Technical Specification Group Services and System Aspects ***TSGS#14(01)0718***
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Title: **TR on " Charging implications of IMS architecture"**
Agenda Item: **7.2.3**

This TR is the results of the action point decided at the joint SA1/SA2/SA5 meeting on IMS charging help in August 2001 in Sophia-Antipolis.

It identifies the charging implications of the IMS architecture. It is expected that the content of this TR will act as a basis for CRs against the architecture specifications of SA2, clarifying the architecture implications on charging, and the Charging Principles specification of SA5, which contains the charging architecture and mechanisms. It should also lead to detailed specification of Charging Data Description in SA5.

It is now judged ready for hand-over of IMS offline charging from SA2 to SA5.

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Technical Report

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Foreword

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

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Version x.y.z

where:

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

1 Scope

The present document identifies the charging implications of the IMS architecture, which is described in 23.002 [5] and 23.228 [4].

It is expected that the content of this TR will act as a basis for

- change requests against the architecture specifications [4, 5] of SA2, clarifying the architecture implications on charging,
- change requests against the Charging Principles specification [3] of SA5, which contains the charging architecture and mechanisms.
- detailed specification of Charging Data Description [6] in SA5.

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.

[7] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

- 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 41.001: "GSM Release specifications".

[2] 3GPP TS 21.905: "Vocabulary for 3GPP Specifications".

[3] 3GPP TS 32.200: "Charging Principles".

[4] 3GPP TS 23.228: "IP Multimedia (IM) Subsystem - Stage 2".

[5] 3GPP TS 23.002: "Network architecture".

[6] 3GPP TS 32.225: "Charging Data Description for IMS".

Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions given in TS 21.905 [2] and the following apply.

Billing: The functions whereby charging data are transformed into bills requiring payment. In case of pre-paid, billing means the deduction of an account. As an outcome of the transformation an invoice, including an optional list of detailed charges, has to be delivered to the user. The billing function is located in the appropriated billing domain, which is not a part of the CS domain, PS domain or IMS.

IMS Advice of Charge: A service that provides the IMS subscriber with information about the applicable charging rates at session establishment or when charging rates change during the session. The IMS provides the capabilities to provide the AoC service to the subscriber. The AoC service itself is not to be standardized.

Pre-paid billing: Billing arrangement between customer and operator/service provider where the customer deposits an amount of money in advance, which is subsequently used to pay for service usage.

Post paid billing: Billing arrangement between customer and operator/service provider where the customer periodically receives a bill for service usage in the past period.

Note: Pre-paid and post-paid are different payment methods for the subscribers. These payment methods could be based on both on-line and off-line charging mechanisms. To get full credit control, pre-paid should be built on on-line charging. If the operator would like to have post-paid subscribers on credit control, these subscribers should be charged with the on-line charging mechanism.

Charging: The functions whereby information related to a chargeable event is formatted and transferred in order to make it possible to determine usage for which the charged party may be billed. This applies for all charging levels (e.g., transport, service, content, etc.).

On-Line Charging: A charging process where charging information can affect, in real-time, the service rendered and therefore directly interacts with the session/service control.

Note: Due to the real-time interaction between charging and session/service control, this mode requires real-time interfaces.

Off-line charging: A charging process where charging information does not affect, in real-time, the service rendered.

Note: No real-time interaction is required between charging and session/service control but charging information may be delivered in real time or near real time.

3.2 Symbols

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

Rf	Offline Charging Reference Point between an IMS Network Entity and CCF

3.3 Abbreviations

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

AS	Application Server
BGCF	Breakout Gateway Control Function
BS	Billing System
CCF	Charging Collection Function
CDR	Charging Data Records
CGF	Charging Gateway Function
CPCF	Content Provider Charging Function
CS	Circuit Switched
CSCF	Call Session Control Function
GGSN	Gateway GPRS Support Node
HPLMN	Home PLMN
ICID	IMS Charging Identifier
I-CSCF	Interrogating-CSCF
IM	IP Multimedia
IM CN SS	IP Multimedia Core Network Subsystem
IMS	IP Multimedia Core Network Subsystem
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
ISDN	Integrated Services Digital Network
MGCF	Media Gateway Control Function
P-CSCF	Proxy-CSCF
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network

QoS	Quality of Service
RAB	Radio Access Bearer
SCCF	Subscriber Content Charging Function
S-CSCF	Serving-CSCF
SGSN	Serving GPRS Support Node
SIP	Session Initiation Protocol
UE	User Equipment
UMTS	Universal Mobile Telecommunications System

4. General Charging Requirements

Note: The following requirements are to be reviewed further by SA1, SA2, and SA5.

The called network can be – depending on regulatory and operational / trust conditions – the same IMS network as calling's party network or another IMS network or a non IMS network as e.g. Internet / PSTN / ISDN / CS domain of a PLMN.

1. The IMS charging architecture and mechanisms shall allow different charging models as required by regulatory conditions and inter-network policies. At least the following charging models shall be possible in a network:

   - The calling party incurs charging entirely for both the IMS session level charging and the transport level charging (e.g. charging done at GPRS) at calling and called party sides.

   - The calling party incurs transport level charging on calling party's side only and the entire charges related to the IMS session level. In this charging model, a called party incurs the transport level charging associated with that session on called party's side.

2. If the called party requests additional media components with regard to the initial request from calling party then called party can –depending on operational conditions of the service- be charged for these additional components.

3. The A and B parties home networks shall be able to exchange information on the charging to be applied to the current session or to some media component of the session. The calling party's home network can then, according to the service and inter-operator agreement, apply appropriate charging.

4. During session forwarding (e.g. A calls B and is "forwarded to C"), the initial calling party (A) incurs the charges from A to B while the forwarding party (B) incurs charges due to the "forwarded" session (e.g. from B to C).

5. In case of roaming (A calls B that is roaming to IMS network C), the calling party (A) incurs charges up to the home network of B. The latter incurs additional charges due to roaming from home network B to network C.

6. The IMS charging architecture shall allow the operator to support IMS Advice of Charge.

7. The IMS charging architecture shall allow the operator to charge for the transport and/or for the session service and/or for the content.

8. The IMS charging architecture shall allow the operator to charge per media component (e.g. voice, video).

9. The IMS charging architecture shall allow the operator to provide a single pre-paid account for a subscriber. In this case, that account combines the charges incurred by services in CS, PS, IMS, and other domains.

10. Charging indications received from the called network (such as free of charge) shall be taken into account by the Pre-paid mechanisms.

11. The IMS charging architecture shall provide means to correlate charging information generated at transport, service and content charging levels by the network entities in PS domain and IMS.

4 Charging Classification

4.1 Charging Types

Editors note: This chapter gives an overview on prepaid, postpaid and real time postpaid methods.

4.2 Charging Levels

Editors note: This chapter gives an overview on Transport Charging, Service Based Charging and Content Charging.

4.2 Charging Methods

Editors note: This chapter gives an overview on Online and Offline Charging.

5 Architectural Concept

5.1 Network Elements Involved in Charging

5.1.1 Subscriber Content Charging Function (SCCF)

The **Subscriber Content Charging Function (SCCF)** is located in the operator network where the account of the subscriber is located. This account can be a prepaid or a post-paid account. The SCCF handles content charging requests that are made when the subscriber accesses the content. Upon such a content charging request, the SCCF may for example check or debit the subscriber's account. Content charging requests are typically received from the Content Provider Charging Function (CPCF). In particular, the SCCF has the following responsibilities:

- to handle charging requests from the CPCF
- to find the account of the subscriber. The account may be either a prepaid account or a postpaid account.
- to initiate a procedure to get a charging confirmation from the subscriber, if such a confirmation is needed.
- to debit or to credit a certain amount from/to the account of the subscriber.

5.1.2 Content Provider Charging Function (CPCF)

The **Content Provider Charging Function (CPCF)** is located in the operator network and/or in another network such as for example a Service Provider network that supports the content server. It is not expected that every content server has a business relationship with every IMS network. The CPCF receives content charging request from the content server, processes them, and relays them to the Subscriber Content Charging Function (SCCF). Additionally, the CPCF manages the account that is maintained for the content provider. Upon receipt of a charging request from the content server, the CPCF processes the request and relays it to the SCCF. The CPCF modifies the account of the content provider accordingly. In particular, the CPCF has the following responsibilities:

- to handle charging requests from the content server.
- to communicate with the SCCF that manages the subscriber's account. This may imply a request to the SCCF to charge or to credit the account of the subscriber.

5.2 Architecture and Reference Points

5.2.1 Architecture reference model for off-line charging

Figure 5.1 below presents the off-line IMS charging architecture for non-roaming scenario.

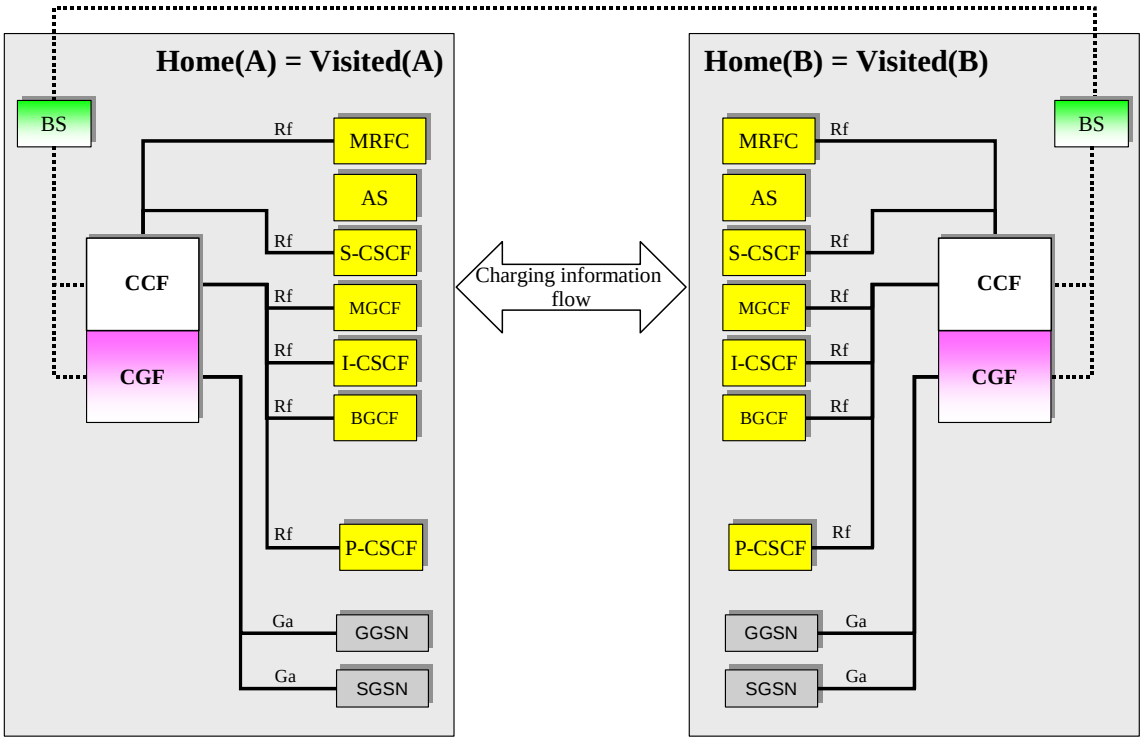

Figure 5.1 Off-line IMS Charging architecture for non-roaming scenario

Note-i: the topological merging of some of the lines representing the Ga or Rf reference points for connecting with the CCF are performed for figure layout purposes only, and do not imply any other logical or physical association.

Note-ii: The interconnection of Application Servers with CCFs is depicted separately below in Figures 5.3 and 5.4.

Figure 5.2 below presents the off-line IMS charging architecture for roaming scenario.

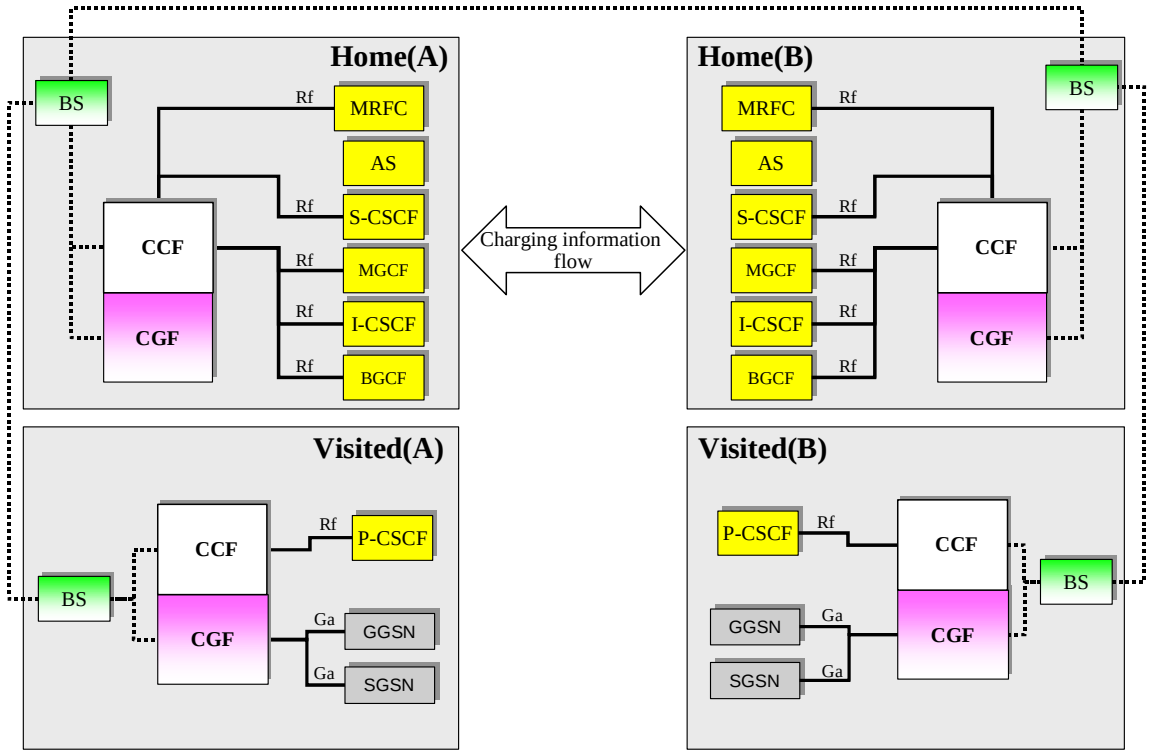

Figure 5.2: Off-line IMS Charging architecture for roaming scenario

Note-i: the topological merging of some of the lines representing the Ga or Rfreference points for connecting with the CCF are performed for figure layout purposes only, and do not imply any other logical or physical association.

Note-ii: The interconnection of Application Servers with CCFs is depicted separately below in Figures 5.3 and 5.4.

For the interconnection of Application Servers with CCFs there have been two different solutions identified. These two solutions are depicted in Figures 5.3 and 5.4.

1. The Application Server may be directly connected to the CCF via an off-line charging interface (Ra). This alternative is depicted in Figure 5.3 below.

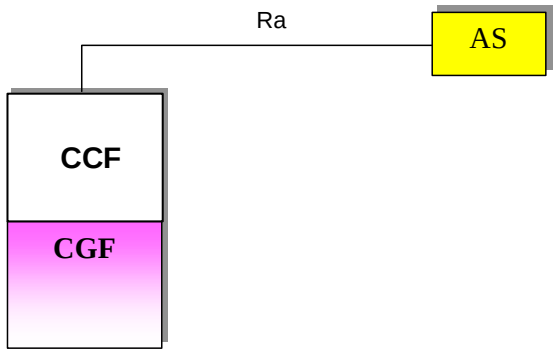

Figure 5.3: AS and CCF are directly connected via an off-line charging interface (Ra)

2. The Application Server may be connected to the CCF via the S-CSCF (ISC and Rf interfaces). This alternative is depicted in Figure 5.4 below.

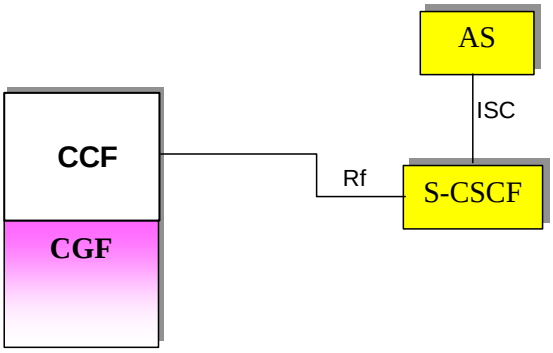

Figure 5.4: AS and CCF are connected via the S-CSCF (ISC and Rf interfaces)

5.2.1.1 Charging Collection Function

The CCF (Charging Collection Function) represented in the Figure 5.1 and 5.2 is a logical function, which will provide charging support for the IMS subscribers.

For off-line charging the CCF supports the following charging related functionality:

- The CCF has functionalities for IMS network entities equivalent to the CGF's functionalities as described in TS 32.200 [3], clause 4.2, for the PS domain. It also supports the following additional functionalities:
  - To enable charging based on different types of traffic (e.g. service charging, usage charging),
  - To enable validating, combining, aggregating and consolidating of the charging information, e.g. access charging information with the respective service (usage) charging information,
  - To enable consolidation of the relevant charging information into configurable format(s) to meet the business requirements (e.g. tariffing criteria, usage information, subscriber identifiers and service identifiers),
  - To enable charging information collection and aggregation in a function within each network from all involved charging information generating network entities. Whether this is conducted on a per- subscriber and/or per-session and/or per-service basis is FFS.
  - To perform correlation of charging information delivered from transport, session, service levels
  - To enable the removal of duplicated charging data.

It is assumed that there is communication taking place between CGF and CCF. Specification of this communication and an interface between CGF and CCF is for further study.

5.2.2 Architecture reference model for on-line charging

Editor's note: To be added later on…

5.2.3 IMS charging architecture reference points

5.2.3.1 Offline Charging Reference Point IMS Network Entity - CCF (Rf)

The Rf reference point supports off-line mechanisms between the CCF and each of the IMS network entities I-CSCF, P-CSCF, S-CSCF, MGCF, MRFC, BGCF.

The Rf reference point shall allow for at least the following features:

- Reliable transfer of Charging Information with acknowledgement mechanisms from the Network Element to the CCF.
- Support redundancy mechanisms.

- Enable re-routing in the event of communication link / node failures, network congestion, or network re-configuration. In addition, network nodes generating and sending CDRs shall support buffering mechanisms.
- Support early detection of congestion at the receiving node in order to activate re-routing.
- Support detection of node / link recovery for re-establishing routing of Charging information.
- Ability of a (the) CCF to advertise to the Network Elements about its CDR receiving capability (e.g. after a period of service downtime).
- Support for multiple payload types to cater for transferring a variety of different charging data.

5.3 Correlation of Charging Information from Different Network Elements and Domains

5.3.1 Charging Correlation Levels

The following levels of correlation for IMS charging shall be considered:

1. **Correlation within a session.** A session may comprise a number of media components. It shall be possible to correlate the charging data of the different media components belonging to a session.
2. **Correlation at media component level.** For a session comprising several media components (such as audio and video), charging data is generated for each media component and needs to be correlated between network elements. For this, a component identifier shall be unique and shall clearly identify to which media component of a session this charging information belongs to. This component identifier is not exchanged between network elements and is based on the ordering of media flows in the SDP. This ordering is the same as the one used in the binding information passed to the PS Domain.

Correlation between the IMS and the PS domain shall take into account the above described levels.

5.3.2 Charging Correlation Principles

To support the correlation of charging information, the following principles apply to both offline and online charging:

1. The correlation of charging information for an IMS session is based on the use of IMS Charging Identifiers.
2. An IMS Charging Identifier (ICID) is used:

   2.1 between and within the Visited IMS and the Home IMS of the A-Party.

   2.2 between the Home IMS of the A-Party and the Home IMS of the B-Party.

   2.3 between and within the Home IMS and the Visited IMS of the B-Party.

   It cannot be assumed that the ICIDs used in the cases 2.1 - 2.3 are the same.
3. For each of the cases 2.1 - 2.3, the first IMS network entity within the SIP signalling path is responsible for assigning the ICID.
4. The ICID is passed to all IMS network entities in the session signalling path. This is performed using SIP signalling.
5. For the charging correlation between the PS domain and the IMS, one or more GPRS Charging IDs, which identify the PDP contexts of the session [7], are passed from the PS domain to the IMS. More specifically, these identifiers need to be transferred from the GGSN to the P-CSCF.
6. The GPRS Charging IDs are passed by the P-CSCF to the S-CSCF and the AS using SIP signalling. They are not transferred from one Home IMS (e.g. of the A-Party) to another Home IMS (e.g. the one of the B-Party).

5.4 Exchange of Charging Information between Networks

5.4.1 Charging information flow between home IMS networks

The Charging information flow may support the following functionalities:

- Indication of who wants to subsidize whom (e.g. "A-party pays" or "reverse charge call")
- Indication of media resources to be subsidized (e.g. final SDP negotiated between A and B UEs)

The following mechanisms have been identified for charging information flow:

- Pre-arranged mechanism based on secure relation between networks
- Additionally, real-time negotiations on a per-session basis may be conducted:
  - Using the session initiatiation protocol
  - Negotiation between the charging domains (CCFs)

5.4.2 Identification of operators for charging

To enable the different operators involved in IMS sessions to identify each other, the Inter Operator Identification concept (IOI) is introduced. Inter Operator Identification allows operators involved with session signalling to identify each other. The Inter Operator Identification (IOI) concept may help to support inter operator charging.

The following requirements relate to the Inter Operator Identification concept:

- The Inter Operator Identification concept shall allow operators to uniquely identify each other for the SIP based requests; for example between A's HPLMN and B's HPLMN.
- The Inter Operator Identification concept can be used for inter operator accounting identification purposes.
- It shall be possible to prevent the information used for Inter Operator Identification from being passed to the UE.
- It shall be possible to apply the Inter Operator Identification concept on a peer to peer basis between operators. It shall be possible to use different identity values for operator identification between operators involved in IMS sessions.

Note: The format of the identities used for Inter Operator Identification is for further study.

Note: The allocation of identities used for Inter Operator Identification is for further study

Note: The relationship of the Inter Operator Identification concept with security aspects between operators is for further study.

6 Examples for Charging Scenarios

6.1 Transactions of Content Charging

In the following scenario, we assume that a subscriber (UE-A) accesses content provided by a content server (UE-B).

Figure 1 shows the transactions that are required between UE-A, SCCF, CPCF, and the content server in order to perform content charging.

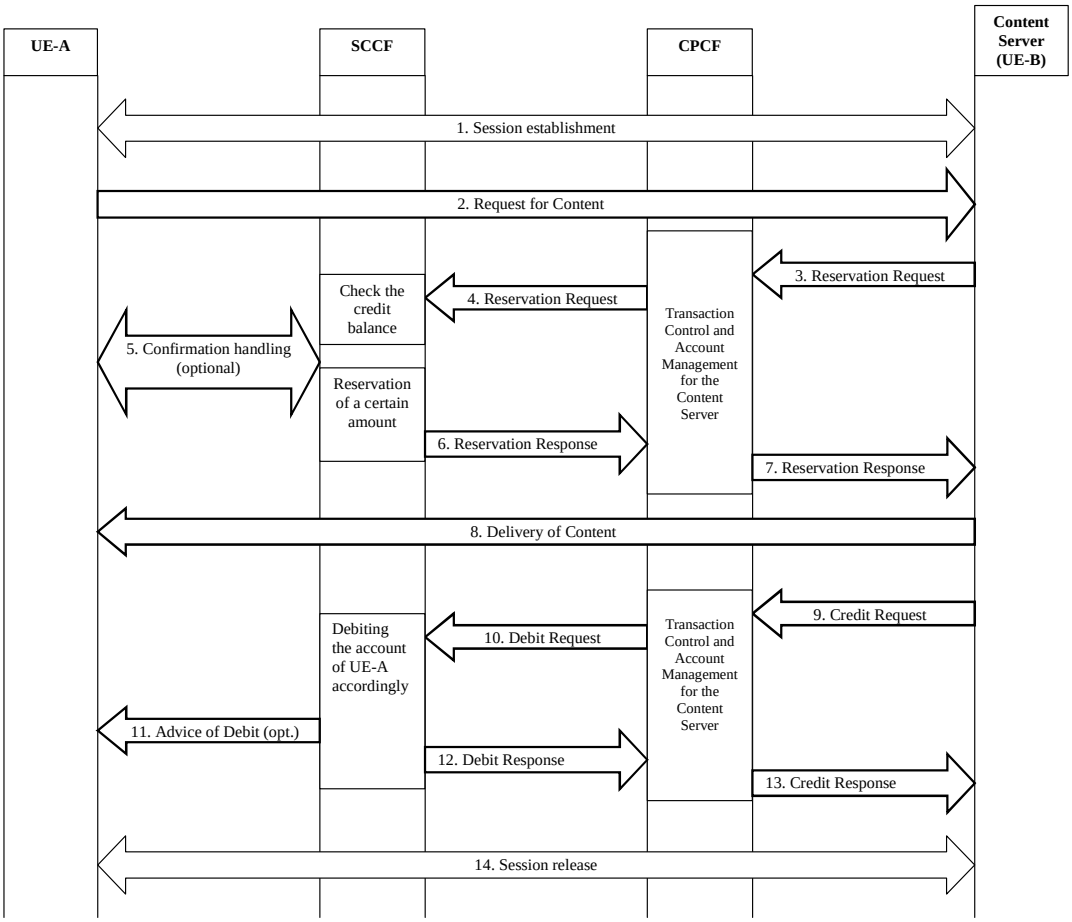

Figure 1: Transactions for content charging

Description of the transactions between the involved entities:

1. The session is established.
2. UE-A requests the desired content from the content server.
3. The content server sends a credit reservation request to the CPCF. The CPCF supervises the transaction and manages the account that is maintained for the content server.
4. The CPCF forwards the reservation request to the SCCF. The SCCF checks the credit balance of UE-A.
5. SCCF initiates a confirmation handling to the UE-A, if such a confirmation is desired.
6. If the credit balance is sufficient, the SCCF reserves the amount of money in advance and sends a reservation response to the CPCF.
7. The credit approval is forwarded to the content server by sending a reservation response.
8. As requested by UE-A, the content server delivers the desired content.
9. The content server sends a credit request to the CPCF. The CPCF supervises the transaction and manages the account that is maintained for the content server.
10. On reception of a debit request, the SCCF debits the subscriber's account.
11. Optionally, the SCCF may send an advice of debit to the subscriber (UE-A).
12. The SCCF acknowledges the debit request by sending a debit response to the CPCF.

13. The CPCF acknowledges the credit request by sending a credit response to the content server.
14. The session is released.

7 Charging Message Flows

Annex A:
Change history

It is usual to include an annex (usually the final annex of the document) for reports under TSG change control which details the change history of the report using a table as follows:

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2001-08					Creation of Version 0.0.0		0.0.0
2001-10					Output of SA2/SA5 Drafting at SA2#19bis	0.0.0	0.1.0
2001-11					Output of SA2#20 in Kobe	0.1.0	0.2.0
2001-12					Output of SA2/SA5 Session at SA2#21/SA5#24 in Cancun	0.2.0	0.3.0
2001-12					Document version raised to 1.0.0, presentation to SA#14 for information	0.3.0	1.0.0