP population in the ACCR.

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.

<div style="border:1px solid black; text-align:center; font-weight:bold;">End of Change in Clause 4.2.2.2</div>

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

AVP	Used in offline ACR
Diameter base protocol AVPs	
<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~~
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 P-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.

| Change in Clause 6 |

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~~CC-Request-Type ~~EVENT_RECORD~~EVENT_REQUEST which is sent with an ~~A~~CCR 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~~CC-Request-Type ~~START~~INITIAL / ~~INTERIM~~UPDATE / ~~STOP_RECORD~~TERMINATE-REQUEST 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 ~~A~~CCR Event messages are generated, or ECUR, using ~~A~~CCR ~~Start~~INITIAL, TERMINATE~~Stop~~ and ~~Interim~~UPDATE. The decision whether to apply IEC or ECUR is based on the service and/or operator's policy.

NOTE: To the extent possible alignment with the IETF Diameter 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.
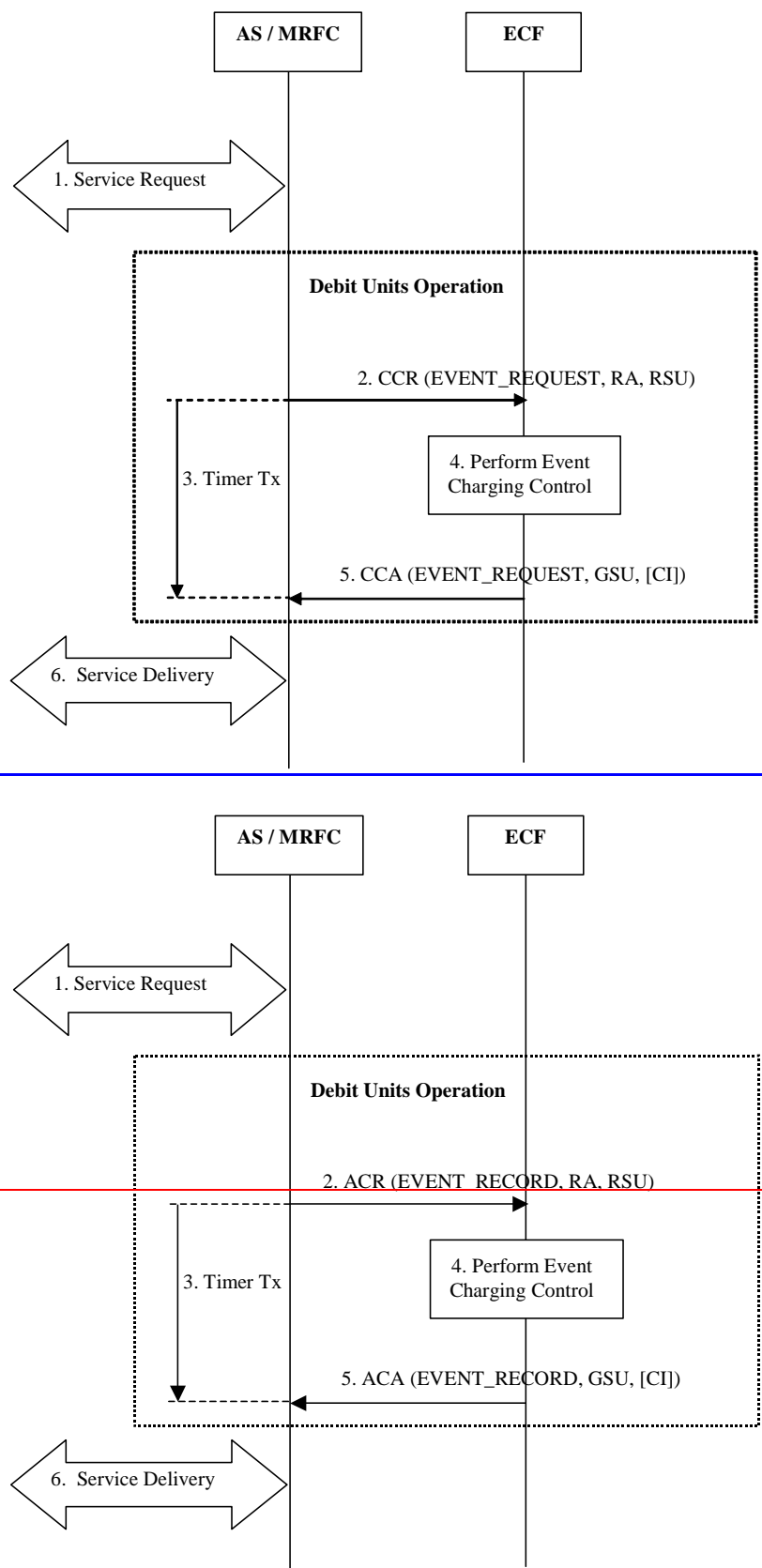

Figure 6.1: IEC - Debit Units Operation

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*~~*Credit-Control-Request* (~~A~~CCR) with ~~*Accounting-Record*~~*CC-Request*-*Type* AVPset to ~~EVENT_RECORD~~EVENT_REQUEST to indicate service specific information to the ECF. The *Requested-Action* AVP (RA) is set to DIRECT_DEBITING. If known, the AS/MRFC may include *Requested-Service-Unit* AVP (RSU) (monetary or non monetary units) in the request message.
3. Having transmitted the ~~*Accounting Request*~~*CC_request* message the AS/MRFC starts the communication supervision timer Tx [13]. Upon receipt of the ~~*Accounting*~~*Credit-Control-*Answer (~~A~~CCA) message the AS/MRFC shall stop timer Tx.
4. The ECF determines the relevant service charging parameters in conjunction with the other internal charging functions of the OCS.
5. The ECF returns ~~*Accounting Answer*~~*CC_answer* message with ~~*Accounting-Record*~~*CC-Request*-*Type* AVP set to ~~EVENT_RECORD~~EVENT_REQUEST to the AS/MRFC in order to authorize the service execution
   (*Granted-Service-Unit* AVP (GSU) and possibly *Cost-Information* AVP (CI) indicating the cost of the service are included in the ~~*Accounting Answer*~~*CC_answer* message). The ~~*Accounting Answer*~~*CC_answer* message has to be checked by the AS/MRFC accordingly and the requested service is controlled concurrently with service delivery.
6. 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 behaviour 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 Units Operation Failure

This case comprises situations where either no, or an erroneous response, is received from the ECF. The "no response" case is detected by the AS/MRFC when the connection supervision timer Tx expires [13] before a response *Accounting*Credit-Control-*Answer* (ACCA) is received. The case of receiving an erroneous response implies that the AS/MRFC receives a *Accounting*Credit-Control-*Answer* (ACCA), which it is unable to process, while Tx is running. The failure handling complies with the failure procedures for "Direct Debiting" scenario described in [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 T-flag as described in [3]. For optimized performance, uniqueness checking against other received requests is only necessary for those records marked with the T-flag received within a reasonable time window. This focused check is based on the inspection of the *Session-Id* and *Accounting-Record*CC-Request-*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.
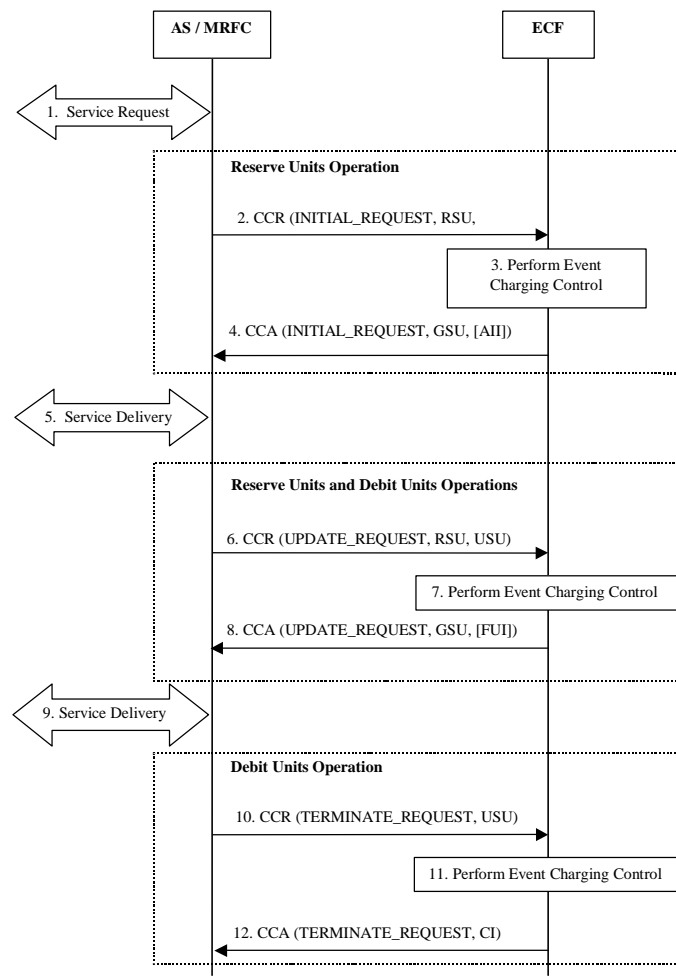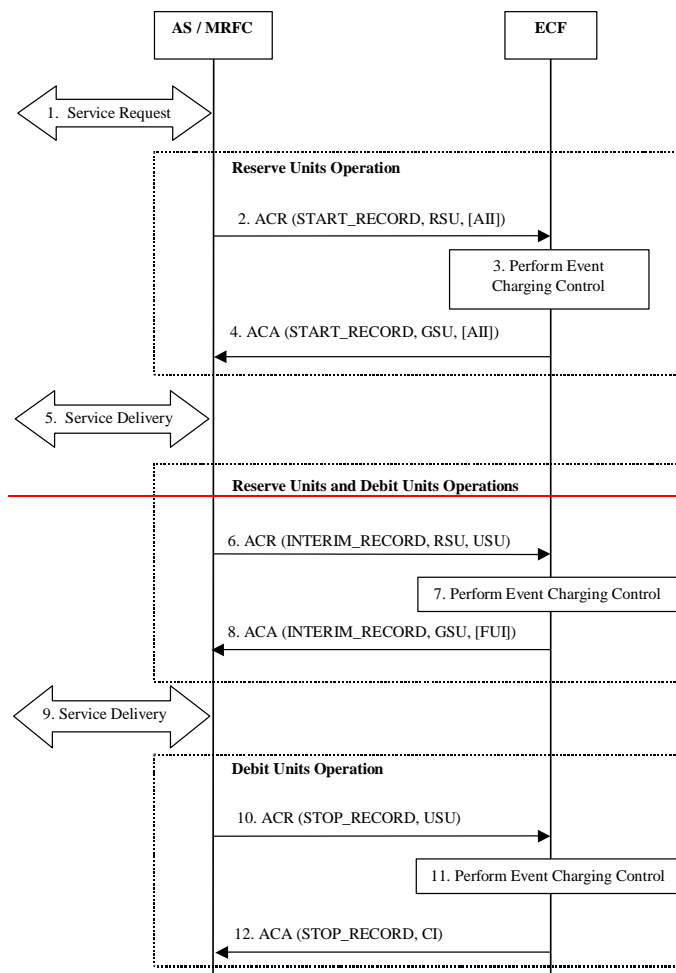
Figure 6.2: ECUR - Reserve Units and Debit Units Operations

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 ~~AC~~CCR with ~~Accounting-Record~~*CC-Request-Type* AVP set to ~~START_RECORD~~INITIAL-REQUEST to the ECF. If known, the AS/MRFC may include *Requested-Service-Unit* (RSU) AVP (monetary or non monetary units) and *Acc-Interim-Interval* (AII) AVP 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~~*CC_answer* message with ~~Accounting Record~~*CC-Request-Type* set to ~~START_RECORD~~INITIAL-REQUEST 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~~*CC_answer* message). If requested, the ECF returns the *Acc-Interim-Interval* (AII) AVP with value field set to a non-zero value.

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 ~~A~~CCR with ~~Accounting-Record~~CC-Request-Type AVP set to ~~INTERIM_RECORD~~UPDATE-REQUEST, to report the units used and request additional units, respectively. The ~~A~~CCR message with ~~Accounting-Record~~CC-Request-Type AVP set to ~~INTERIM_RECORD~~UPDATE-REQUEST must be sent by the AS/MRFC between the ~~START_RECORD~~INITIAL-REQUEST and ~~STOP_RECORD~~TERMINATE-REQUEST either on request of the credit control application within the interim interval or if the interim interval is elapsed. If known, the AS/MRFC may include *Requested-Service-Unit* AVP (monetary or non monetary units) in the request message. The *Used-Service-Unit* (USU) AVP is complemented in the ~~ACR~~CCR message to deduct units from both the user's account and the reserved units, respectively.

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~~CC_answer message with ~~Accounting-Record~~CC-Request-Type set to ~~INTERIM_RECORD~~UPDATE-REQUEST to the AS/MRFC, in order to allow the content/service delivery to continue (new *Granted-Service-Unit (GSU) AVP* and possibly *Cost-Information (CI) AVP* indicating the cumulative cost of the service are included in the ~~Accounting-Answer~~CC_answer message). The ECF may include in the ~~ACA~~CCA message the *Final-Unit-Indication* (FUI) AVP 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 ~~A~~CCR with ~~Accounting-Record~~CC-Request-Type AVP set to ~~STOP_RECORD~~TERMINATE-REQUEST 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 ~~A~~CCR message by sending ~~A~~CCA message with ~~Accounting-Record~~CC-Request-Type AVP indicating ~~STOP_RECORD~~TERMINATE-REQUEST (possibly *Cost-Information* AVP indicating the cumulative cost of the service is included in the ~~Accounting-Answer~~CC_answer message).

NOTE: The ECUR scenario is supervised by corresponding timers (e.g. accounting interval timer) that are not shown in the figure 6.2.

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~~CC_answer. The Tariff Switch Time is evaluated by the AS/MRFC relative to the time stamp of the ~~Accounting-Request~~CC_request (~~Accounting-Record~~CC-Request-Type ~~START_RECORD~~INITIAL-REQUEST or ~~INTERIM_RECORD~~UPDATE-REQUEST). 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~~*CC_request* to the ECF. The ~~Accounting Request~~*CC_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~~*CC_answer*.
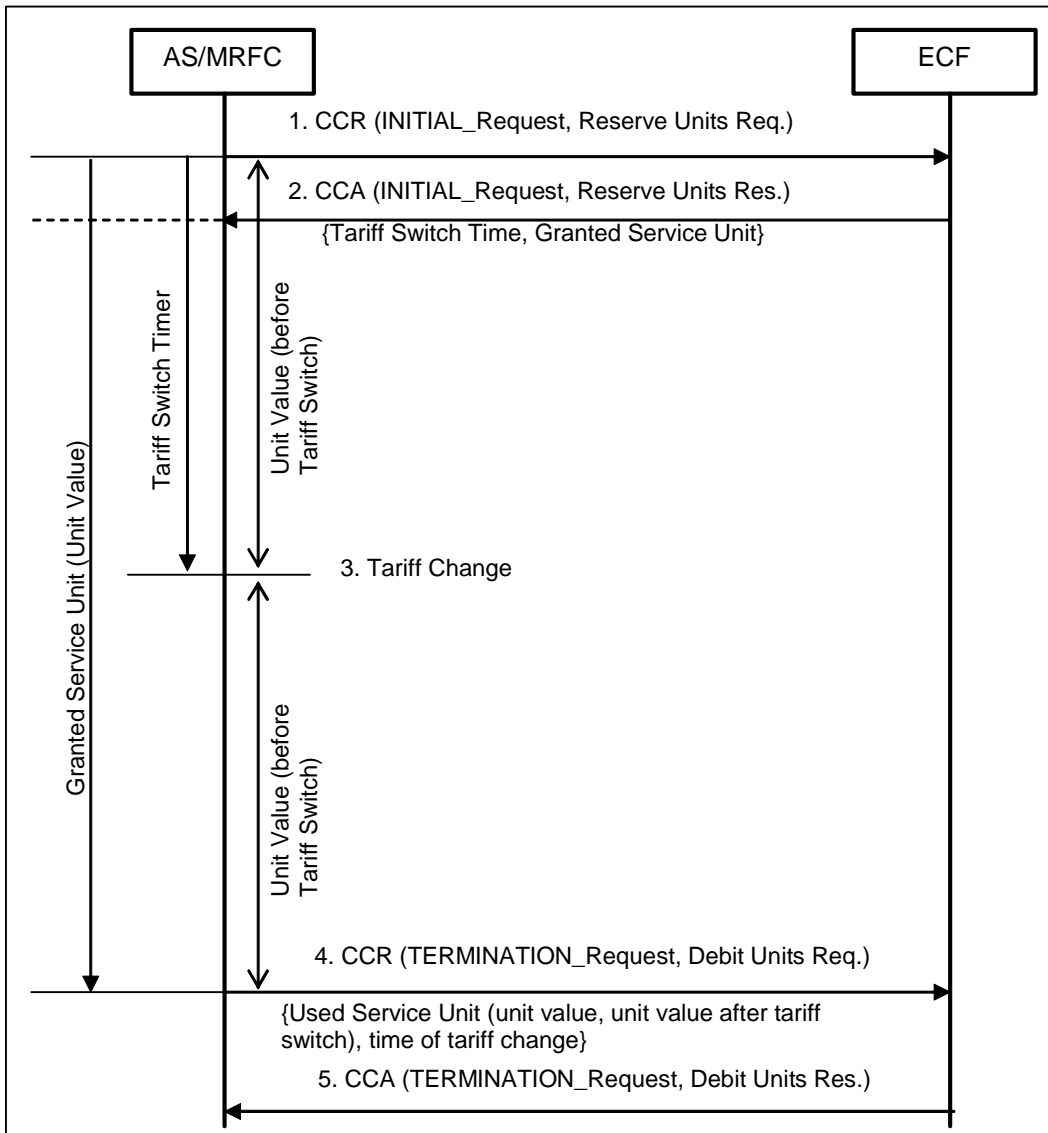
If the tariff switch timer expired, the AS/MRFC further continues usage metering using the post-switch quota, if provided, but no ~~Accounting Request~~*CC_request* is sent. If no specific units were granted to after tariff switch time, the AS/MRFC continues usage metering with the remaining units granted.
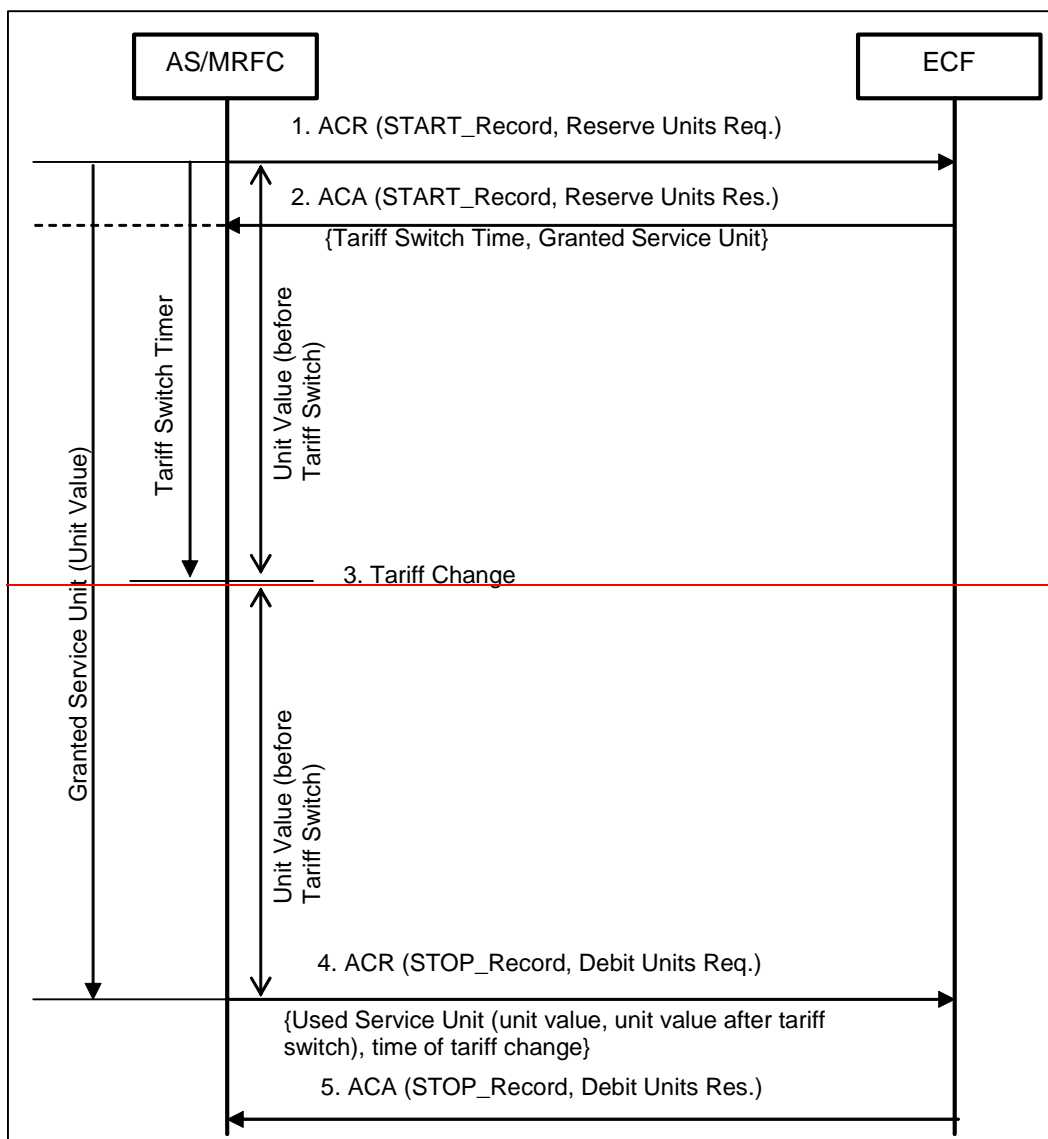
If the post switch quota is exhausted, the AS/MRFC sends an ~~Accounting Request~~*CC_request* to the ECF, containing the service units used before the last tariff switch, the service units used after the last tariff switch and the tariff switch time.

If the granted units - provided in one portion - are exhausted, an ~~Accounting Request~~*CC_request* is sent. If a tariff switch has occurred in this time, the ~~Accounting Request~~*CC_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~~*CC_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 ~~Accounting Request~~CC_request takes place, as the granted service units were not exhausted.

AS/MRFC   ECF

1. CCR (INITIAL_Request, Reserve Units Req.)

2. CCA (INITIAL_Request, Reserve Units Res.)
{Tariff Switch Time, Granted Service Unit}

Tariff Switch Timer

Unit Value (before Tariff Switch)

Granted Service Unit (Unit Value)

3. Tariff Change

Unit Value (before Tariff Switch)

4. CCR (TERMINATION_Request, Debit Units Req.)
{Used Service Unit (unit value, unit value after tariff switch), time of tariff change}

5. CCA (TERMINATION_Request, Debit Units Res.)

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~~CCR with ~~*Accounting-Record*~~*CC-Request*-*Type* set to ~~START_RECORD~~INITIAL-REQUEST to ECF. The *Requested-Action* is set to RESERVE_UNITS.
2. Once the reservation has been made, ECF returns an ~~ACA~~CCA with ~~*Accounting-Record*~~*CC-Request*-*Type* set to ~~START_RECORD~~INITIAL-REQUEST to the AS/MRFC in order to authorize the content/service delivery. The ~~ACA~~CCA 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~~CCA, the AS/MRFC evaluates the tariff switch time relative to the timestamp of the ~~ACR~~CCR, 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~~CCR with ~~*Accounting-Record*~~*CC-Request*-*Type* set to ~~STOP_RECORD~~TERMINATE-REQUEST 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*~~*CC_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 behaviour 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 [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 initial~~start- session accounting~~credit control report message).

- Zero, one or more interim interrogations (extending the update~~interim accounting~~credit control report message).

- Final interrogation (extending the terminate~~stop- session accounting~~ credit control 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~~CC_request* and *~~Accounting Answer~~CC_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~~CC_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~~CC-Request	MRFC, AS	ECF	~~ACR~~CCR
~~Accounting~~CC-Answer	ECF	MRFC, AS	~~ACA~~CCA

6.1.3.2 Structure for the ~~Accounting~~Credit Control Message Formats

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

Those Diameter AVPs that are used for online 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~~Credit-Control-Request Message

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

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

Diameter Credit Control~~Base Protocol~~ AVPs	
AVP	**Used in Online ~~ACR~~CCR**
<Diameter Header: 272~~1~~, REQ, PXY>	Yes
<Session-Id>	Yes
{ Origin-Host }	Yes
{ Origin-Realm }	Yes
{ Destination-Realm }	Yes
{ Auth-Application-Id }	Yes
{~~Accounting-Record~~ CC-Request-Type }	Yes
{~~Accounting-Record~~ CC-Request-Number }	Yes
[Destination-Host]	Yes
[Acct-Application-Id]	No
[Vendor-Specific-Application-Id]	Yes
[User-Name]	Yes
[~~Accounting~~ CC-Sub-Session-Id]	Yes~~No~~
[Accounting-RADIUS-Session-Id]	No
[Acct-Multi-Session-Id]	Yes~~No~~
[Acct-Interim-Interval]	Yes
[Accounting-Realtime-Required]	No
[Origin-State-Id]	Yes
[Event-Timestamp]	Yes
*[Subscription-Id]	Yes
[Service-Identifier]	Yes
[Termination-Cause]	Yes
[Requested-Service-Unit]	Yes
[Requested-Action]	Yes
*[Used-Service-Unit]	Yes
[Multiple-Service-Indicator]	Yes
*[Multiple-Service-Credit-Control]	Yes
*[Service-Parameter-Info]	Yes
[CC-Correlation-Id]	Yes
[User-Equigment-Info]	Yes
* [Proxy-Info]	Yes~~No~~
* [Route-Record]	Yes~~No~~
*[AVP]	Yes~~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
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]	Yes
*[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
[Service-Id]	Yes
[UUS-Data]	Yes
[Cause]	Yes

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

6.1.3.2.2 ~~Accounting~~Credit-Control-Answer Message

Table 6.3 illustrates the basic structure of a Diameter *~~Accounting~~CC-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~~CCR record type that is being replied to.

Table 6.3: ~~Accounting~~Credit-Control- Answer (~~ACA~~CCA) Message Contents for Online Charging

Diameter Credit Control~~base protocol~~ AVPs	
AVP	**Used in online ~~ACA~~CCA**
<Diameter Header: 272~~1~~, PXY>	Yes
<Session-Id>	Yes
{ Result-Code }	Yes
{ Origin-Host }	Yes
{ Origin-Realm }	Yes
{ Auth-Application-Id }	Yes
{~~Accounting-Record~~CC-Request-Type}	Yes
{~~Accounting-Record~~CC-Request-Number}	Yes
[Acct-Application-Id]	No
[Vendor-Specific-Application-Id]	Yes
[User-Name]	Yes
[CC-Session-Failover]	Yes
[~~Accounting~~CC-Sub-Session-Id]	Yes
[Accounting-RADIUS-Session-Id]	No
[Acct-Multi-Session-Id]	Yes~~No~~
[Error-Reporting-Host]	No
[Acct-Interim-Interval]	Yes
[Accounting-Realtime-Required]	No
[Origin-State-Id]	Yes
[Event-Timestamp]	Yes
*[Subscription-Id]	Yes
[Granted-Service-Unit]	Yes
*[Multiple-Service-Credit-Control]	Yes
[Cost-Information]	Yes
[Final-Unit-Indication]	Yes
[Check-Balance-Result]	Yes
[Credit-Control-Failure-Handling]	Yes
[Debit-Debiting-Failure-Handling]	Yes
[Validity-Time]	Yes
*[Redirect-Host AVP]	Yes
[Redirect-Host-Usage]	Yes
[Redirect-Max-Cache-Time]	Yes
* [Proxy-Info]	Yes~~No~~
* [Route-Record]	Yes
*[AVP]	Yes~~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:

- Initial request~~Start session accounting~~ credit control data.

- Update request~~Interim session accounting~~ credit contol data.

- Terminate request~~Stop session accounting~~credit control data.

- Event accounting data.

~~ACR~~CCR types initial~~start~~, update~~interim~~ and terminate~~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~~CCR 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~~CC-Request* and *~~Accounting~~CC-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	MRFC	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			
<Session-Id>[Subscription-Id]		SISE	SISE
{ Origin-Host }[Requested-Action]		SISE	SISE
{ Origin-Realm }*[Requested-Service-Unit]		SISE	SISE
{ Destination-Realm }*[Used-Service-Unit]		SISE	SISE
{ Auth-Application-Id }[Tariff-Switch-Definition]		SISE	SISE
{ CC-Request-Type }*[Service-Parameter-Info]		SISE	SISE
{ CC-Request-Number }[Abnormal-Termination-Reason]		SISE	SISE
[Destination-Host]*[Accounting-Correlation-Id]		SISE	SISE
[Credit-Control-Failure-Handling]		SISE	SISE
[Direct-Debiting-Failure-Handling]		SISE	SISE
[User-Name]*[Granted-Service-Unit]		SISE	SISE
[CC-Sub-Session-Id][Cost-Information]		SISE	SISE
[Final-Unit-Indication]		-	-
[Acct-Multi-Session-Id][Check-Balance-Result]		SISE	SISE
[Origin-State-Id]			
[Event-Timestamp]		SISE	SISE
*[Subscription-Id]		SISE	SISE
[Service-Identifier]		SISE	SISE
[Termination-Cause]		SISE	SISE
[Requested-Service-Unit]		SISE	SISE
[Requested-Action]		SISE	SISE
*[Used-Service-Unit]		SISE	SISE
[Multiple-Service-Indicator]		SISE	SISE
*[Multiple-Service-Credit-Control]		SISE	SISE
*[Service-Parameter-Info]		SISE	SISE
[CC-Correlation-Id]		SISE	SISE
[User-Equipment-Info]		SISE	SISE
* [Proxy-Info]		-	-
* [Route-Record]		-	-
*[AVP]		-	-
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

AVP name	Node Type	MRFC	AS
	Supported ACRs	S/I/S/E	S/I/S/E
[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]		SISE	
[UUS-Data]		SISE	SISE
[Cause]		--SE	--SE

Table 6.5: Detailed Diameter ACA Message Contents for Online Charging

AVP name	Node Type	ECF
	Supported ACAs	**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		
<Session-Id>[Subscription-Id]		SISE
{ Result-Code }[Requested-Action]		SISE
{ Origin-Host }*[Requested-Service-Unit]		SISE
{ Origin-Realm }*[Used-Service-Unit]		SISE
{ Auth-Application-Id }[Tariff-Switch-Definition]		SISE
{CC-Request-Type}*[Service-Parameter-Info]		SISE
{CC-Request-Number}[Abnormal-Termination-Reason]		SISE
*[Accounting-Correlation-Id]		-
[Credit-Control-Failure-Handling]		-
[User-Name][Direct-Debiting-Failure-Handling]		-
[CC-Session-Failover]*[Granted-Service-Unit]		SISE
[CC-Sub-Session-Id][Cost-Information)		SISE
[Final-Unit-Indication]		SISE
[Acct-Multi-Session-Id][Check-Balance-Result]		SISE
[Credit-Control-Failure-Handling]		SISE
[Origin-State-Id]		SISE
[Event-Timestamp]		SISE
*[Subscription-Id]		SISE
[Granted-Service-Unit]		SISE
*[Multiple-Service-Credit-Control]		SISE
[Cost-Information]		SISE
[Final-Unit-Indication]		SISE
[Check-Balance-Result]		SISE
[Credit-Control-Failure-Handling]		-
[Debit-Debiting-Failure-Handling]		-
[Validity-Time]		SISE
*[Redirect-Host AVP]		SISE
[Redirect-Host-Usage]		SISE
[Redirect-Max-Cache-Time]		SISE
* [Proxy-Info]		-
* [Route-Record]		-
*[AVP]		-

End of Change in Clause 6

Change in Clause 7.1

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	~~ACR~~	~~ACA~~
	Table #		5.4	5.5	~~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}			-	-	~~-~~	~~-~~
<Diameter-Header:271,REQ,PXY>			Yes	Yes	~~Yes~~	~~Yes~~
{Destination-Host}			-	-	~~-~~	~~-~~
{Destination-Realm}			Yes	-	~~Yes~~	~~-~~
[Error-Message]			-	-	~~-~~	~~-~~
[Error-Reporting-Host]			-	No	~~-~~	~~No~~
[Event-Timestamp]			Yes	Yes	~~Yes~~	~~Yes~~
*[Failed-AVP]			-	-	~~-~~	~~-~~
*[Proxy-Info]			No	No	~~No~~	~~No~~
{Origin-Host}			Yes	Yes	~~Yes~~	~~Yes~~
{Origin-Realm}			Yes	Yes	~~Yes~~	~~Yes~~
[Origin-State-Id]			Yes	Yes	~~Yes~~	~~Yes~~
*[Redirected-Host]			-	-	~~-~~	~~-~~
[Redirected-Host-Usage]			-	-	~~-~~	~~-~~
[Redirected-Max-Cache-Time]			-	-	~~-~~	~~-~~
{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	~~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   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 i.e. the same application id as used by the Cx interface protocol as defined in [19].

7.1.2   Result-Code AVP

This subclause defines new *Result-Code* AVP (AVP code 298) values that must be supported by all Diameter implementations that conform to the present document.

The *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   4100

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   4102

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   5100

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

7.1.2   User-Name AVP

The *User-Name* AVP (AVP code 1) contains the Private User Identity [18], if available in the node.

7.1.3   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'.

End of Change in Clause 7.1

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	Must	May	Should not	Must not	May Encr.
AVPs from Diameter Credit Control								
~~[Subscription-Id]~~	~~200~~	~~[13]~~						
~~[Requested-Action]~~	~~201~~	~~[13]~~						
~~*[Used-Service-Unit]~~	~~202~~	~~7.2.44~~	~~Grouped~~					
~~{Unit-Type}~~	~~203~~	~~7.2.41~~	~~Enumerated~~					
~~{Unit-Value}~~	~~204~~	~~7.2.42~~	~~Float64~~					
~~{Unit-Value-After-Tariff-Switch}~~	~~205~~	~~7.3.43~~	~~Float64~~					
~~{Currency-Code}~~	~~206~~	~~[13]~~						
~~[Tariff-Switch-Definition]~~	~~207~~	~~7.2.37~~	~~OctetString~~					
~~*[Service-Parameter-Info]~~	~~208~~	~~[13]~~						
~~[Abnormal-Termination-Reason]~~	~~209~~	~~[13]~~						
~~*[Accounting-Correlation-Id]~~	~~210~~	~~[13]~~						
~~[Credit-Control-Failure-Handling]~~	~~211~~	~~[13]~~						
~~[Direct-Debiting-Failure-Handling]~~	~~212~~	~~[13]~~						
~~*[Granted-Service-Unit]~~	~~213~~	~~7.2.19~~	~~Grouped~~					
~~{Unit-Type}~~	~~214~~	~~7.2.41~~	~~Enumerated~~					
~~{Unit-Value}~~	~~215~~	~~7.2.42~~	~~Float64~~					
~~{Unit-Value-After-Tariff-Switch}~~	~~216~~	~~7.3.43~~	~~Float64~~					
~~{Currency-Code}~~	~~217~~	~~[13]~~						
~~[Cost-Information]~~	~~218~~	~~7.2.13~~	~~Grouped~~					
~~{Cost}~~	~~219~~	~~[13]~~						
~~{Currency-Code}~~	~~220~~	~~[13]~~						
~~[Final-Unit-Indication]~~	~~221~~	~~[13]~~						
~~[Check-Balance-Result]~~	~~222~~	~~[13]~~						
CC-Correlation-Id	[13]	[13]	OctetString					
CC-Input-Octets	[13]	[13]	Unsigned64					
CC-Money	[13]	[13]	Grouped					
CC-Output-Octets	[13]	[13]	Unsigned64					
CC-Request-Number	[13]	[13]	Unsigned32					
CC-Request-Type	[13]	[13]	Enumerated					
CC-Service-Specific-Units	[13]	[13]	Unsigned64					
CC-Session -Failover	[13]	[13]	Enumerated					
CC-Sub-Session-Id	[13]	[13]	Unsigned64					
CC-Time	[13]	[13]	Unsigned32					
CC-Total-Octets	[13]	[13]	Unsigned64					
CC-Unit-Type	[13]	[13]	Enumerated					
Check-Balance-Result	[13]	[13]	Enumerated					
Cost-Information	[13]	[13]	Grouped					
Cost-Unit	[13]	[13]	UTF8String					
Credit-Control	[13]	[13]	Enumerated					
Credit-Control-Failure-Handling	[13]	[13]	Enumerated					
Currency-Code	[13]	[13]	Unsigned32					
Direct-Debiting	[13]	[13]	Enumerated					
Failure-Handling-Exponent	[13]	[13]	Integer32					
Final-Unit-Action	[13]	[13]	Enumerated					
Final-Unit-Indication	[13]	[13]	Grouped					
Granted-Service-Unit	[13]	[13]	Grouped					
Granted-Service-Unit -Pool-Identifier	[13]	[13]	Unsigned32					
Granted-Service-Unit -Pool-Reference	[13]	[13]	Grouped					
Multiple-Services-Credit-Control	[13]	[13]	Grouped					
Multiple-Services-Indicator	[13]	[13]	Enumerated					
Rating-Group	[13]	[13]	Unsigned32					
Redirect-Address-Type	[13]	[13]	Enumerated					
Redirect-Server	[13]	[13]	Grouped					
Redirect-Server-Address	[13]	[13]	UTF8String					
Requested-Action	[13]	[13]	Enumerated					
Requested-Unit	[13]	[13]	Grouped					
Restriction -Filter-Rule	[13]	[13]	IPFiltrRule					
Service-Identifier	[13]	[13]	UTF8String					
Service-Parameter-Info	[13]	[13]	Grouped					
Service-Parameter-Type	[13]	[13]	Unsigned32					
Service- Parameter-Value	[13]	[13]	OctetString					
Subscription-Id	[13]	[13]	Grouped					
Subscription-Id-Data	[13]	[13]	UTF8String					
Subscription-Id-Type	[13]	[13]	Enumerated					
Tariff-Change-Usage	[13]	[13]	Enumerated					
Tariff-Time-Change	[13]	[13]	Time					
Unit-Value	[13]	[13]	Grouped					
Used-Service-Unit	[13]	[13]	Grouped					
User-Equipment-Info	[13]	[13]	Grouped					
User-Equipment-Info-Type	[13]	[13]	Unsigned32					
User-Equipment-Info-Value	[13]	[13]	UTF8String					

AVP Name	AVP Code	Clause Defined	Value Type	AVP Flag rules				
				Must	May	Should not	Must not	May Encr.
Value-Digits	[13]	[13]	Integer64					
Validity-Time	[13]	[13]	Unsigned32					
3GPP Diameter Accounting AVPs								
[Event-Type]	223	7.2.16	Grouped					
[SIP-Method]	224	7.2.34	UTF8String					
[Event]	225	7.2.15	UTF8String					
[Content-Type]	226	7.2.12	UTF8String					
[Content-Length]	227	7.2.11	UTF8String					
[Content-Disposition]	228	7.2.10	UTF8String					
[Role-of-Node]	229	7.2.27	Enumerated					
[User Session Id]	230	7.2.45	UTF8String					
[Calling-Party-Address]	231	7.2.7	UTF8String					
[Called-Party-Address]	232	7.2.6	UTF8String					
[Time-stamps]	233	7.2.39	Grouped					
[SIP-Request-Timestamp]	234	7.2.35	UTF8String					
[SIP-Response-Timestamp]	235	7.2.36	UTF8String					
[Application-server]	236	7.2.3	UTF8String					
[Application-provided-called-party-address]	237	7.2.2	UTF8String					
[Inter-Operator-Identifier]	238	7.2.22	Grouped					
[Originating-IOI]	239	7.2.25	UTF8String					
[Terminating-IOI]	240	7.2.38	UTF8String					
[IMS-Charging-Identifier]	241	7.2.20	UTF8String					
*[SDP-Session-Description]	242	7.2.31	UTF8String					
*[SDP-Media-component]	243	7.2.28	Grouped					
[SDP-Media-Name]	244	7.2.30	UTF8String					
*[SDP-Media-Description]	245	7.2.29	UTF8String					
[GPRS-Charging-Id]	246	7.2.18	UTF8String					
[GGSN-Address]	247	7.2.17	IPAddress					
[Served-Party-IP-Address]	248	7.2.32	IPAddress					
[Authorized-QoS]	249	7.2.4	UTF8String					
[Server-Capabilities]	250	[19]						
[Trunk-Group-Id]	251	7.2.40	Grouped					
[Incoming-Trunk-Group-Id]	252	7.2.21	UTF8String					
[Outgoing-Trunk-Group-Id]	253	7.2.26	UTF8String					
[Bearer-Service]	254	7.2.5	OctetString					
[Service-Id]	255	7.2. 33	UTF8String					
[UUS-Data]	256	7.2.46	Grouped					
[Amount-of-UUS-data]	257	7.2.1	UTF8String					
[Mime-type]	258	7.2.23	UTF8String					
[Direction]	259	7.2.14	Enumerated					
[Cause]	260	7.2.8	Grouped					
{Cause-Code}	261	7.2.9	Enumerated					
{Node-Functionality}	262	7.2.24	Enumerated					

7.2.1   Amount-of-UUS-Data AVP

The *Amount-Of-UUS-Data* AVP (AVP code 257) 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) 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 236) 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) is of type UTF8String 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 254) 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) 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) 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) 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>

> {Cause-Code}

> {Node-Functionality}

7.2.9 Cause-Code AVP

The *Cause-Code* AVP (AVP code 261) 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 200OK 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) 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].

7.2.11   Content-Length AVP

The *Content-Length* AVP (AVP code 227) is of type UTF8String and holds the size of the of the message-body, as described in [17].

7.2.12   Content-Type AVP

The *Content-Type* AVP (AVP code 226) is of type UTF8String and holds the media type (e.g. application/sdp, text/html) of the message-body, as described in [17].

7.2.13   Cost-Information AVP

The *Cost-Information* AVP (AVP Code 218) 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: 218>

        { Cost }

~~{ Currency Code }~~

7.2.14 Direction AVP

The *Direction* AVP (AVP code 259) 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) 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) 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 >

          [SIP-Method]

          [Event]

          [Content-Type]

          [Content-Length]

          [Content-Disposition]

7.2.17 GGSN-Address AVP

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

7.2.18 GPRS-Charging-ID AVP

The *GPRS-Charging-ID* AVP (AVP code 246) is of type UTF8String and holds a sequence number generated by the GGSN at PDP context activation, as described in [2].

~~7.2.19 Granted-Service-Unit AVP~~

~~If the ACA containing the *Granted Service Unit* AVP (AVP code 213) 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: 213 >~~

~~{ Unit Type }~~

~~{ Unit-Value }~~

7.2.20 IMS-Charging-Identifier (ICID) AVP

The *IMS-Charging-Identifier* AVP (AVP code 241) 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.

7.2.21 Incoming-Trunk-Group-ID AVP

The *Incoming-Trunk-Group-ID* AVP (AVP code 252) 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) 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 >

        [Originating-IOI]

        [Terminating-IOI]

7.2.23 Mime-Type AVP

The *Mime-Type* AVP (AVP code 258) 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) 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) 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) 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) 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) 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 >
>
> > [SDP-Media-Name]
> >
> > *[SDP-Media-Description]
> >
> > [GPRS-Charging-Id]

7.2.29　SDP-Media-Description AVP

The *SDP-Media-Description* AVP (AVP code 245) is of type UTF8String and holds the content of an "attribute-line" (i=, c=, b=, k=, a=, etc.) related to a media component, as described in [17]. 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) 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) is of type UTF8String and holds the content of an "attribute-line" (i=, c=, b=, k=, a=, etc.) related to a session, as described in [17].

7.2.32　Served-Party-IP-Address AVP

The *Served-Party-IP-Address* AVP (AVP code 248) 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.

7.2.33　Service-ID AVP

The *Service-ID* AVP (AVP code 255) 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) 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.

7.2.35 SIP-Request-Timestamp AVP

The *SIP-Request-Timestamp* AVP (AVP code 234) 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) 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 Tariff-Switch-Definition AVP

The *Tariff-Switch-Definition* AVP (AVP Code 207) 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).

7.2.38 Terminating-IOI AVP

The *Terminating-IOI* AVP (AVP code 240) 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-Stamp* AVP (AVP code 233) 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 >

    [SIP-Request-Timestamp]

    [SIP-Response-Timestamp]

7.2.40 Trunk-Group-ID AVP

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

It has the following ABNF grammar:

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

    [Incoming-Trunk-Group-ID]

    [Outgoing-Trunk-Group-ID]

7.2.41 Unit-Type AVP

The *Unit-Type* AVP is of type Enumerated (AVP Code 203) 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.

7.2.42   Unit-Value AVP

The *Unit Value* AVP is of type Float64 (AVP Code 204) 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.

7.2.43 Unit-Value-After-Tariff-Switch AVP

The *Unit-Value-After-Tariff-Switch* AVP is of type Float64 (AVP Code 205) 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.

7.2.44 Used-Service-Unit AVP

The *Used-Service-Unit* AVP is of type Grouped AVP (AVP Code 202) 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: 202 >

        { Unit-Type }

        { Unit-Value }

        { Unit-Value-After-Tariff-Switch }

        [Currency-Code]

7.2.45 User-Session-ID AVP

The *User-Session-Id* AVP (AVP code 230) 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) 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: 256 >

            [Amount-of-UUS-Data]

[Mime-Type]

[Direction]

End of Change in subclause 7.2

Annex A (Normative):
Diameter Credit Control Application

The document included in this Annex is the latest available Internet Draft at the time of writing. When the IETF issues the RFC to this Internet Draft then a change request will be provided to replace the text in Annex A with a reference in clause 2.

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INTERNET-DRAFT   Ericsson,
Draft:<draft-hakala-diameter-credit-control-05.txt>   Juha-Pekka
Expires: May 2003   Koskinen,
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                                                       November 2002

                      Diameter Credit Control Application

Status of this memo

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   should be directed to the authors.

Abstract

   This document specifies a Diameter application that is used for real-
   time cost and credit control between a service element and a credit
   control server in service environment.

   Diameter accounting messages with additional AVPs are used to
   transfer service and credit control information between the service
   element and the credit control server.

CR page 38

1 Introduction

   This Diameter application, combined with the Diameter base protocol
   [DIAMBASE], describes the accounting protocol that can be used for
   real time cost and credit control in the service environment.

   The next generation wireless networks specify (e.g. 3G Charging and
   Billing requirements [3GPPCHARG]) more critical requirements for the
   accounting applications. The accounting application must be able to
   rate accounting information in real time. For example, for the
   service environment it is vital to be able to rate service event
   information instantly.

   There also exists a demand for the end user credit control. The
   accounting application must be able to check the end user's account
   for coverage for the requested service event charge prior to
   execution of that service event. All the chargeable events related to
   a specific account must be prevented from the end user when the
   credit of that account is exhausted or expired.

   Also a mechanism should be provided to indicate to the end user of
   the charges to be levied for a chargeable event.

   There are as well services such as gaming or advertising that in some
   situations rather refund than deduct the end user's account.

   To fulfill all these needs a new type of accounting application is
   needed, the credit control application. This application is used for
   real-time delivery of service event information in the service
   environment from the service element to the credit control server to
   minimize the financial risk.

1.1. Requirements language

   In this document, the key words "MAY", "MUST, "MUST NOT", "optional",
   "recommended", "SHOULD", and "SHOULD NOT", are to be interpreted as
   described in [KEYWORDS].

1.2 Terminology

   AAA
   Authentication, Authorization and Accounting

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Accounting
The act of collection of information on resource usage for the purposes of trend analysis, auditing, billing or cost allocation.

Accounting Server
The accounting server receives accounting data from the service elements and other devices and translates it into session records. It acts as an interface to back-end rating, billing, and operations support systems.

Charging
In the telecom world charging is synonym to accounting. A function whereby information related to a chargeable event is transferred in order to make it possible to determine usage for which the charged party may be billed.

Credit Control
Credit control is a mechanism, which directly interacts in real-time with an account and controls or monitors the charges, related to the service usage. Credit control is a process of checking if credit is available, credit reservation, reduction of credit from the end user account when service is completed and refunding of reserved credit not used.

Credit Control Server
It is located in the home environment and is accessed by service elements in real-time for purpose of price determination and credit control before the service event is delivered to the end-user. It may also interact with business support systems.

Diameter Credit Control Client
A Diameter credit control client is an entity that interacts with a credit control server.

Diameter Credit Control Server
A Diameter credit control server is an entity that handles credit control request.

Rating
The act of determining the cost of the service event.

Service
A type of task that is performed by a service element for an end user.

Service Element
A network element that provides a service to end user. A service element itself can include the application service providers or application service providers can be located in an other domain.

Service Event
Any event which creates value for the end-user.

1.3 Advertising application support

Diameter nodes conforming to this specification MAY advertise support by including the value of TBD (X) in the Acct-Application-Id AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer command [DIAMBASE].

2 Architecture Model

A service element provides services to end-users. When accounting is used a service element collects service event information and reports it while and/or after services are provided to an accounting server by using an accounting protocol. Alternatively the accounting server may query the service element for service event information.

The accounting protocol can for example be RADIUS accounting protocol or the Diameter base protocol with a Diameter application.

If real-time credit control is required, the service element (credit control client) contacts the credit control server with service event information included before the service is provided. The credit control server, depending on the service event information, MAY perform the rating of the service event, pricing of the service event, credit check and credit-reservation from the account. The service element monitors the service execution according to the instructions returned by the credit control server. After the service completion the credit control server deducts the money from the account.

If direct debiting/refunding is requested, the credit control server deducts/increases the end user's account, respectively. The service element can also enquire the price of the service or the account balance status from the credit control server.

In a multi-service environment it might happen that an end user with already ongoing service (e.g. voice call) issues a new service request (e.g. data service) towards same account or during an active multimedia session an additional media type is added to the session causing a new simultaneous request towards same account. Consequently this SHOULD be considered when units are granted to the services.

There MAY be multiple credit control servers in the system for reasons of redundancy and load balancing. The system MAY also contain separate rating server(s) and accounts MAY locate in a centralized database. System internal interfaces can exist to relay messages between servers and an account manager. However the detailed architecture of credit control system and its interfaces are implementation specific and are out of scope of this specification.

The credit control protocol is the Diameter base protocol with the Diameter credit control application.

```
                                      accounting
      +-------------+   +-------------+ protocol   +---------------+
      |    End      |<----->|  Service  |<------------->|  Accounting   |
      |    User     |  +-->|  Element  |<-----+    |    Server     |
      +-------------+  |   +-------------+      |    +---------------+
                       |          |            |
      +-------------+  |          |            |
      |    End      |<--+          |            |
      |    User     |              +------->|Credit Control|
      +-------------+        credit control  |    Server     |
                                 protocol    +---------------+
```
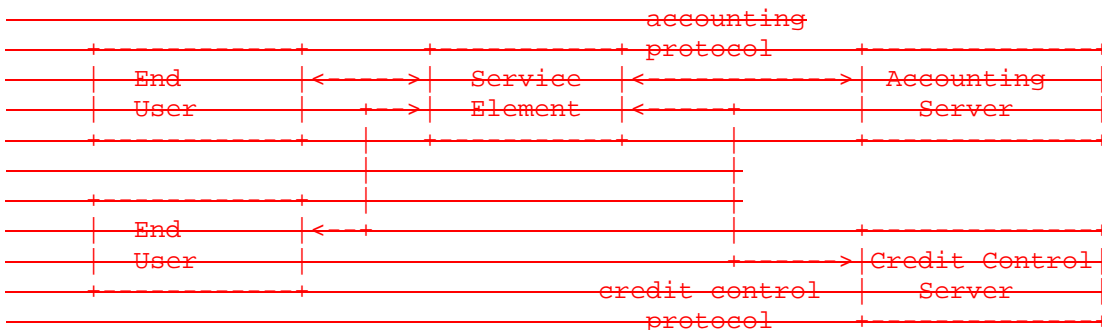
The credit control server and accounting server in this architecture model are logical entities. The real configuration MAY combine them into a single host.

There MAY exist protocol transparent Diameter relays and redirect agents between credit control client and credit control server. These

agents transparently support the Diameter credit control application.

If Diameter credit control proxies exist between the credit control client and the credit control server, they MUST advertise the Diameter credit control application support.

3 Service Control

When an end user requests a service the request is forwarded to a service element in the home domain, that is the same administrative domain, in which the end user's credit control server is located. In some cases it might be possible that the service element in the visited domain can offer service event to the end user, but in that case a commercial agreement must exist between the service element in the visited domain and in the home domain.

The service element SHOULD authenticate and authorize the end user before any request is sent to the credit control server. The way how the authentication and/or authorization are performed in the service element and the authentication and/or authorization messages that are used are not defined in this application. The methods defined in other Diameter applications or other legacy authentication and authorization methods can be used.

Each credit control session MUST have globally unique Session-Id as defined in [DIAMBASE] and it MUST NOT be changed during the life time of a credit control session.

The Diameter credit control client in the service element MAY get information from the authorization server regarding the way accounting data shall be forwarded (accounting protocol, credit control protocol or both) based on its knowledge of the end user. This means that the accounting information is forwarded to the accounting server as defined in [DIAMBASE], the credit control server SHOULD be contacted before the service event is offered to the end user or both the accounting protocol and the credit control protocol MAY be used in parallel.

The authorization server MAY include the Accounting Realtime Required AVP to determine what to do if the sending of accounting records to the accounting server has been temporarily prevented as defined in [DIAMBASE]. The Accounting-Realtime-Required AVP is not used by this application. Instead of or in addition to the Accounting-Realtime-Required AVP the authorization server MAY include the Credit-Control-Failure-Handling AVP and Direct-Debiting-Failure-Handling AVP to determine what to do if the sending of credit control messages to the credit control server has been temporarily prevented. The usage of Credit-Control-Failure-Handling AVP and the Direct-Debiting-Failure-Handling AVP gives flexibility to have different failure handling for credit control session and one time event direct debiting. The credit control server MAY override the failure handling for credit control session by including the Credit-Control-Failure-Handling AVP in the Accounting-Answer.

The usage of separate AVPs makes it possible to have different failure handling towards accounting servers and credit control servers, in case both should be used parallel. It is recommended that the client complements the credit control failure procedures with backup accounting flow towards an accounting server. With different combinations of above AVPs different safety levels can be built. For example by choosing the Credit-Control-Failure-Handling AVP equal to CONTINUE and Accounting-Realtime-Required AVP equal to DELIVER_AND_GRANT the service can be granted to the end user even if

the connection to the credit control server is down but the accounting server is able to collect the accounting information, provided that there is information exchange taking place between the accounting server and credit control server.

If authentication and authorization is done based on Diameter application the authorization server MAY include the Acct-Interim-Interval AVP to control the operation of the device in the service element operating as a client as defined in [DIAMBASE]. If the Acct-Interim-Interval AVP is included then the interim interval MAY be present in the request message sent to the credit control server.

The Diameter credit control server MAY override the interim interval. It is up to the credit control server to determine, even independently from the requested value, the allowed interim interval to be used for consumption of the granted service units. The credit control server MAY return the interim interval in the Answer message to the credit control client. It can be included in the Answer message even in case it is not present in the Request message. Alternatively the accounting interim interval can be omitted from the Answer message. However, since interim records are also produced at the expiry of granted service units and/or for mid-session service events the omission of Acct-Interim-Interval does not mean that interim records are not produced.

During authorization, the authorization server MAY return the Accounting-Multi-Session-Id, which the Diameter credit control client MAY include in all subsequent accounting messages. The Accounting-Multi-Session-Id AVP MAY include the value of the original Session-Id. It's contents are implementation specific, but MUST be globally unique across other Accounting Multi Session Id, and MUST NOT be changed during the life time of a credit control session. There are certain applications that require multiple accounting sub-sessions. Such applications would send messages with a constant Session Id AVP, but a different Accounting Sub Session Id AVP. If several credit sub-sessions will be used, all sub-sessions MUST be closed separately before the closing the main session. The absence of this AVP implies no sub-sessions are in use.

If the credit control client wants to perform credit-reservation before granting service to the end user it MUST use several interrogations towards the credit control server. In this case the credit control server MUST maintain the accounting session state.

A one time event MAY be used when there is no need to maintain any state in the Diameter credit control server, for example enquiring the price of the service.

3.1 Session Based Credit Control

For a session based credit control several interrogations are needed: the first, intermediate (optional) and the final interrogation.

3.1.1 First Interrogation

The first interrogation MUST be sent before the Diameter credit control client in a service element allows any service event to the end user. The Accounting-Record-Type is set to the value START_RECORD in the first request message. The Subscription-Id-Data AVP SHOULD be included to identify the end user in the credit control server.

If the Diameter credit control client knows the cost of the service event the monetary amount to be charged is included in the Requested-

Service-Unit AVP. If the Diameter credit control client does not know the cost of the service event, the Requested-Service-Unit AVP MAY contain the number of requested service events and the Service-Parameter-Info AVP SHOULD contain the service event information to be rated by the credit control server. The Service-Parameter-Info AVP always refers to the requested service units.

The Event-Timestamp AVP contains the time when the service event is requested in the service element.

The credit control server SHOULD rate the service event and make a credit-reservation from the end user's account that covers the cost of the service event. If the type of the Requested-Service-Unit AVP is money, no rating is needed but the corresponding monetary amount is reserved from end user's account.

The credit control server returns the Granted-Service-Unit AVP in the Answer message to the Diameter credit control client. The Granted-Service-Unit AVP contains the amount of service units that the Diameter credit control client can provide to the end user until a new Accounting-Request MUST be sent to the credit control server. If several unit types are sent in the Answer message the credit control client MUST handle each unit type separately. However there MUST be maximum one instance of the same unit type in one Answer message. When the granted service units for one unit type have been spent a new Accounting-Request MUST be sent to the credit control server even though there would be service units left for other units types. The type of the Granted-Service-Unit AVP can be time, volume, service specific or money depending on the type of service event. It is not allowed to change the unit type(s) within the session.

If the credit control server determines that no further control is needed for the service it MAY include the result code indicating that the credit control is not applicable (e.g. service is free of charge) and terminate the credit control session.

The Accounting-Answer message MAY also include the Final-Unit-Indication AVP to indicate that the Answer message contains the final units for the service session. After the end user has used these units, the Diameter credit control client is responsible for terminating the service session and the credit control session by sending the final interrogation to the credit control server.

3.1.2 Intermediate Interrogation

When all the granted service units for one unit type are spent by the end user or the interim interval is expired the Diameter credit control client MUST send a new Accounting-Request to the credit control server. In case the Acct-Interim-Interval is used it is always up to the Diameter credit control client to send a new request well in advance before the expiration of the previous request in order to avoiding interruption in the service element. Even if the granted service units reserved by the credit control server have not been spent upon expiration of the accounting interim interval, the Diameter credit control client MUST send a new Accounting-Request to the credit control server.

There can be also mid-session service events, which might affect the rating of the current service events. In this case a spontaneous updating (a new Accounting-Request) SHOULD be sent including information related to the service event even if all the granted service units have not been spent or the accounting interim interval has not expired.

When the used units are reported to the credit control server the credit control client will not have any units in its possession before new granted units are received from the credit control server. When the new granted units are received from the credit control server these units apply from the point where the measurement of the reported used units stopped.

The Accounting-Record-Type AVP is set to the value INTERIM_RECORD in the intermediate request message. The Subscription-Id-Data AVP SHOULD also be included in the intermediate message to identify the end user in the credit control server.

The Requested-Service-Unit AVP contains the new amount of requested service units. The Used-Service-Unit AVP contains the amount of used service units measured from the point when the service became active or, in case of interim interrogations are used during the session, from the point when the previous measurement ended. The same unit types that are used in the previous message MUST be used. If several unit types were included in the previous Answer message the used service units for each unit type MUST be reported.

The Event-Timestamp AVP contains the time of the event that triggered the sending of the new Accounting-Request.

The credit control server MUST deduct the used monetary amount from the end user's account. It MAY rate the new request and make a new credit-reservation from the end user's account that covers the cost of the requested service event.

The Accounting Answer message with the Accounting Record Type AVP set to the value INTERIM_RECORD MAY include the Cost-Information AVP containing the accumulated cost estimation for the session without taking any credit-reservation into account.

There MAY be several intermediate interrogations within a session.

3.1.3 Final Interrogation

When the end user terminates the service session or when all the granted units are used after a Final-Unit-Indication AVP has been received from the credit control server, the Diameter credit control client MUST send a final Accounting-Request message to the credit control server. The Accounting-Record-Type AVP is set to the value STOP_RECORD.

The Event-Timestamp AVP MAY contain the time of the session was terminated.

The Used-Service-Unit AVP contains the amount of used service units measured from the point when the service became active or, in case of interim interrogations are used during the session, from the point when the previous measurement ended. If several unit types were included in the previous answer message the used service units for each unit type MUST be reported.

After final interrogation the credit control server MUST refund the reserved credit amount not used to the end user's account and deduct the used monetary amount from the end user's account.

The Accounting-Answer message with the Accounting-Record-Type set to the value STOP_RECORD SHOULD include the Cost-Information AVP containing the estimated total cost for the session in question.

3.1.4 Failure Procedures

Since the credit control application is based on real-time bi-
directional communication between the credit control client and the
credit control server alternative destinations and buffering of
messages are not sufficient in the event of communication failures.
Since the credit control server has to maintain a session state the
credit control message stream MUST not be moved to a backup credit
control server during an ongoing credit control session. However,
Diameter agents MAY perform failover to an alternative agent when
they detect a transport failure. As a consequence the credit control
server MAY receive duplicate messages. These duplicates or out of
sequence messages can be detected in the credit control server based
on the credit control server session state machine (section 3.3),
Session-Id AVP and Accounting-Record-Number AVP.

If a communication failure occurs during an ongoing credit control
session the credit control client will terminate or continue the
service depending on the value set in the Credit-Control-Failure-
Handling AVP. The Credit-Control-Failure-Handling AVP MAY be sent
from the authorization server and in the Accounting-Answer from the
credit control server. For new credit control sessions failover to
alternative credit control server SHOULD be performed, if possible.

The timer Tx (as defined in section 8) is used in the credit control
client to supervise the communication with the credit control server.

If the credit control server detects a failure during an ongoing
credit control session it will terminate the credit control session
and return the reserved units back to the end user's account.

The supervision session timer Ts as defined in [DIAMBASE] is used in
the credit control server.

3.2 One Time Event

The one time event is used when there is no need to maintain
accounting session state in the credit control server.

The one time event can be used when the service element wants to know
the cost of the service event without any credit-reservation or to
check the account balance without any credit-reservation. It can be
used also for refunding service units on the user's account or direct
debiting without any credit-reservation.

3.2.1 Service Price Enquiry

Sometimes the service element needs to know the price of the service
event. There might exist services offered by application service
providers, whose prices are not known in the service element. End
user might also want to get an estimation of the price of a service
event before requesting it.

A Diameter credit control client requesting the cost information MUST
set the Accounting-Record-Type AVP equal to EVENT_RECORD, include the
Requested-Action AVP set to PRICE_ENQUIRY and set the requested
service event information into the Service-Parameter-Info AVP in the
Accounting-Request message.

The credit control server calculates the cost of the requested
service event, but it does not perform any account balance check or
credit-reservation from the account.

The estimated price of the requested service event is returned to the credit control client in the Cost Information AVP in the Accounting Answer message.

3.2.2 Balance Check

Sometimes Diameter credit control client needs only to verify that the end user's account balance covers the cost for a certain service without reserving any units from the account at the time of the enquiry. This method does not guarantee that there would be credit left when the Diameter credit control client requests the debiting of the account with a separate request.

A Diameter credit control client requesting the balance check MUST set the Accounting-Record-Type AVP equal to EVENT_RECORD, include Requested-Action AVP set to CHECK_BALANCE and include the Subscription-Id-Data to identify the End-User in the credit control server.

The credit control server makes the balance check, but it does not do any credit reservation from the account.

The result of balance check (Credit/No Credit) is returned to the credit control client in the Check-Balance-Result AVP in the Accounting Answer message.

3.2.3 Direct Debiting

There are certain one time events for which service execution is always successful in the service environment. Sometimes the delay between the service invocation and the actual service delivery to the end user can be so long that the use of the session based credit control would lead to unreasonable long credit control sessions. In these cases the Diameter credit control client can use the one time event scenario for direct debiting. The Diameter credit control client SHOULD be sure that the requested service event execution will be successful, when this scenario is used.

The Accounting-Record-Type is set to the value EVENT_RECORD and the Requested-Action AVP set to DIRECT_DEBITING in the Accounting-Request message. The Subscription-Id-Data AVP SHOULD be included to identify the End-User in the credit control server. The Event-Timestamp AVP contains the time when the service event is requested in the service element.

The Diameter credit control client MAY include the monetary amount to be charged in the Request-Service-Unit AVP, if it knows the cost of the service event. If the Diameter credit control client does not know the cost of the service event, then the Service-Parameter-Info AVP SHOULD contain the service event information to be rated by the credit control server. The Service-Parameter-Info AVP always refers to the requested service unit.

The credit control server SHOULD rate the service event and deduct the corresponding monetary amount from end user's account. If the type of the Requested-Service-Unit AVP is money, no rating is needed but the corresponding monetary amount is deducted from the End User's account.

The credit control server returns the Granted-Service-Unit AVP in the Answer message to the Diameter credit control client. The Granted-Service-Unit AVP contains the amount of service units that the

Diameter credit control client can provide to the end user. The type of the Granted-Service-Unit can be time, volume, service specific or money depending on the type of service event.

If the credit control server determines that no credit control is needed for the service it MAY include the result code indicating that the credit control is not applicable (e.g. service is free of charge).

For informative purposes, the Accounting-Answer message SHOULD also include the Cost-Information AVP containing the estimated total cost of the requested service.

3.2.4 Refund

There MAY be a need to refund service units on the end user's account, for example gaming services.

The credit control client MUST set Accounting-Record-Type AVP to the value EVENT_RECORD and the Requested-Action AVP to REFUND in the Accounting-Request message. The Subscription-Id-Data AVP SHOULD be included to identify the End-User in the credit control server.

The Diameter credit control client MAY include the monetary amount to be refunded in the Request-Service-Unit AVP, if it knows the cost of the service event. If the Diameter credit control client does not know the cost of the service event, then the Service-Parameter-Info AVP SHOULD contain the service event information to be rated by the credit control server. The Service-Parameter-Info AVP always refers to the requested service unit.

For informative purposes, the Accounting-Answer message MAY also include the Cost-Information AVP containing the estimated monetary amount of refunded unit.

3.2.5 Failure Procedure

There MAY exist protocol transparent Diameter relays and redirect agents or Diameter credit control proxies between credit control client and credit control server. These agents MAY perform failover procedures if they detect transport failure as described in [DIAMBASE].

When the credit control client detects a communication failure to the credit control server its behavior depends on the requested action. The timer Tx (as defined in section 8) is used in the credit control client to supervise the communication with the credit control server.

In case the requested action is Service Price Enquiry or Balance Check and communication failure is detected the credit control client MAY forward the request messages to an alternative credit control server, if possible.

If the requested action is DIRECT_DEBITING and the Direct-Debiting-Failure-Handling AVP is set to TERMINATE_OR_BUFFER the credit control client SHOULD terminate the service if it can determine from the result code or error code in the answer message that units have not been debited. Otherwise the credit control client SHOULD grant the service to the end user and store the record in the credit control application level non-volatile storage. The credit control client MUST mark these request messages as possible duplicate by setting the T-flag in the command header as described in [DIAMBASE] section 3. If the Direct-Debiting-Failure-Handling AVP is set to CONTINUE the

service SHOULD be granted even if credit control messages can't be delivered. If the timer Tx expires the credit control client MUST continue the service and eventually buffer the request according to the value of the Direct-Debiting-Failure-Handling AVP.

The Accounting-Request with requested action REFUND should always be stored in the credit control application level non-volatile storage in case of temporary failure. The credit control client MUST mark the re-transmitted request message as possible duplicate by setting the T-flag in the command header as described in [DIAMBASE] section 3.

The implementation MAY choose to limit the number of re-transmission attempts and define a re-transmission interval.

Because there can appear duplicate request for various reason the credit control server is therefore responsible for the real time duplicate detection. Implementation issues for duplicate detection are discussed in [DIAMBASE] Appendix C. When the credit control client re-sends messages from its application level non-volatile storage it MUST mark these request messages as possible duplicate by setting the T-flag in the command headers as described in [DIAMBASE] section 3.

Only one place in the credit control system SHOULD be responsible for duplicate detection. If there is only one credit control server within the given realm the credit control server MAY perform duplicate detection. In case when more than one credit control server are supporting the credit control application the accounting manager controlling the account database MAY be responsible for duplicate detection.

3.3 Credit Control Session State Machine

The following state machines MUST be supported for credit control applications.

The first two state machines are to be observed by credit control clients. The first one describes the session based credit control and the second one event based credit control. The third state machine describes the credit control session from a credit control server perspective.

Any event not listed in the state machines MUST be considered as an error condition, and a corresponding answer, if applicable, MUST be returned to the originator of the message.

In the state table, the event 'Failure to send' means that the Diameter credit control client is unable to communicate with the desired destination (i.e. the answer message is not received within the validity time of the request). This could be due to the peer being down, or due to a physical link failure in the path to/from the credit control server.

The event 'Temporary error' means that the Diameter credit control client received a transient failure notification in the Accounting Answer command (i.e. the peer sending back a transient failure or temporary protocol error notification DIAMETER_TOO_BUSY, or DIAMETER_LOOP_DETECTED in the Result-Code AVP).

The event 'Failed answer' means that the Diameter credit control client received non-transient failure (permanent failure) notification in the Accounting Answer command.

The action 'store record' means that a record is stored in the credit control application level non-volatile storage.

The event 'Not successfully processed' means that the credit control server could not process the message, e.g. due to unknown end user, account being empty or due to errors defined in [DIAMBASE].

The states PendingS, PendingI, PendingL PendingE and PendingB stand for pending states to wait for an answer to an accounting request related to a Start, Interim, Stop, Event or Buffered record respectively.

CLIENT, SESSION BASED

State	Event	Action	New State
Idle	Client or device requests access	Send accounting start req., start Tx.	PendingS
PendingS	Successful accounting start answer received	Stop Tx	Open
PendingS	Failure to send, or temporary error and credit control fault handling equal to CONTINUE	Grant service to end user	Idle
PendingS	Failure to send, or temporary error and credit control fault handling equal to TERMINATE	Disconnect user/dev	Idle
PendingS	Tx expired and credit Control fault handling equal to TERMINATE	Disconnect user/dev	Idle
PendingS	Tx expired and credit control fault handling equal to CONTINUE	Grant service to end user	Idle
PendingS	Accounting start answer received with result code SERVICE_ DENIED or USER_NOT_FOUND	Disconnect user/dev	Idle
PendingS	Accounting start answer received with result code equal to credit control N/A	Grant service to end user	Idle
PendingS	Failed accounting start answer received and credit control fault handling equal to CONTINUE	Grant Service to end user	Idle
PendingS	Failed accounting start answer received and credit control failure handling equal to TERMINATE	Disconnect user/dev	Idle
PendingS	User service terminated	Queue termination event	PendingS

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State	Event	Action	New State
~~PendingS~~	~~Change in rating condition~~	~~Queue changed rating condition event~~	~~PendingS~~
~~Open~~	~~Granted unit elapses and no final unit indication received~~	~~Send accounting interim req., start Tx.~~	~~PendingI~~
~~Open~~	~~Granted unit elapses and final unit indication received~~	~~Disconnect send accounting stop req., start Tx.~~	~~PendingL~~
~~Open~~	~~Change in rating condition in queue~~	~~Send accounting interim req., Start Tx.~~	~~PendingI~~
~~Open~~	~~Service terminated in queue~~	~~Send accounting stop req., start Tx~~	~~PendingL~~
~~Open~~	~~Change in rating condition or interim interval elapses~~	~~Send accounting interim req., Start Tx.~~	~~PendingI~~
~~Open~~	~~User service terminated~~	~~Send accounting stop req., start Tx~~	~~PendingL~~
~~PendingI~~	~~Successful accounting interim answer received~~	~~Stop Tx~~	~~Open~~
~~PendingI~~	~~Failure to send, or temporary error and credit control fault handling equal to CONTINUE~~	~~Grant service to end user~~	~~Idle~~
~~PendingI~~	~~Failure to send, or temporary error and credit control fault handling equal to TERMINATE~~	~~Disconnect user/dev~~	~~Idle~~
~~PendingI~~	~~Tx expired and credit control fault handling equal to TERMINATE~~	~~Disconnect user/dev~~	~~Idle~~
~~PendingI~~	~~Tx expired and credit control fault handling equal to CONTINUE~~	~~Grant service to end user.~~	~~Idle~~
~~PendingI~~	~~Accounting interim answer received with result code SERVICE_DENIED~~	~~Disconnect user/dev~~	~~Idle~~

State	Event	Action	New State
PendingI	Accounting interim answer received with result code equal to credit control N/A	Grant service to end user	Idle
PendingI	Failed accounting interim answer received and credit control fault handling equal to CONTINUE	Grant service to end user.	Idle
PendingI	Failed accounting interim answer received and credit control fault handling equal to TERMINATE	Disconnect user/dev	Idle
PendingI	User service terminated	Queue termination event	PendingI
PendingI	Change in rating condition	Queue changed rating condition event	PendingI
PendingL	Successful accounting stop answer received		Idle
PendingL	Tx expired		Idle
PendingL	Failure to send, or temporary error or failed answer		Idle
PendingL	Change in rating condition		PendingL

CLIENT, EVENT BASED

State	Event	Action	New State
Idle	Client or device requests a one-time service	Send accounting event req., Start Tx.	PendingE
Idle	Records in storage	Send stored records	PendingB
PendingE	Successful accounting event answer received		Idle
PendingE	Failure to send, temporary error or failed accounting event answer received, or Tx expired, requested action GET_BALANCE or PRICE_ENQUIRY	Indicate service error	Idle
PendingE	Accounting event answer received with result code SERVICE_ DENIED or USER_NOT_FOUND	Disconnect user/dev	Idle

State	Event	Action	New State
PendingE	Accounting event answer received with result code credit control N/A, requested action DIRECT_DEBITING	Grant service to end user	Idle
PendingE	Failure to send, temporary error or failed accounting event answer received, or Tx expired, requested action DIRECT_DEBITING and fault handling equal to CONTINUE	Grant service to end user	Idle
PendingE	Failed accounting event answer received, requested action DIRECT_DEBITING and fault handling equal to TERMINATE_OR_BUFFER	Disconnect user/dev	Idle
PendingE	Failure to send or Tx expired, requested action DIRECT_DEBITING and fault handling equal to TERMINATE_OR_BUFFER	Grant service to end user and store record with T-flag	Idle
PendingE	Temporary error, requested action DIRECT_DEBITING and fault handling equal to TERMINATE_OR_BUFFER	Disconnect user/dev	Idle
PendingE	Failed accounting event answer received, requested action REFUND	Indicate service error and delete record	Idle
PendingE	Failure to send or Tx expired, requested action REFUND	Store record with T-flag	Idle
PendingE	Temporary error and requested action REFUND	Store record	Idle
PendingB	Successful accounting answer received	Delete record	Idle
PendingB	Failed accounting answer received	Delete record	Idle
PendingB	Failure to send or temporary error		Idle

SERVER, SESSION AND EVENT BASED

State	Event	Action	New State
Idle	Accounting start request received and successfully processed.	Send accounting start answer,	Open

		reserve units, start Ts	
Idle	Accounting start request received, but not successfully processed.	Send accounting start Answer with Result-Code != SUCCESS	Idle
Idle	Accounting event request received and successfully processed.	Send accounting event answer, debit units	Idle
Idle	Accounting event request received, but not successfully processed.	Send accounting event Answer with Result-Code != SUCCESS	Idle
Open	Accounting Interim request received and successfully processed	Send accounting answer, debit used units and reserve new units, Restart Ts	Open
Open	Accounting interim request received, but not successfully processed.	Send accounting interim Answer with Result-Code != SUCCESS, debit used units	Idle
Open	Accounting stop request received, and successfully processed	Send accounting stop answer, Stop Ts, debit used units	Idle
Open	Accounting stop request received, but not successfully processed.	Send accounting stop Answer with Result-Code != SUCCESS, debit used units	Idle
Open	Session supervision timer Ts expired	Stop Ts, release reserved units	Idle

4 Accounting AVPs

This section defines the accounting AVPs that are specific to Diameter Credit Control Application and MAY be included in the Diameter accounting messages [DIAMBASE].

Accounting-Request command MAY include the following additional AVPS:
     [Subscription-Id]
     [Requested-Action]
    *[Requested-Service Unit]
    *[Used-Service-Unit]
    *[Service-Parameter-Info]
     [Abnormal-Termination-Reason]
    *[Accounting-Correlation-Id]
     [Credit-Control-Failure-Handling]

Accounting-Answer command MAY include a following additional AVPS:
     [Subscription-Id]
    *[Granted-Service-Unit]
     [Cost-Information]
     [Final-Unit-Indication]
     [Check-Balance-Result]
     [Credit-Control-Failure-Handling]

The following table describes the Diameter AVPs defined in Credit Control application, their AVP Code values, types, possible flag values and whether the AVP MAY be encrypted.

Attribute Name	AVP Code	Section Defined	Data Type	AVP Flag rules				
				MUST	MAY	SHLD NOT	MUST NOT	MAY Encr
Abnormal-Termination Reason	XXX	4.1	Enumerated	M	P		V	Y
Accounting-Correlation-Id	XXX	4.2	OctetString	M	P		V	Y
Check-Balance-Result	XXX	4.3	Enumerated	M	P		V	Y
Cost-Information	XXX	4.5	Grouped	M	P		V	Y
Credit-Control-Failure-Handling	XXX	4.6	Enumerated	M	P		V	Y
Direct-Debiting-Failure-Handling	XXX	4.8	Enumerated	M	P		V	Y
Final-Unit-Indicator	XXX	4.9	Unsigned32	M	P		V	Y
Granted-Service-Unit	XXX	4.10	Grouped	M	P		V	Y
Requested-Action	XXX	4.11	Enumerated	M	P		V	Y
Requested-Service Unit	XXX	4.12	Grouped	M	P		V	Y
Service-Parameter Info	XXX	4.14	Grouped	M	P		V	Y
Subscription-Id	XXX	4.17	Grouped	M	P		V	Y
Used-Service-Unit	XXX	4.22	Grouped	M	P		V	Y

4.1 Abnormal-Termination-Reason AVP

The Abnormal-Termination-Reason AVP (AVP Code TBD) is of type Enumerated and contains information about the reason for an abnormal service termination in a service element.

The following reasons are defined:

SERVICE_ELEMENT_TERMINATION   0
    An error occurred in the service element.

CONNECTION_TO_END-USER_BROKEN   1
    The connection to the end-user is broken.

4.2 Accounting-Correlation-Id AVP

The Accounting-Correlation-Id AVP (AVP Code TBD) is type of OctetString and contains information to correlate accounting data generated for different components of the service, e.g. transport and service level.

4.3 Check-Balance-Result AVP

The Check-Balance-Result AVP (AVP code TBD) is of type Enumerated and contains the result of the balance check. This AVP is applicable only when the Requested-Action AVP indicates CHECK_BALANCE in the Accounting-Request command.

The following values are defined for the Check-Balance-Result AVP.

ENOUGH_CREDIT   0
    There is enough credit in the account to cover the requested
    service.

NO_CREDIT   1
    There isnÆt enough credit in the account to cover the
    requested service.

4.4 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 Unit-Value AVP contains the cost estimate (always type of money) of the service in case of price enquiry or the accumulated cost estimation in the case of credit control session.
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 estimation 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 estimated total cost for the requested service.

It has the following ABNF grammar:

        <Cost-Information>::=< AVP Header: TBD >
                            { Unit-Value }
                            { Currency-Code }

4.5 Credit-Control-Failure-Handling AVP

The Credit-Control-Failure-Handling AVP (AVP Code TBD) is of type Enumerated. The credit control client uses information in this AVP to decide what to do if the sending of credit control messages to the credit control server has been for instance temporarily prevented due to a network problem.

TERMINATE   0
When the Credit-Control-Failure-Handling AVP is set to TERMINATE the service MUST only be granted as long as there is a connection to the credit control server. If the credit control client does not receive any Accounting-Answer message within the Tx timer (as defined in section 8) the credit control request is regarded failed. The moving of already started credit control session to alternative server is not allowed.

This is the default behaviour if the AVP isn't included in the reply from the authorization or credit control server.

CONTINUE   1
When the Credit-Control-Failure-Handling AVP is set to CONTINUE the service SHOULD be granted even if credit control messages can't be delivered.

4.6 Currency-Code AVP

The Currency-Code AVP (AVP Code TBD) is of type Unsigned32 and contains a currency code that specifies in which currency the values of AVPs containing monetary units were given. It is specified using the numeric values defined in the ISO 4217 standard.

4.7 Direct-Debiting-Failure-Handling AVP

The Direct-Debiting-Failure-Handling AVP (AVP Code TBD) is of type Enumerated. The credit control client uses information in this AVP to decide what to do if the sending of credit control messages (Requested-Action AVP set to Direct Debiting) to the credit control server has been for instance temporarily prevented due to a network problem.

TERMINATE_OR_BUFFER   0
When the Direct-Debiting-Failure-Handling AVP is set to TERMINATE_OR_BUFFER the service MUST be granted as long as there is a connection to the credit control server. If the credit control client does not receive any Accounting-Answer message within the Tx timer (as defined in section 8) the credit control request is regarded failed. The client SHOULD terminate the service if it can determine from the failed answer that units have not been debited. Otherwise the credit control client SHOULD grant the service, store the request to application level non-volatile storage and try to re-send the request. These requests MUST be marked as possible duplicate by setting the T-flag in the command header as described in [DIAMBASE] section 3.

This is the default behaviour if the AVP isn't included in the reply from the authorization server.

CONTINUE   1
When the Direct-Debiting-Failure-Handling AVP is set to CONTINUE the service SHOULD be granted even if credit control messages can't be delivered.

4.8 Exponent AVP

Exponent AVP is of type Integer32 (AVP code TBD) and contains the exponent value to be applied for the Value Digit AVP within the Unit Value AVP.

4.9 Final-Unit-Indication AVP

The Final-Unit-Indication AVP (AVP Code TBD) is of type Unsigned32 and indicates that the Granted-Service-Unit AVP in the accounting command contains the final units for the service. After these units have expired, the Diameter credit control client in a service element is responsible for terminating the service and sending the STOP_RECORD to the credit control server.
If more than one unit types are received in the Accounting-Answer, the Unit type which first expired SHOULD cause the termination.
If included in a command, the value of this AVP is always 1.

4.10 Granted-Service-Unit AVP

Granted-Service-Unit AVP (AVP Code TBD) is of type Grouped and contains the amount of units that the Diameter credit control client can provide to the end user until the service must be released or the new Accounting-Request must be sent. The Unit-Value AVP contains the granted units and the Unit-Type AVP defines the type of the unit.

If the Unit-Type AVP is set to time in the Accounting-Answer command, the Unit Value AVP specifies the granted time in seconds.

If the Unit-Type AVP is set to volume in the Accounting-Answer command, the Unit-Value AVP specifies the granted volume in bytes.

If the Unit-Type AVP is set to service specific in the Accounting-Answer command, the Unit-Value AVP specifies the granted number of service specific units (e.g. number of events, points) given in a selected service.

If the Unit-Type AVP is set to money in the Accounting-Answer command, the Unit-Value AVP specifies the granted monetary amount in the given currency. If the unit type is money, a Currency Code AVP SHOULD be included.

It has the following ABNF grammar:

```
<Granted-Service-Unit>::=< AVP Header: TBD >
                          { Unit-Type }
                          { Unit-Value }
                          [ Currency-Code ]
```

4.11 Requested-Action AVP

The Requested-Action AVP (AVP Code TBD) is type of Enumerated and contains the requested action being sent by Accounting-Request command where the Accounting-Record-Type is set to EVENT_RECORD. The following values are defined for the Requested-Action AVP:

DIRECT DEBITING   0
Direct debiting indicates that the request is to decrease the end user's account according to information specified in the Requested-Service-Unit AVP and/or Service-Parameter-Info AVP. The Granted-Service Unit AVP in the Accounting-Answer command contains the debited units.

REFUND ACCOUNT   1
Refund account indicates that the request is to increase the end

user's account according to information specified in the
Requested-Service-Unit AVP and/or Service-Parameter-Info AVP.
The Granted Service Unit AVP in the Accounting Answer command
contains the refunded units.

CHECK_BALANCE   2
Check balance indicates that the request is a balance check
request. In this case the checking of the account balance is
done without any credit reservation from the account. The Check-
Balance-Result AVP in the Accounting-Answer command contains the
result of the Balance Check.

PRICE_ENQUIRY   3
Price Enquiry indicates that the request is a price enquiry
request. In this case neither checking of the account balance
nor reservation from the account will be done, only the price of
the service will be returned in the Cost-Information AVP in the
Accounting-Answer Command.

4.12 Requested-Service-Unit AVP

The Requested-Service-Unit AVP (AVP Code TBD) is of type Grouped and
contains the amount of requested units specified by the Diameter
credit control client. The included Unit-Value AVP contains the
requested Unit-Value and the Unit-Type AVP defines the type of the
unit.

If the Unit Type AVP is set to time in the Accounting-Request
command, the Unit-Value AVP specifies the requested time in seconds.

If the Unit type AVP is set to volume in the Accounting Request
command, the Unit-Value AVP specifies the requested volume in bytes.

If the Unit-type AVP is set to service specific in the Accounting-
Request command, the Unit Value AVP specifies the used number of
service specific units (e.g. number of events) given in a selected
service.

If the Unit Type AVP is set to money in the Accounting Request
command, the Unit-Value AVP specifies the monetary amount in the
given currency. If the unit type is money, a Currency-Code AVP SHOULD
be included.

It has the following ABNF grammar:

        <Requested-Service-Unit>::=< AVP Header: TBD >
                                   { Unit-Type }
                                   { Unit-Value }
                                   [Currency-Code]

4.13 Service-Parameter-Info AVP

The Service-Parameter-Info AVP (AVP Code TBD) is of type Grouped and
contains a service specific information used for price calculation or
rating. The Service-Parameter-Type AVP defines the service parameter
type and the Service-Parameter-Value AVP contains the parameter
value. Alternatively it MAY also contain IANA registered standard
AVPs or vendor specific AVPs. The actual contents of these AVPs are
not within the scope of this document and SHOULD be defined in
another Diameter application, standards written by other
standardization bodies, or service specific documentation.

In case of unknown service request (e.g. unknown AVP or Service-Parameter-Type), the corresponding answer message MUST contain error code DIAMETER_AVP_UNSUPPORTED or DIAMETER_INVALID_AVP_VALUE. An Accounting Answer message with these errors MUST contain one or more FAILED-AVP AVPs containing the AVPs that caused the failure.

It has the following ABNF grammar:

```
<Service-Parameter-Info>::=< AVP Header: TBD >
                          [ Service-Parameter-Type ]
                          [ Service-Parameter-Value ]
                          [ AVP ]
```

4.14 Service-Parameter-Type AVP

The Service-Parameter-Type AVP is of type Unsigned32 (AVP Code TBD) and defines the type of the service event specific parameter (e.g. it can be end-user location, service name). The different parameters and their types are service specific and the meanings of these parameters are not defined in this document. The Service-Parameter-Value AVP contains the service parameter type.

4.15 Service-Parameter-Value AVP

The Service-Parameter-Value AVP is of type UTF8String (AVP Code TBD) and contains the value of the service parameter type.

4.16 Subscription-Id AVP

The Subscription-Id AVP (AVP Code TBD) is used to identify the end userÆs subscription and is of type Grouped. The Subscription Id AVP includes a Subscription-Id-Data AVP that hold the identifier and a Subscription-Id-Type AVP that defines the identifier type.

It has the following ABNF grammar:

```
<Subscription-Id>::=< AVP Header: TBD >
                    { Subscription-Id-Data }
                    { Subscription Id Type }
```

4.17 Subscription-Id-Data AVP

The Subscription-Id-Data AVP (AVP Code TBD) is used to identify the end-user and is of type UTF8String. The Subscription-Id-Type AVP defines which type of identifier is used.

4.18 Subscription-Id-Type AVP

The Subscription-Id-Type AVP (AVP Code TBD) is of type Enumerated and it is used to determine which type of identifier that is carried by the Subscription-Id AVP.

The identifier can be one of the following:

END_USER_MSISDN   0
     The identifier is in international MSISDN format, according to the ITU-T E.164 numbering plan as defined in [E164] and [CE164].

END_USER_IMSI   1
     The identifier is in international IMSI format, according to the ITU-T E.212 numbering plan as defined in [E121] and [CE121].

END_USER_SIP_URL   2
          The identifier is in the form of a SIP URL as defined in
          [SIP].

      END_USER_NAI   3
          The identifier is in the form of a Network Access Identifier
          as defined in [NAI].

      END_USER_PRIVATE   4
          The Identifier is a credit control server private identifier.

4.19 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:

      CREDIT_TYPE_TIME   0
          The unit is of type time, given in seconds.

      CREDIT_TYPE_VOLUME   1
          The unit is of type volume, given in bytes.

      CREDIT_TYPE_SERVICE_SPECIFIC   2
          The unit is service specific (e.g. number of events,
          points, chips, services etc), given in a selected service.

      CREDIT_TYPE_MONEY   3
          The unit is of type money, given as a monetary value, whose
          currency SHOULD be specified by the Currency Code AVP.

4.20 Unit-Value AVP

   Unit Value AVP is of type Grouped (AVP Code TBD). The value can be
   time in seconds, volume in bytes, number of service specific units or
   monetary amount depending on the given unit type. The Unit-Value is a
   value together with an exponent, i.e. Unit-Value = Value-Digits AVP *
   10^Exponent. This representation avoids unwanted rounding off. For
   example the value of 2,3 is represented as Value-Digits = 23 and
   Exponent = -1. The absence of exponent part MUST be interpreted as
   exponent being equal to zero.

   It has the following ABNF grammar:

              <Unit-Value>::=< AVP Header: TBD >
                             { Value-Digits }
                             [Exponent]

4.21 Used-Service-Unit AVP

   The Used-Service-Unit AVP is of type Grouped AVP (AVP Code TBD) and
   contains the amount of used units measured from the point when the
   service became active or, in case of interim interrogations are used
   during the session, from the point when the previous measurement
   ended. The included Unit-Type AVP defines the type of the unit and
   the Unit-Value AVP contains the used amount.

   If the Unit Type AVP is set to time in the Accounting-Request
   command, the Unit-Value AVP specifies the used time in seconds.

   If the Unit-Type AVP is set to volume in the Accounting-Request
   command, the Unit-Value AVP specifies the used volume in bytes.

If the Unit-type AVP is set to service specific in the Accounting-Request command, the Unit Value AVP specifies the used number of service specific units (e.g. number of events) given in a selected service.

If the Unit-Type AVP is set to money in the Accounting-Request command, the Unit-Value AVP specifies the used monetary amount in the given currency. If the unit type is money, a Currency-Code AVP SHOULD be included.

It has the following ABNF grammar:

```
        <Used-Service-Unit>::=< AVP Header: TBD >
                             { Unit-Type }
                             { Unit-Value }
                             [ Currency-Code ]
```

4.22 Value-Digits AVP

The Value-Digits AVP is of type Unsigned64 (AVP code TBD) and contains the number of seconds, volume in bytes, number of service specific units or monetary amount depending on the given Unit-Type AVP. If decimal values are needed to present the units, the scaling MUST be indicated with the related Exponent AVP. For example for the monetary amount $ 0,05 the value of Value-Digits AVP MUST be set to 5 and the scaling MUST be indicated with the Exponent AVP set to û2.

5 Result Code AVP values

This section defines new Result Code AVP [DIAMBASE] values that must be supported by all Diameter implementations that conform to this specification.

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 userÆs session to be terminated.

5.1 Transient Failure

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 credit control server 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 is needed for the service (e.g. service is free of charge).

5.2 Permanent Failures

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

DIAMETER_USER_UNKNOWN   50XX
The specified end user is unknown in the credit control server.

6 AVP Occurrence Table

The following table presents the AVPs defined in this document, and specifies in which Diameter messages they MAY, or MAY NOT be present. Note that AVPs that can only be present within a Grouped AVP are not represented in this table.

The table uses the following symbols:

0		The AVP MUST NOT be present in the message.
0+		Zero or more instances of the AVP MAY be present in the message.
0-1		Zero or one instance of the AVP MAY be present in the message. It is considered an error if there are more than once instance of the AVP.
1		One instance of the AVP MUST be present in the message.
1+		At least one instance of the AVP MUST be present in the message.

6.1 Accounting AVP Table

The table in this section is used to represent which Credit Control applications specific AVPs defined in this document are to be present in the accounting messages.

	Command Code	
Attribute Name	ACR	ACA
Abnormal-Termination-Reason	0-1	0
Accounting-Correlation-Id	0-1	0
Credit-Control-Failure-Handling	0-1	0-1
Check-Balance-Result	0	0-1
Cost-Information	0	0-1
Direct-Debiting-Failure-Handling AVP	0	0
Final-Unit-Indication	0	0-1
Granted-Service-Unit	0	0+
Requested-Action	0-1	0
Requested-Service-Unit	0-1	0
Service-Parameter-Info	0+	0
Subscription-Id	0-1	0-1
Used-Service-Unit	0+	0

7 IANA Considerations

This section contains the namespaces that have either been created in this specification, or the values assigned to existing namespaces managed by IANA.

7.1 Application Identifier

This specification assigns the value TBD to the Application Identifier namespace defined in [DIAMBASE]. See section 1.3 for more information.

7.2 Command Codes

This specification uses the value 271 from the Command code namespace

defined in [DIAMBASE].

7.3 AVP Codes

This specification assigns the values TBD – TBD from the AVP code namespace defined in [DIAMBASE] See section 4.0 for the assignment of the namespace in this specification.

7.4 Result-Code AVP Values

This specification assigns the values 40XX and 50XX from the Result-Code AVP (AVP Code 268) value namespace defined in [DIAMBASE]. See section 5.0 for the assignment of the namespace in this specification.

7.5 Abnormal-Termination-Reason AVP

As defined in Section 4.1, the Abnormal-Termination-Reason AVP (AVP Code TBD) defines the values 0-1. All remaining values are available for assignment via Designated Expert [IANA].

7.6 Check-Balance-Result AVP

As defined in Section 4.3, the Check-Balance-Result AVP (AVP Code TBD) defines the values 0-1. All remaining values are available for assignment via Designated Expert [IANA].

7.7 Credit-Control-Failure-Handling AVP

As defined in Section 4.6, the Credit-Control-Failure-Handling AVP (AVP Code TBD) defines the values 0 1. All remaining values are available for assignment via Designated Expert [IANA].

7.8 Direct-Debiting-Failure-Handling AVP

As defined in Section 4.8, the Direct-Debiting-Failure-Handling AVP (AVP Code TBD) defines the values 0-1. All remaining values are available for assignment via Designated Expert [IANA].

7.9 Requested-Action AVP

As defined in Section 4.11, the Requested-Action AVP (AVP Code TBD) defines the values 0-3. All remaining values are available for assignment via Designated Expert [IANA].

7.10 Subscription-Id-Type AVP

As defined in Section 4.17, the Subscription-Id-Type AVP (AVP Code TBD) defines the values 0-4. All remaining values are available for assignment via Designated Expert [IANA].

7.11 Unit-Type AVP

As defined in Section 4.20, the Unit-Type AVP (AVP Code TBD) defines the values 0-3. All remaining values are available for assignment via Designated Expert [IANA].

8 Credit Control Application related parameter

Tx timer
When real-time credit control is required, the credit control client contacts the credit control server before and during the service is provided to an end user. Due to real-time nature of

application the communication delays SHOULD be minimized, e.g. to avoid too long service set up time experienced by the end user. The Tx timer is introduced to control the waiting time in the client in the PENDING state.

The recommended value is 10 seconds.

9 Security Considerations

The security models as defined in the Diameter base protocol [DIAMBASE] applies to this application too.

10 References

10.1 Normative

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10.2 Non-Normative

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End of Change in Annex A
End of Document

~~Annex B~~ (informative):
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
Mar 2003	S_19	SP-030057	004	--	Alignment of Immediate Event Charging (IEC) description with the latest draft IEFT Credit-Control specification	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	005	--	Correction of the IMS Charging Identifier (ICID) definition	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	006	--	Correction of IMS-CDR definitions	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	007	--	Inclusion of IETF draft 'Hakala-diameter-credit-control' specification version 05	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	008	--	Removal of Re-Transmission Attribute Value Pair (AVP) in order to align duplicate detection procedure with the Diameter Base protocol	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	009	--	Correction of the accounting session supervision (Offline) - alignment with the Diameter Base protocol	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	010	--	Correction of the accounting session supervision (Online) - alignment with the Diameter Base protocol	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	011	--	Correction of the support of local file storage and use of FTP for transfer of Accounting Information	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	012	--	Correction of abnormal session termination procedure	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	013	--	Correction of network initiated session release procedure - alignment with SIP (IETF RFC 3261)	5.1.0	5.2.0
Mar 2003	S_19	SP-030057	014	--	Correction of media modification procedures - add the UPDATE SIP method	5.1.0	5.2.0
Jun 2003	S_20	SP-030271	015	--	Corrections to align "Event Charging with Unit Reservation" (ECUR) with IETF Credit Control Application	5.2.0	5.3.0
Jun 2003	S_20	SP-030271	016	--	Correction of usage of Application-Provided-Called-Party-Address AVP	5.2.0	5.3.0
Jun 2003	S_20	SP-030271	017	--	Correction of "Cause" and "Service-ID"AVP	5.2.0	5.3.0
Jun 2003	S_20	SP-030271	018	--	Correction to some AVP definitions	5.2.0	5.3.0
Jun 2003	S_20	SP-030271	019	--	Correction on ICID definition	5.2.0	5.3.0
Dec 2003	S_22	SP-030622	020	--	Correction of MRFC-CDR content definition for multi-party-call establishment	5.3.0	5.4.0
Dec 2003	S_22	SP-030622	021	--	Correction on ICID definition	5.3.0	5.4.0
Dec 2003	S_22	SP-030622	022	--	Removal of ASR and ASA	5.3.0	5.4.0
Mar 2004	S_23	SP-040143	023	--	Correction of AVP Codes and Diameter protocol specific details	5.4.0	5.5.0
Mar 2004	S_23	SP-040143	024	--	Corrections on the Session Description Protocol (SDP) parameters	5.4.0	5.5.0
Mar 2004	S_23	SP-040143	025	--	Correction of reference to diameter base protocol	5.4.0	5.5.0