

1 3GPP2 X.S0013-007-A v1.0

2 *Version 1.0*

3 *Date: November 2005*

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3RD GENERATION  
PARTNERSHIP  
PROJECT 2  
"3GPP2"

7 ***All-IP Core Network Multimedia Domain***

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9 ***IP Multimedia Subsystem - Charging Architecture***

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**All-IP Core Network Multimedia Domain**  
**IP Multimedia Subsystem - Charging Architecture**

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## 2 **Foreword**

3 (This foreword is not part of this document).

4 This document was prepared by 3GPP2 TSG-X.

5 This document contains major modifications from the previous revision.

6 This document is part of the series of documents X.S0013.

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## 14 **Revision History**

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<i><b>REVISION HISTORY</b></i>		
<i><b>Revision number</b></i>	<i><b>Content changes.</b></i>	<i><b>Date</b></i>
0	Initial Publication	December 2003
A	Revision to add new capabilities	November 2005

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# 1 Scope

The present document describes the architecture for charging and billing for IMS services.

For the purpose of the present document, the charging data is considered to be generated and collected by charging functions in the network elements.

The objectives of the present document are:

- to describe principles of charging in an IMS network;
- to provide a description of the charging architecture; and
- to provide the descriptions of events and triggers for the generation of charging data.

## 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.

[1] 3GPP2 X.S0013-008-A v1.0: "IP Multimedia Subsystem; Offline Accounting Information Flows and Protocols"

[2] 3GPP2 X.S0013-000-A v1.0: "All-IP Core Network Multimedia Domain; Overview"

## 3 Definitions, abbreviations and symbols

### 3.1 Definitions

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

**account:** structure residing in the OCS for holding dynamic subscriber data with monetary equivalence. Accounts may have a currency or a unit type. As opposed to bank accounts, transaction history is not necessarily kept in the OCS account data structure.

**accounting:** process of apportioning charges between the Home Environment, Serving Network and User.

**account balance:** the current value of an account of service usage.

**accounting information record:** record generated by a network element for the purpose of passing relevant data or information to a centralized accounting function.

**advice of charge:** real-time display of the network utilization charges incurred by the Mobile Station. The charges are displayed in the form of charging units. If a unit price is stored by the MS then the display may also include the equivalent charge in the home currency.

**billing:** function whereby records generated by the charging function are transformed into bills requiring payment.

**chargeable event:** activity utilizing telecommunications network infrastructure and related services for user to user communication (e.g. a single call, a data communication session or a short message), or for

1 user to network communication (e.g. service profile administration), or for inter-network communication  
2 (e.g. transferring calls, signaling, or short messages), or for mobility (e.g. roaming or inter-system  
3 handover), which the network operator wants to charge for.

4 **charged party:** user involved in a chargeable event who has to pay parts or the whole charges of the  
5 chargeable event, or a third party paying the charges caused by one or all users involved in the chargeable  
6 event, or a network operator.

7 **charging:** function whereby information related to a chargeable event is formatted and transferred in order  
8 to make it possible to determine usage for which the charged party may be billed.

9 **charging data:** data generated by a network element for the purpose of billing a subscriber for the provided  
10 service. It includes data identifying the user, the session and the network elements as well as information  
11 on the network resources and services used to support a subscriber session.

12 **counter:** temporary aggregation of units of service usage, which may be in relation to subscriber  
13 contractual terms (e.g. number of used SMS per day or number of free minutes per month)  
14 These form the basis for any type of loyalty program like discounts or bonus.

15 **domain:** part of a communication network that provides services using a certain technology

16 **near real time:** near real time charging and billing information is to be generated, processed, and  
17 transported to a desired conclusion in less than 1 minute.

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

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

23 **rating:** The act of determining the cost of the service event.

24 **real time:** real time charging and billing information is to be generated, processed, and transported to a  
25 desired conclusion in less than 1 second.

26 **settlement:** payment of amounts resulting from the accounting process.

27 **tariff:** set of parameters defining the network utilization charges for the use of a particular service

28

### 29 **3.2 Abbreviations**

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

31	3G	3 <sup>rd</sup> Generation
32	AAA	Authentication, Authorization, and Accounting
33	ACR	Accounting Requests
34	AS	Application Server
35	BCF	Bearer Charging Function
36	BGCF	Breakout Gateway Control Function
37	BS	Billing System
38	CSCF	Call Session Control Function
39	ECF	Event Charging Function
40	ICID	IMS Charging ID
41	ICN	IP Connectivity Network
42	I-CSCF	Interrogating CSCF
43	IMS	IP Multimedia Subsystem
44	ISC	IMS Service Control
45	ISUP	ISDN User Part
46	IP	Internet Protocol
47	MGCF	Media Gateway Control Function

1	MRFC	Media Resource Function Controller
2	MS	Mobile Station
3	OCF	Online Charging Functions
4	OCS	Online Charging System
5	P-CSCF	Proxy CSCF
6	PDSN	Packet Data Serving Node
7	PLMN	Public Land Mobile Network
8	SCCF	Subscriber Content Charging Function
9	SCF	Session Charging Function
10	S-CSCF	Serving CSCF
11	SDP	Session Description Protocol
12	SIP	Session Initiation Protocol
13	TCID	Transport Charging ID
14	UE	User Equipment

### 15 3.3 Symbols

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

17		
18	Rf	Offline Charging Reference Point between an IMS Network Entity, or an AS and
19		AAA.
20	Ro	Online Charging Reference Point between an AS ,MRFC , and the ECF, or an IMS
21		Gateway Function or IMS CSCF and the SCF.
22	X1	Online Charging Reference Point between the OCF and the Account Balance
23		Management Function
24	X2	Online Charging Reference Point between the OCF and the Operator's Post-
25		Processing System
26	X3	Online Charging Reference Point between the OCF and the Rating Function
27	X4	Online Charging Reference Point between the Account Balance Management
28		Function and the Recharging Server

## 29 4 Architecture

### 30 4.1 Charging Mechanisms

31 The charging functionality is based on the IMS network nodes reporting accounting information upon  
 32 reception of various SIP methods or ISUP messages, as most of the accounting relevant information is  
 33 contained in these messages. This reporting is achieved by sending Diameter *Accounting Requests* (ACR)  
 34 [Start, Interim, Stop and Event] from the IMS nodes to the AAA and/or ECF.

#### 35 4.1.1 Off-line Charging

36 Offline charging is a mechanism where charging information does not affect, in real-time, the service  
 37 rendered. With Off-line charging, the accounting information is gathered from various IMS network nodes  
 38 where it may be held for later forwarding to the Billing System. See Section 4.2.1.1 for further  
 39 information.

#### 40 4.1.2 On-line Charging

41 Online charging is a mechanism where charging information can affect, in real-time, the service rendered  
 42 and therefore a direct interaction of the charging mechanism with the control of network resource usage is  
 43 required. The subscriber's account is decremented in some units based on current usage of the system.  
 44 Charging may be based on events, time, or resource usage. See Section 4.2.1.2 for further information.

1 **4.2 Logical Network and Charging Architecture**

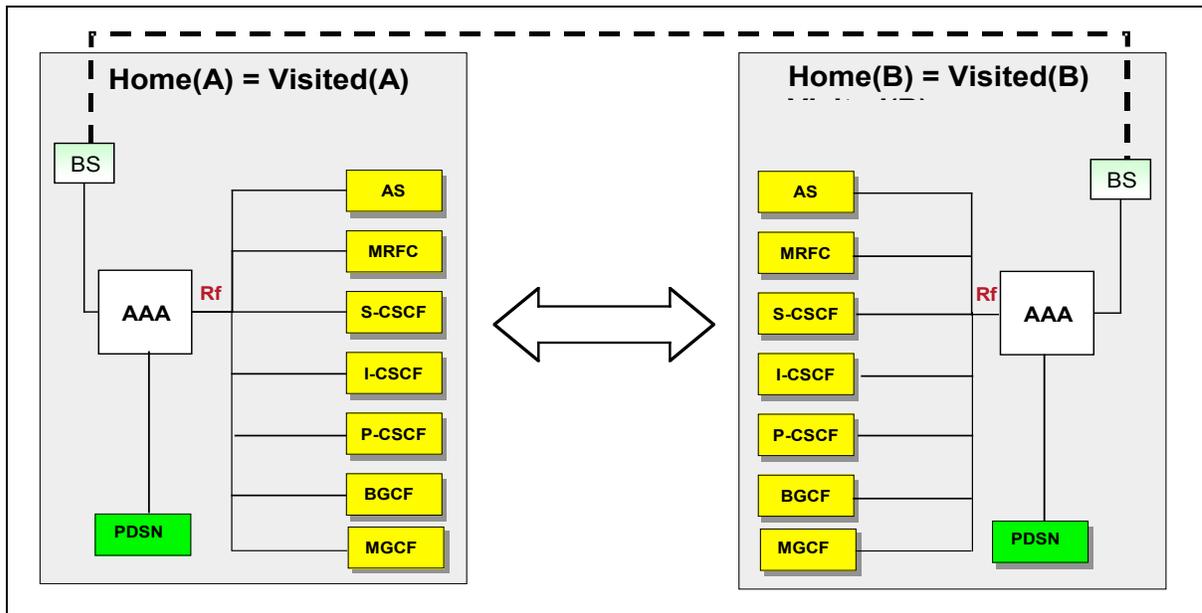
2 **4.2.1 IMS Architecture**

3 The overall IMS architecture is described in [2]. For a more detailed description of Offline  
 4 charging see [1].

5

6 **4.2.1.1 Architecture reference model for off-line charging**

7 Figure 4.1 presents the off-line IMS charging architecture for non-roaming scenario between two IMS  
 8 users.



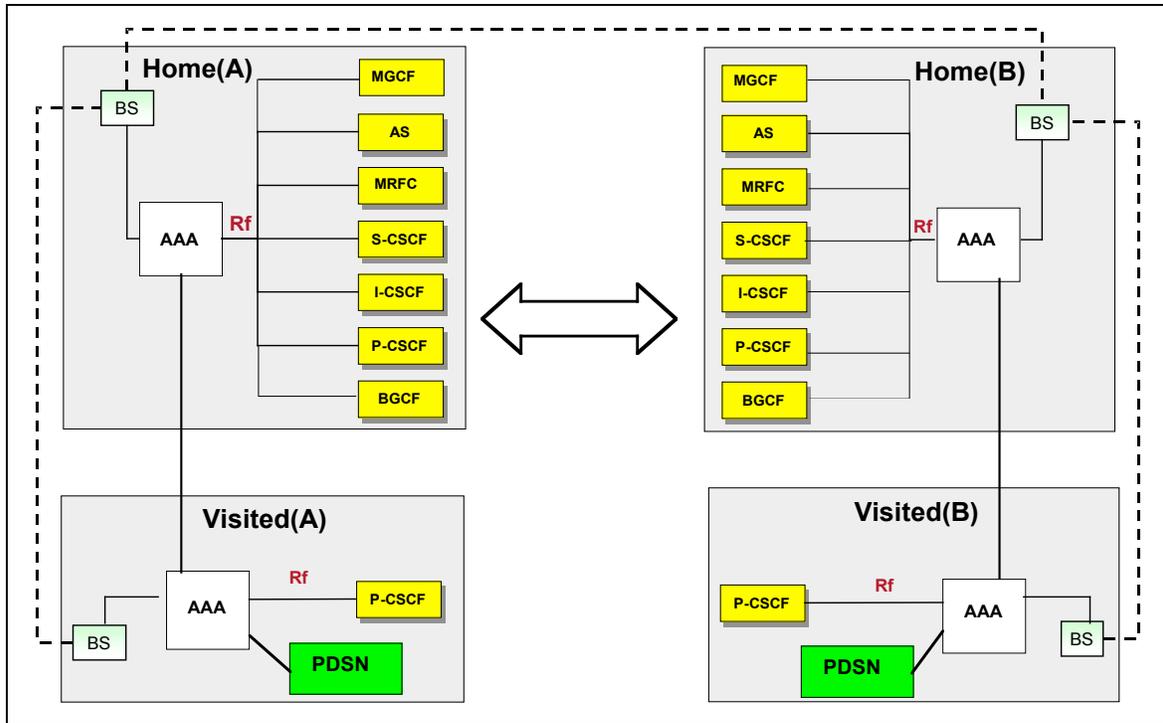
9  
 10

11 **Figure 4.1: Off-line IMS Charging architecture for non-roaming scenario**

12 NOTE: The topological merging of some of the lines representing the Rf reference points for  
 13 connecting with the AAA are performed for figure layout purposes only, and do not imply  
 14 any other logical or physical association.

15 The interfaces between the PDSN and AAA, between AAA of User A's Home System and User B's Home  
 16 System, and between the AAA and billing system are outside the scope of this specification.

17 Figure 4.2 presents the off-line charging architecture for roaming scenario between two IMS users.



1  
2

3 **Figure 4.2: Off-line IMS Charging architecture for roaming scenario**

4 NOTE 1: The topological merging of some of the lines representing the Rf reference points for  
5 connecting with the AAA are performed for figure layout purposes only, and do not imply  
6 any other logical or physical association.

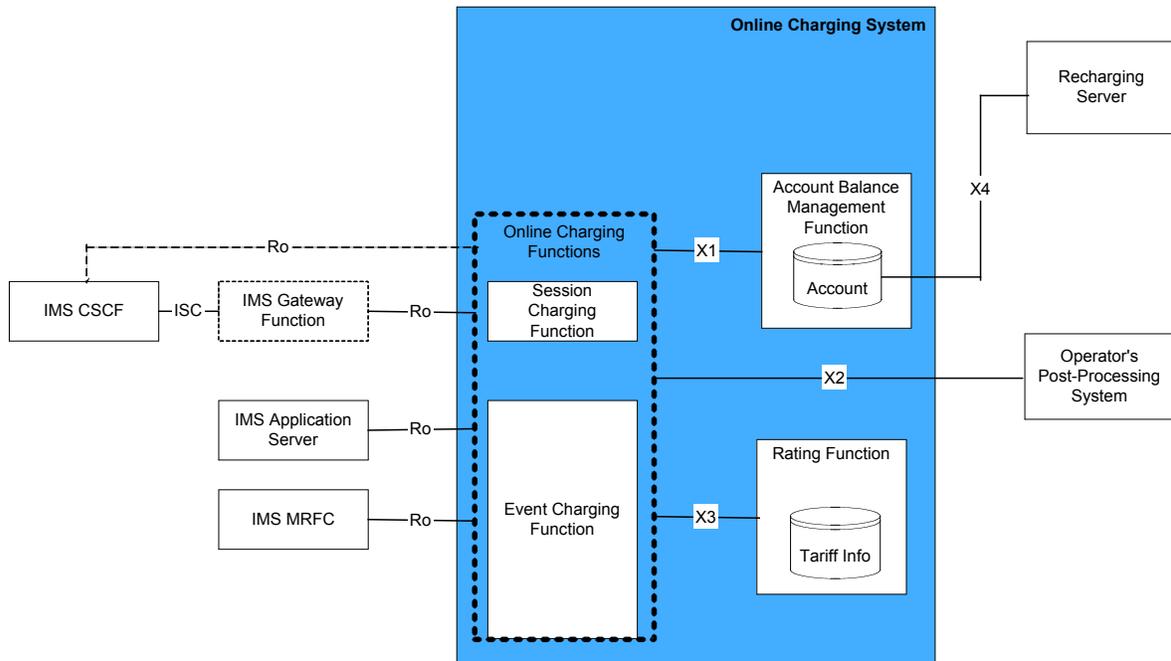
7 NOTE 2: In the roaming scenario, the P-CSCF is present either in the visited network or the home  
8 network but not both.

9 In the off-line charging model operators have traditionally exchanged charging information between billing  
10 systems as shown in the figure. Operators may desire to exchange charging information in near real time  
11 utilizing the AAA infrastructure. In this case, the AAA in the visited network may pass information to the  
12 AAA in the home network. The interface between the PDSN and AAA, and those between the AAA and  
13 billing systems are outside the scope of this specification.

#### 14 **4.2.1.2 Architecture reference model for on-line charging**

15 Figure 4.3 below presents the on-line IMS charging architecture.

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4 **Figure 4.3: On-line IMS Charging architecture**

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NOTE 1: The lines representing the Session and Event Charging Functions with Account Balance Management Function, Rating Function and the operator's post-processing system respectively are drawn only once for figure layout purposes only.

NOTE 2: The support of ISC as charging interface towards IMS CSCF requires additional functionality to be provided by the OCS. The support of Ro as charging interface towards OCS requires an imbedded IMS-GW to be provided by the IMS CSCF.

12  
13  
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The Session Charging Function (SCF) performs IMS session charging using the Ro reference point towards the IMS CSCF. Whether the CSCF is directly connected to the OCS or via a gateway (IMS Gateway Function) is beyond the scope of the present document.

15

The Event Charging Function (ECF) performs event-based charging using the Ro reference point.

16  
17

The Rating Function and the Account Balance Management Function allows the interaction between Charging Functions (BCF, SCF, ECF) and Rating Function.

18  
19

Beyond those depicted in the figure, there may be other external systems connected to the OCS. These systems are beyond the scope of this document

20 **4.3 Charging Functions**

21 **4.3.1 AAA**

22  
23  
24

The AAA main functionalities for IMS are that it provides the mechanism to transfer charging information from the IMS nodes to the network operator's chosen Billing Systems(s). The main functions of the AAA are:

- 25 - the collection of Session charging information from the IMS nodes;
- 26 - intermediate data storage buffering;
- 27 - the transfer of the charging data to the billing systems.

1 The AAA acts as storage buffer for near real-time charging data collection. It provides the charging data to  
 2 the billing system. This specification identifies the external interfaces of the AAA for accounting purposes,  
 3 but does not specify the internal functionality. However, some of the AAA functionality is described to  
 4 indicate its behavior. The AAA may perform specific activities, such as consolidation of data, pre-  
 5 processing of data fields, filtering of un-required data fields, and adding of Operator defined fields for  
 6 specific billing systems. These specific activities may be performed to optimize the charging information  
 7 that is to be forwarded to the Billing System, which should reduce the load in the Billing System.

8 The AAA can receive data from the IMS nodes in near real-time mode. It should have enough storage to  
 9 enable it to transmit the collected charging data to the Billing System in file mode. The AAA may have to  
 10 support several transmission protocols towards the Billing System, depending on the Billing System(s)  
 11 used. One of the purposes of the AAA is to reduce the number of different interfaces between the Billing  
 12 System and the IMS nodes sending charging data. If a new Billing System is introduced it shall be  
 13 interfaced to the AAA, i.e. the protocol stacks and configurations of the IMS nodes do not need to be  
 14 updated. The usage and load of mass memory media can be more evenly distributed. The AAA may be  
 15 distributed to several physical nodes to facilitate redundancy.

#### 16 **4.3.2 Session Charging Function (SCF)**

17 The Session Charging Function (SCF) performs session based charging and credit control:

- 18 • on the subsystem level, based on session resource usage requests received from the network (e.g. the  
 19 IMS CSCF). It controls sessions in the network, e.g. it has the ability to grant or deny a session  
 20 setup request and to terminate an existing session;
- 21 • on the service level, based on service usage requests received from the network. It controls service  
 22 availability in the network, e.g. it has the ability to grant or deny a usage of a service.

23 The SCF communicates with the Rating Function in order to determine the value of the requested bearer  
 24 resources or the requested session. It also communicates with the Account Balance Management Function  
 25 to query and update the subscriber's account

#### 27 **4.3.3 Event Charging Function (ECF)**

28 The Event Charging Function (ECF) performs event based charging and credit control (e.g. content  
 29 charging):

- 30 • on a subsystem level, based on session resource usage requests received from the network (e.g. the  
 31 IMS MRFC). It controls the resource availability in network, e.g. it has the ability to grant or deny  
 32 the resource usage;
- 33 • on service level, based on application server requests received from the network (e.g. an IMS  
 34 application server). It controls the application service availability in the network, e.g. it has the  
 35 ability to grant or deny the service usage in the network.

36 The ECF communicates with the Rating Function in order to determine the value of the requested service  
 37 usage. It also communicates with the Account Balance Management Function to query and update the  
 38 subscriber's account

#### 39 **4.3.4 Rating Function**

40 The Rating Function performs both monetary and non-monetary unit determination (rating). It provides the  
 41 following functionalities:

- 42 • Rating for network- and external services and applications (session, service, event) before and after  
 43 service delivery;
- 44 • Cross-product and cross-channel discounts, benefits and allowances.

45 The Rating Function must be able to handle a wide variety of rateable instances, such as:

- 1 • Rating of volume (in terms of granted units or money, e.g. based on charging initiated by an access  
2 network entity);
- 3 • Rating of time (in terms of granted units or money, e.g. based on charging initiated by a SIP  
4 application);
- 5 • Rating of events

6 The Rating Function includes the determination of the tariff or the price of a chargeable event; examples  
7 include the price of a call minute, data volume, multimedia session, Web content, etc.

8 Upon receipt of a rate request (price or tariff request) from the Charging Function, the Rating Function:

- 9 • Evaluates the request. Rate requests include various rating parameters such as service identifier,  
10 subscriber reference, network identification, user location, service usage time, transferred data  
11 volume, etc.
- 12 • Determines the applicable price or tariff model and returns it to the Charging Function.

13 To support the online rating process, the Rating Function needs counters. The counters may be maintained  
14 by the Rating Function or by the Account Balance Management function. A Rating Function that does not  
15 maintain counters will be marked as class "A" Rating Function. A Rating Function that maintains counters  
16 will be marked as class "B" Rating Function.

#### 17 **4.3.5 Account Balance Management Function**

18 Not specified in the current document.

### 19 **4.4 Implementation of Offline and Online Charging**

20 The IMS charging architecture, described in this specification specifies that for offline charging all  
21 communications between the IMS network entities and the AAA are carried out on the Rf interface. On the  
22 other hand, for online charging the Ro interface is used by the AS and MRFC towards the Event Charging  
23 Function and the Ro interface is used between the IMS S-CSCF or an IMS Gateway Function and the  
24 Session Charging Function. The rules governing the selection of the proper interfaces are described in the  
25 subclauses below.

#### 26 **4.4.1 On-line charging reference point IMS Network Entity - ECF (Ro)**

27 Event-based charging between an AS or MRFC and the ECF is performed using the Ro reference point. Ro  
28 is an open interface which is standardized in [3]. The protocol for the Ro reference point is easily  
29 extendable to include additional online charging functions. The Ro reference point supports integrity  
30 protection and authentication for the case that the AS is outside the operator domain.

#### 31 **4.4.2 Usage of Rf and Ro Interfaces**

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

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

1    **4.4.3 Usage of Rf and ISC Interfaces**

2    All other IMS nodes (S-CSCF, P-CSCF, I-CSCF, BGCF and MGCF) apply offline charging via the Rf  
3    interface using the AAA address as received via SIP signaling or the locally configured AAA address. The  
4    IMS S-CSCF supports online charging using the ISC interface to an IMS Gateway function which uses the  
5    Ro interface to the Session Charging Function. Alternatively the IMS S-CSCF supports online charging  
6    using the Ro interface directly to the Session Charging Function.