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Contents

Foreword

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  - 1 presented to TSG for information;
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Introduction

3GPP TR 23.815 [1] identified three reference points related to the Online Charging System (OCS), namely Rb, Rc, and Re. The OCS is considered to be a framework that comprises, but may not be limited to, the functions employed for prepaid rating and real-time account manipulation. According to 3GPP TR 23.815 [1], the above reference points were scheduled for standardisation in Release 6, but an exact definition of their functionalities does not exist yet. Note that, in contrast to 3GPP TR 23.815 [1], the present document is not limited to IMS but intends to cover all charging domains.

The Rc and Re reference points are necessary for operators in order to seamlessly integrate online charging for the bearer, service and IMS levels in the same OCS.

1 Scope

The present document analyses the architectures and functions of the OCS and thereby derives the functionality of the OCS reference points. It is expected that the content of the present document will serve as a basis for detailed 3GPP specifications of reference points between the logical OCS functionalities. The functionality of the OCS, as described in the present document, applies to all charging domains (bearer, session and service).

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 23.815: "Charging implications of IMS architecture".

[2] 3GPP TS 32.200: "Telecommunication management; Charging management; Charging principles". Valid up to Release 5.

[3] 3GPP TS 32.225: "Telecommunication management; Charging management; Charging data description for the IP Multimedia Subsystem (IMS)". Valid up to Release 5.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions, as specified in 3GPP TS 32.200 [2] and 3GPP TS 32.225 [3], apply:

charging: 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.)

chargeable event: activity utilising 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 user to network communication (e.g. service profile administration), or for inter-network communication (e.g. transferring calls, signalling, or short messages), or for mobility (e.g. roaming or inter-system handover), which the network operator wants to charge for

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

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

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

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

tariff: set of parameters defining the network utilisation charges for the use of a particular service

3.2 Symbols

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

Bo	Off-line Charging Reference Point towards the operator's post-processing system
Rc	On-line Charging Reference Point towards the Account Balance Management Function
Re	On-line Charging Reference Point towards the Rating Function
Ro	IMS On-line Charging Reference Point towards the online charging functions (ECF, SCF)
Ro'	On-line charging reference point for non-IMS services (e.g. MMS) towards the online charging functions (ECF, SCF, BCF).

Note that the distinction between Ro and Ro' is made in the present document for descriptive purposes only. The definition of extensions of the Ro reference point and the question whether Ro and Ro' are identical in terms of protocol specification or not, is beyond the scope of the present document. These reference points are to be defined in other 3GPP specifications.

3.3 Abbreviations

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

AoC	Advice of Charge
AS	Application Server
BCF	Bearer Charging Function
CAMEL	Customised Applications for Mobile network Enhanced Logic
CAP	CAMEL Application Part
CDR	Charging Data Record
CSCF	Call Session Control Function
ECF	Event Charging Function
GCID	GPRS Charging ID
GGSN	Gateway GPRS Support Node
HTTP	HyperText Transfer Protocol
ICID	IMS Charging Identifier
IM	IP Multimedia
IMS	IP Multimedia Core Network Subsystem
IP	Internet Protocol
LCS	Location Services
MMS	Multimedia Messaging Service
MRFC	Media Resource Function Controller
OCS	Online Charging System
PS	Packet-Switched
SCF	Session Charging Function
SGSN	Serving GPRS Support Node
SIP	Session Initiation Protocol
SOAP	Simple Object Access Protocol
WLAN	Wireless Local Area Network
XML	eXtented Mark-up Language

4 Required functionality of OCS

The Online Charging System (OCS) shall support mechanisms for:

- online bearer charging towards access network entities (e.g. SGSN, GGSN, IP Flow Handler, WLAN). Online charging reference points to be supported are Ro, Ro' and CAP;

- online charging of applications/services that are provided to subscribers via service nodes (outside the core network) e.g. MMS and LCS. The online charging reference point to be supported is Ro';

- IMS online charging. Online charging reference point to be supported is Ro;

- correlation of bearer, service and IMS charging;
- account balance management towards e.g. recharge server, hot billing server;
- generation of Charging Data Records (CDRs) and their transfer to the operator's post-processing system.

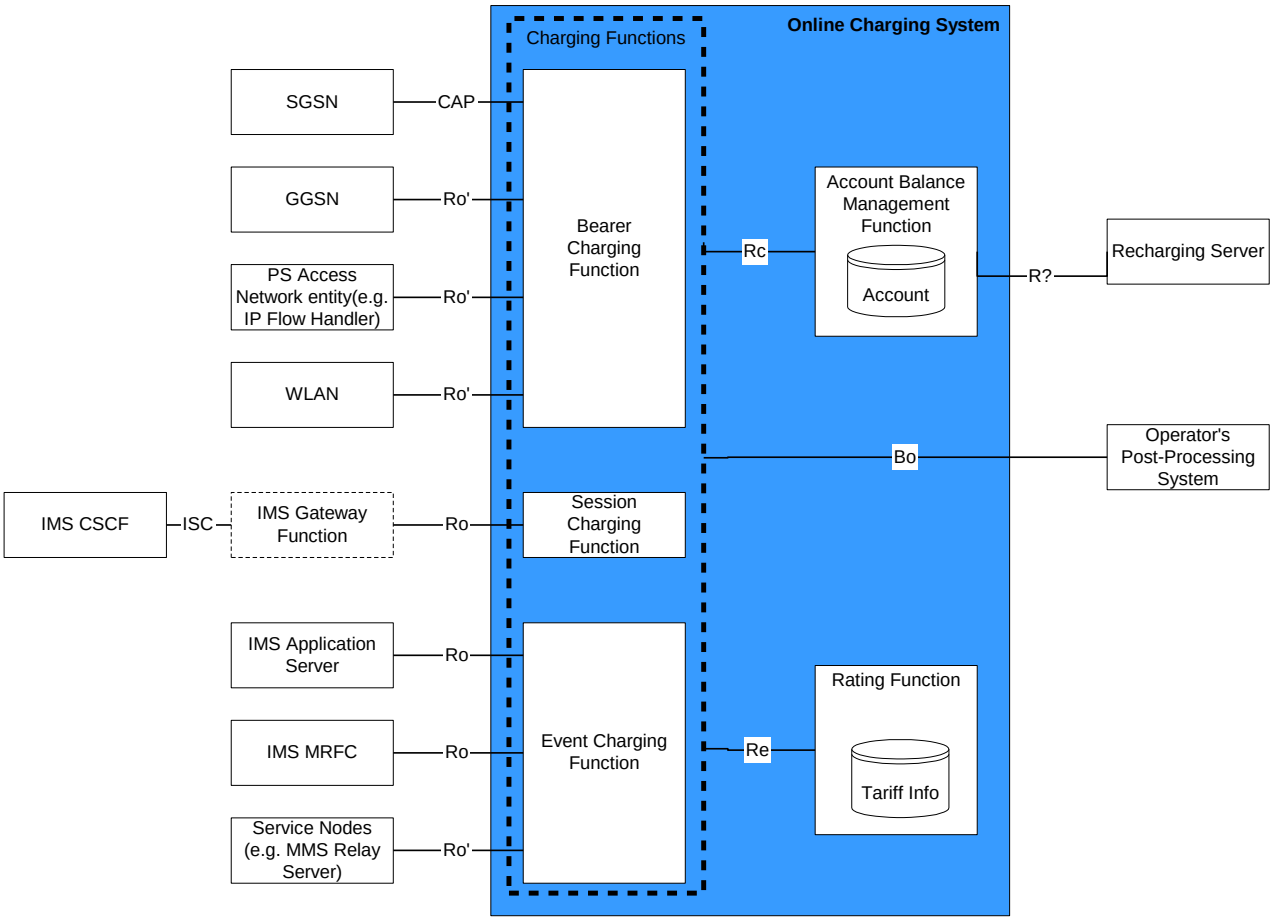
To support these requirements, the functions listed below are necessary in the OCS:

1. rating (before and/or after service consumption)
   - unit determination: calculation and reservation of a number of session-related non-monetary units (service units, data volume, time and events);
   - price determination: calculation of monetary units (price) for a given number of non-monetary units;
   - tariff determination: determination of tariff information based on the subscribers contractual terms and service being requested (e.g. e-parameters for AoC) ;
   - get/set counters applicable for rating (alternatively these counters can be here or in the subscriber account balance management; for further details refer to subclause 5.1.2)
2. subscriber account balance management
   - check account balance;
   - account balance update (credit/debit);
   - account balance reservation;
   - get/set counters;
   - get/set expiry date of the (prepaid) account (optional)
3. charging transaction control
   - perform charging control on request basis for bearer and events/services;
   - immediate charging and charging with reservation;
   - generation of charging information/CDR per charging transaction.
4. correlation function: for further study in later releases

5 Architectural concept

5.1 Architecture reference model for online charging

In 3GPP TR 23.815 [1] a reference architecture for IMS online charging is defined which structures the Online Charging System into different logical functions and reference points between them. Based on this architecture and the requirements given before, a general reference architecture for online charging is defined (see Figure 5-1) that is designed to support online charging mechanisms for bearer charging, service charging and IMS charging.



NOTE: The lines representing the Rc, Re and Bo reference points connecting the Bearer, Session and Event Charging Functions with Account Balance Management Function, Rating Function and the operator's post-processing system respectively are performed only once for figure layout purposes only.

NOTE: The support of ISC as charging interface towards IMS S-CSCF requires additional functionality to be provided by the OCS. The support of Ro as charging interface towards OCS requires additional functionality to be provided by the IMS CSCF. This issue is analysed in more detail in sub-clause 5.4.

Figure 5-1: Online Charging System

Concerning the distinction between Ro and Ro' refer to clause 3.2.

Note that towards the SGSN, the OCS or a separate function could provide a translation between CAP and Ro. This is beyond the scope of the present document.

The Bearer Charging Function (BCF) performs bearer charging using the CAP interface towards the SGSN and Ro reference point or variants thereof towards other network entities in the access domain.

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.

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

The Rating Function and the Account Balance Management Function are described in clause 4. The Re reference point allows the interaction between Charging Functions (BCF, SCF, ECF) and Rating Function.

The Rc reference point allows the interaction between Charging Functions (BCF, SCF, ECF) and Account Balance Management Function to access the account of the subscriber and correlation information. Further analysis is needed whether this reference point can be used as well for interactions with external servers such as recharge server or hot billing server within the operator domain.

The Bo reference points allows the collection and transfer of charging information from the Charging Functions (BCF, SCF, ECF) to the operator's post-processing system.

Compared with the IMS OCS the following extensions and modifications have been made:

- Use of the Event Charging Function (ECF) to support online charging mechanisms also towards service nodes such as MMS Relay Server. The ECF performs event-based charging towards IMS Application Server and MRFC using the Ro reference point. As it is expected that variants of Ro will be used as online charging interface towards service nodes, the ECF is well suited to perform online charging towards service nodes.

- Extension of the Bearer Charging Function to support not only CAP, but also Ro or variants thereof as online charging interface. This extension is motivated by the ongoing standardisation activities. It is expected that Ro or variants thereof will be used as online charging interface towards different access network entities.

- Use of Ro instead of ISC as online charging interface towards IMS Gateway Function, which may or may not be integrated with the IMS S-CSCF. The main motivation behind is that ISC is a service interface. It defines the reference point between a CSCF and an Application Server and as such provides no support for online charging. An extension of ISC would mean to mix service and charging interface. Since there exists already a suitable online charging interface, namely Ro, that provides appropriate mechanisms for online charging of IMS sessions, it is proposed to use Ro as online charging interface instead of extending ISC. A more detailed analysis is given in subclause 5.4.

- Renaming of Correlation Function into Account Balance Management Function. As before the function provides access to account and correlation information.

- For Bearer and Session Charging Functions a similar interface structure is proposed as for the ECF. Considering the functionality of a (bearer, session or event) charging function, in all cases access to the Account Balance Management Function and the Rating Function is needed. It is therefore proposed to use Re as rating reference point towards the Rating Function and Rc as reference point to access account and correlation information also for the Bearer and Session Charging Functions.

- As a consequence of the above two points, reference point Rc is used between Session Charging Function and Account Balance Management Function instead of reference point Rb.

- An additional reference point for charging data collection interfaces from Bearer, Session and Event Charging Functions towards the operator's post-processing system is proposed (Bo).

- An additional reference point between Account Balance Management Function and external systems within the operators domain is foreseen to support access to account and related data e.g. for recharging or hot billing purposes. It has to be analysed whether the functionality provided via the Rc reference point is sufficient or whether it needs extensions so that a different reference point should be defined.

5.1.1 Functional split between Charging Function and Rating Function

Void.

5.1.2 Functional split between Charging Function and Rating Function

5.1.2.1 Option 1: Repository style

Account Balance Management Function and Rating Function serve as data repositories, the charging functions (BCF, SCF, ECF) perform charging control and the required computations. Figure 5-2 illustrates this model.

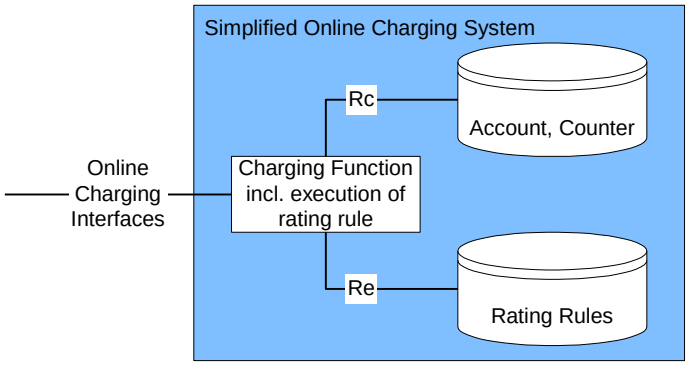


Figure 5-2: Repository style model

Upon receipt of a charging request, the charging function fetches data from Account Balance Management Function (e.g. account, counters) and from the Rating Function (tariff rule). It applies the tariff rule using data from the charging request and from the Account Balance Management Function, i.e. the charging function performs the unit calculation/rating. It will update account and counters accordingly.

This model follows the architectural pattern called repository style. It has the following characteristics:

- Clear separation of execution and data.
- Data can be fetched simultaneously.
- No transfer of data between Account Balance Management Function and Rating Function needed.

To be analysed: protocol implications of transferring tariff rules.

5.1.2.2 Option 2: Rating Engine

This model assumes that rating is performed by the Rating Function. Figure 5-3 illustrates the model.

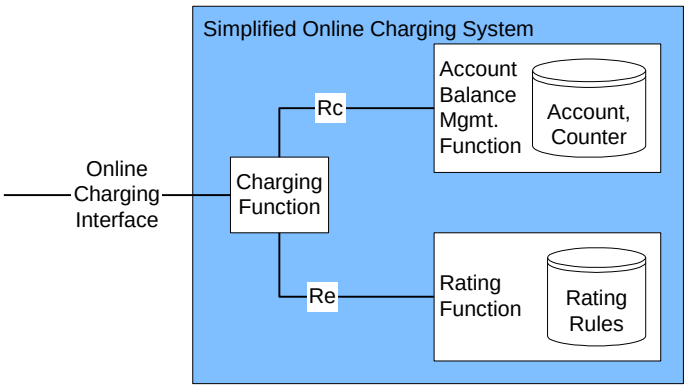


Figure 5-3: Rating Engine model

Upon receipt of a charging request, the charging function fetches data from the Account Balance Management Function (e.g. account, counters). In its rating request towards the Rating Function rating relevant information such as subscriber service usage counters or loyalty accounts are transferred. In the case of a price request for an event the Rating Function identifies the tariff rule to be applied and performs the price determination using the input parameters from the rating request. As response, it will return the calculated price and information on whether/how counters are to be updated. The update is done by the Charging Function. In the case of a tariff request for session or bearer charging, the Rating function determines and directly returns the applicable tariffs (both monetary and for counters, e.g. e-parameters). The determination of the price and the counter changes is done in the Charging Function, which also updates the account and counters.

This design supports the use of a logically common Rating Function for online and offline charging, i.e. it enables a common rating infrastructure for online and offline charging.

The concept for data distribution between Rating and Account Balance Management in this design is motivated by a clear separation of account related data, which may need to be updated during the online charging request, from rating execution and tariff information (e.g. rating rules).

In this option, transfer of data from the Account Balance Management Function to the Rating Function via the Charging Function is necessary.

5.1.2.3 Option 3: Extended Rating Engine

The extended rating engine model has a similar architecture as the rating engine (figure 5-3). However, in an extended Rating Engine, the rating function is also responsible for storing and managing at least some of the counters needed for the rate calculation (e.g. bonus counters, free minutes per time period). Figure 5-4 illustrates the model:

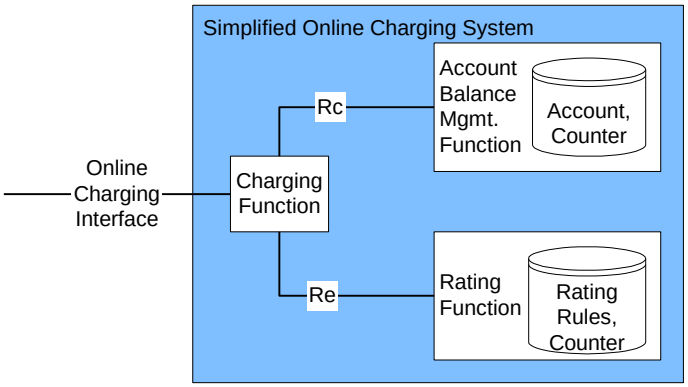


Figure 5-4: Extended Rating Engine model

A rating request can be either for a price for a given service usage (price request) or tariff for AoC (e.g. e-parameters). In the rating request, the charging function provides the request type, information regarding subscriber identity and service identifier. As response, the rating engine will return the calculated price or tariff, respectively.

This design supports common rating infrastructure for online and offline charging as well.

The concept for data distribution between Rating and Account Balance Management in this option is motivated by the encapsulation principle of object oriented design, i.e. all the data that is needed for an object (here: rating engine) should reside within that object.

In this option, an additional scenario - as compared to option 2 - needs to be supported on the Re-reference point, i.e. the charging function has to inform the rating function about the success of service delivery before counters can be updated and the rating function has to acknowledge the successful counter update.

5.1.2.4 Recommendation

The comparison between the above Re reference point options is depicted in table 5.2:

Table 5.2: Functional split options comparison

Aspect	Option 1: Repository Style	Option 2: Rating Engine	Option 3: Extended Rating Engine
Complexity	Very Complex – Need to export a full rating schema	Moderate	Moderate
Durability / Flexibility	Inflexible – Need to change I/F for every schema enhancement	Fully flexible – Bounded only by the counter manipulation methodology	Fully flexible – Bounded only by interface functionality
Rating Functionality	Spread between Charging & Rating	Focused in the Rating Engine	Only in the Rating Engine
Coupling	Tight	Moderate	Moderate
Counters fetch	N/A	Charging function must fetch all associated counters (note 1)	Counters are fetched on a need to use basis
Counters locking	N/A	Must lock all counters for each request (note 1)	Counters are locked on a need to use basis
Counters update	Update of counters similar to account update via Rc-Reference point	Update of counters similar to account update via Rc-Reference point	Additional messages on Re-Reference point and transaction control / session handling necessary (note 2)
Performance	High	Potentially less than Option 1 due to counters locking.	Potentially less than Option 1 due to additional messages on the Re reference point.

NOTE 1: Load could be reduced, depending on the functionality of the Rc-reference point and logic within the charging function.

NOTE 2: Overhead caused by the additional messages could be relieved, if account balance management and rating function reside in the same physical entity.

Option 1 is not recommended, due to it's tight coupling, inflexibility and complexity.

Option 2 has the advantages, that there is a clear architectural split: dynamic subscriber data (account balance, counters) are maintained only in the Account Balance Management Function. Furthermore, the Rating engine can be stateless.

Option 3 has the advantage, that the load on the Re-reference point can be lowered, however the Re-reference point needs to be extended for synchronisation purposes. Tariff requests for charging are not required for this option.

To allow for a common rating infrastructure for online and offline charging, options 2 and/or 3 are recommended.

5.1.2 Bearer Charging Function (BCF)

The BCF performs the bearer level charging based on bearer usage requests received from the network. It controls the bearer usage in the network, e.g. in terms of time or volume granted. It communicates with the Rating Function in order to determine the value of the requested bearer resources. It communicates with the Account Balance Management Function to query and update the subscribers' account and counters status (counters not applicable in the "Extended Rating Engine" option, ref. subclause 5.1.2.3).

Concerning the correlation of charging information, refer to the discussion in subclause 5.3.

5.1.3 Event Charging Function (ECF)

The ECF performs event based charging (e.g. content charging) based on service usage requests received from the network. It can grant or deny the service usage in the network. It communicates with the Rating Function in order to determine the value of the requested service usage. It communicates with the Account Balance Management Function to query and update the subscribers' account and counters status (counters not applicable in the "Extended Rating Engine" option, ref. subclause 5.1.2.3).

Concerning the correlation of charging information, refer to the discussion in subclause 5.3.

5.1.4 Session Charging Function (SCF)

The SCF performs charging of sessions based on session resource usage requests received from the network (e.g. the IMS CSCF). It controls sessions in the network, e.g. it has the ability to grant or deny a session set-up request and to terminate an existing session. It communicates with the Rating Function in order to determine the value of the requested session. It communicates with the Account Balance Management Function to query and update the subscribers' account and counters status (counters not applicable in the "Extended Rating Engine" option, ref. subclause 5.1.2.3).

Concerning the correlation of charging information, refer to the discussion in subclause 5.3.

Concerning the interface between the SCF and the IMS CSCF, refer also to the discussion in subclause 5.4.

5.1.5 Rating Function

The Rating Function performs both monetary and non-monetary unit determination (rating). It provides following features:

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

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

- Rating of volume (in terms of granted units or money, e.g. based on charging initiated by an access network entity);
- Rating of time (in terms of granted units or money, e.g. based on charging initiated by a SIP application);
- Rating of events (e.g. based on charging of web content or MMS).

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

Upon receipt of a rate request from the Charging Function, the Rating Function:

- Evaluates the request. Rate requests include various rating parameters such as service identifier, subscriber reference, network identification, user location, service usage time, transferred data volume etc. Note that necessary rating information includes counters of subscriber service and subscriber session usage maintained by the Account Balance Management Function and (optionally) the Rating Function, respectively;
- Determines the applicable price or tariff model and returns it to the Charging Function.

5.1.6 Account Balance Management Function

To be defined in a later release.

5.2 Charging architecture reference points

5.2.1 Re Reference Point (BCF, SCF, ECF – Rating Function)

5.2.1.1 Functionality for the "Rating Engine" Option

The following applies with respect to the Rating Interface:

- The Rating Function will potentially cover all rating scenarios for all charging levels (bearer, session and service) and all payment channels (prepaid, postpaid and wallet).
- The Rating Function will cover the following scenarios/use cases **PriceRequest** and **TariffRequest**.

- An additional scenario **ServiceUsageRequest,** where the number of service units for a given price is determined, may be needed. This detail will be studied in the specification of the Re-reference point and is beyond the scope of the present document.

- The Rating Function will operate in a stateless way on a per request basis. No context or state is stored internally.

- The Rating Function will not modify accounts or bonus counters directly. Instead it passes the corresponding information as part of the response (e.g. "debit 1 € from subscriber X", "credit 0.9 € to merchant Y", "add 100 loyalty points of partner Z to subscriber X", "increase counter SMScounter for subscriber X and merchant Y by 1").

- The Rating Interface is an interface in a trusted environment. No session handling, transaction control or authentication will be supported.

- No tickets are written by the rating function. Thus billing relevant information is part of the response (e.g. "tariff Z for gold customers was applied").

- Functional compatibility with existing external Rating is required, thus the functionality of these tariff requests must be covered by Re as well.

Resulting from these requirements following functionality of Re is proposed:

- Basic Functions:
  - Price Request (to calculate a price for given service usage);
  - Service Usage Request (to calculate service units for a given amount of money/loyalty);
  - Tariff Request (to request a tariff that is applicable, e.g. GSM 'e-parameters')
- Extended Functions:
  - Discounts by use of consumer specific counters;
  - Loyalty programs;
  - Taxes.
- Supplement:
  - Detailed Information for use during invoice generation.

To follow the spirit of IETF DIAMETER a lean interface is proposed with just two methods, namely:

- rateRequest (common method for price request and service usage request);
- tariffRequest.

Depending on the service or product offered and on the customer's contract, the Rating Function supports the following scenarios:

- **PriceRequest**: Determination of a price for the execution of a service or the delivery of a good. From the rating perspective this is the same scenario if run before delivery (e.g. for balance check or AoC), after delivery (post-rating for charging) or even later in a re-rating process. The same scenario applies for one-time or recurrent charges.

- **TariffRequest**: Determination of a tariff for a given service. This scenario is used, e.g., for voice calls, where e-parameters are returned by the rating function. Based on the tariff (e-parameters) the charging function calculates either the amount of units for a given price or the price for given number of units. The scenario can also be used for various other services.

Scenarios involving granted units may be covered via a TariffRequest or by the Rating Function directly. The handling of the first case is part of the charging function. For the latter case the Re reference point will offer a special request type:

- **ServiceUsageRequest**: This type of request, also called backward rating, determines the amount of units of a given service given the price. There is no principle difference to a regular price request from the rating perspective.

Potentially the Rating Function would also be able to determine granted units for a given service type.

Input for Rating:

- Rating Request Type: Price Request, Service Usage Request, Tariff Request.
- Service-specific data: Service-ID, Time/Date of Service usage, QoS, ...
- Subscriber-specific static data: Subscriber-ID, Partner-ID {MVNO, merchant, ...}, additional tariff information ("Friends & Family" list, …), other static data.
- Subscriber specific dynamic data: Account Balances incl. units/currency {money, loyalty}, Subscriber Counters (Service-Type {SMS/MMS/Volume/Time} used per time-unit {day/week/month/year}), other dynamic data)

Output of Rating:

- Rating Request Type Response: Price or Service units or Tariff incl. tariff switch information (e-Parameters, Tariff Switch Time (absolute time/duration), ...);
- Charge and Recharge Information: Value for accounts and Subscriber Counters (e.g. charge money, recharge loyalty accounts);
- Tax information;
- Detailed information to be used for invoice generation.

Depending on the technological basis of the interface, results may be passed as return values (as described below) or in equivalent response-"methods" (rateResponse, tariffResponse).

The parameters needed for rating depend on the service type (VoiceCall, VoIP, VoD, SMS, Content, ...). Even if this is a small set, an introduction of methods like rateRequestSMS, ... does not seem to be feasible if the interface should be sufficiently general, extensible and stable. Thus the service type will be passed as an argument instead.

There are basically several options for the protocol to be used:

- XML (via socket, SOAP, HTTP, ...);
- Diameter/Radius;
- CORBA.

There are some arguments in favour of Diameter, however which option to choose will be defined in the specification of the Re-reference point and is beyond the scope of the present document.

5.2.1.2 Functionality for the "Extended Rating Engine" Option

If the Extended Rating Engine option (subclause 5.1.2.3) is chosen, i.e. counters are maintained in the Rating Function, then the Re Reference Point is modified with respect to the previous clause in the following way:

- an additional scenario/use case **ServiceDeliveryConfirmed** has to be covered;
- the Rating Function has to become statefull;
- the Rating Function has to modify counters directly;
- the Rating Function has to handle sessions / has to support transaction control;
- the TariffRequest is required only for AoC.

5.2.2 Rc Reference Point (BCF, SCF, ECF – Account Balance Management Function)

To be defined in a later release.

5.2.3 Reference Point (Account Balance Management Function – ext. server)

Analysis on requirements needed in order to evaluate whether Rc can be used or separate reference point needed. For further study in a later release.

5.2.4 Bo Reference Points (BCF, SCF, ECF – post-processing system)

The Bo reference point represents the intra-billing-domain interface for the CDR file transfer from the OCS to the operator's post-processing system. The functional requirements for this reference point are similar to those of the generic Bx reference point. Re-use of the Bx reference point specification for Bo will be analysed in a later release.

5.3 Impact of Correlation of Charging Information on OCS

The charging architecture shall provide means to correlate charging information generated at bearer, session and service charging levels by the involved network entities.

For this purpose, various information supporting On-line and Off-line charging mechanisms need to be distributed between entities of transport, service and IMS domain. It is necessary to have available information to allow the correlation of charging data from the bearer level, from the IMS session control, and from (IMS and non-IMS) Application Servers.

The implications of this requirement on the online charging architecture are analysed in this sub-clause. The definition of correlation levels and principles is out of the scope of this report. The basic principle will however be described as basis for the analysis of the impacts on OCS functionality.

5.3.1 Basic Principles of Charging Correlation

NOTE: This subclause is based on 3GPP TR 23.815 [1] and is included here just for information. The Basic Principles of Charging Correlation will be defined in the appropriate Rel-6 specification.

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

1) The correlation of charging information for a chargeable event is based on the use of unique Charging Identifiers.

2) In case the charging information to be correlated comes from one network entity, this entity is responsible for generating a unique charging identifier (e.g. transaction/session id). Charging identifier together with network entity identifier are to be included in the charging information (CDR, online charging request).

   In case the charging information to be correlated comes from different network entities, the first network entity in the path is responsible for assigning a charging identifier. Charging identifier together with network entity identifier shall then be passed along the whole signalling path in an end-to-end manner. This shall not preclude further elements along the path generating additional identifiers to be passed along.

   In general: network entities generating charging information shall include charging identifier and their identity and pass this information along the whole path of elements involved in service delivery. Only if sufficient information is exchanged between network entities, correlation is possible.

5.3.2 Implications on OCS

Prerequisite for correlation is that the charging information to be correlated contains an unique identifier. This charging correlation identifier included in the online charging request is the basis for correlation. It enables separate handling of related charging requests.

The Charging Correlation Identifier shall be transmitted over all OCS interfaces to give all OCS functions the option of correlating charging requests. If correlation occurs and the location where it occurs is for further study in a later release. E.g., requests may be correlated in the charging functions, or in an external node, or the Rating Engine may use the charging correlation identifier to identify the appropriate pricing rule, e.g. bearer and/or service price for MMS, bearer and/or session price for IMS.

All charging functions, BCF, SCF and ECF, shall include the charging correlation identifier in the charging information to be transferred to the operator's post-processing system, so that correlation for billing purposes is possible.

5.4 Discussion: Interface towards IMS CSCF

3GPP TS 32.200 [2] defines ISC as interface between IMS CSCF and OCS. ISC is a service interface, it defines the reference point between a CSCF and an Application Server and as such provides no support for online charging.

The use of ISC towards the OCS would therefore require that additional functionality which is usually not part of the OCS but the requesting network entity would have to be supported by the OCS. 3GPP TR 23.815 [1] foresees a Session Charging Function (SCF) for this purpose.

In addition to the core functionality of a charging function (e.g. compared with the BCF and ECF), the tasks of such a SCF would include

- support of ISC, i.e. SIP protocol stack;
- act as IMS application server towards the CSCF;
- budget control for the IMS session;
- call state model;
- session termination if budget is exhausted.

Therefore, in order to not overload the OCS with additional functionality and to keep the online charging architecture consistent and coherent, it is requested to use an interface between CSCF and OCS that supports online charging mechanisms. There are basically two options for this:

- extension of ISC with charging mechanisms;
- use of an existing suitable online charging interface.

An extension of ISC would mean to mix service and charging interfaces. This is neither to be expected acceptable for standardisation nor does it seem to be reasonable. Since there exists already a suitable online charging interface, namely Ro, that provides appropriate mechanisms for online charging of IMS sessions, it is proposed to use Ro as online charging interface instead of extending ISC. As a consequence there is no need for an extended Session Charging Function as described above. Instead, a SCF that is functionally equivalent to the Bearer Charging Function will provide sufficient mechanisms for online charging of IMS sessions.

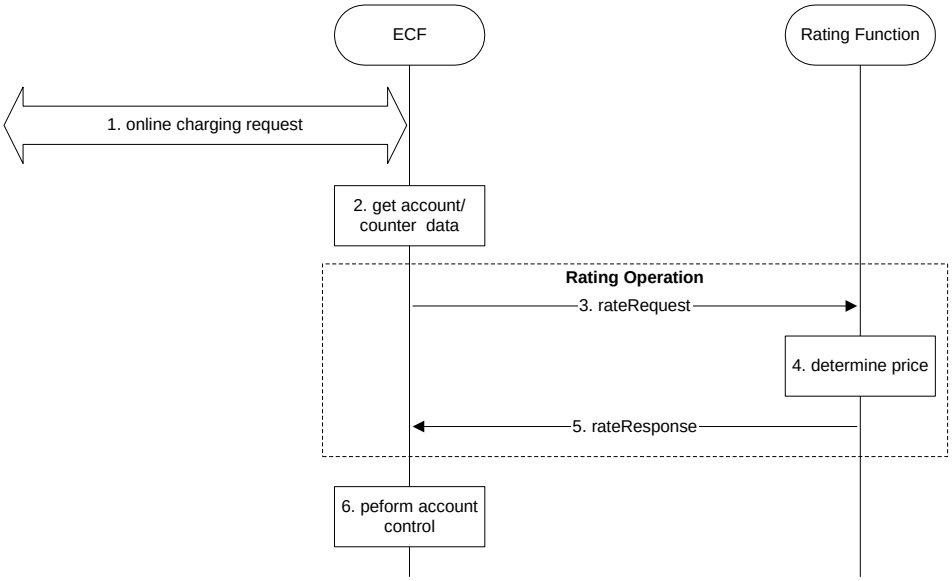
6 Examples for Message Flows via Rc and Re

This clause covers the "Rating Engine" functionality only (subclause 5.1.2.2); the "Extended Rating Engine" functionality (subclause 5.1.2.3) is not covered.

6.1 Re message flow examples

6.1.1 Scenario with rateRequest operation

Figure 6-1 shows an example message flow for the rating operation. The scenario describes the case where the ECF invokes the rateRequest operation.

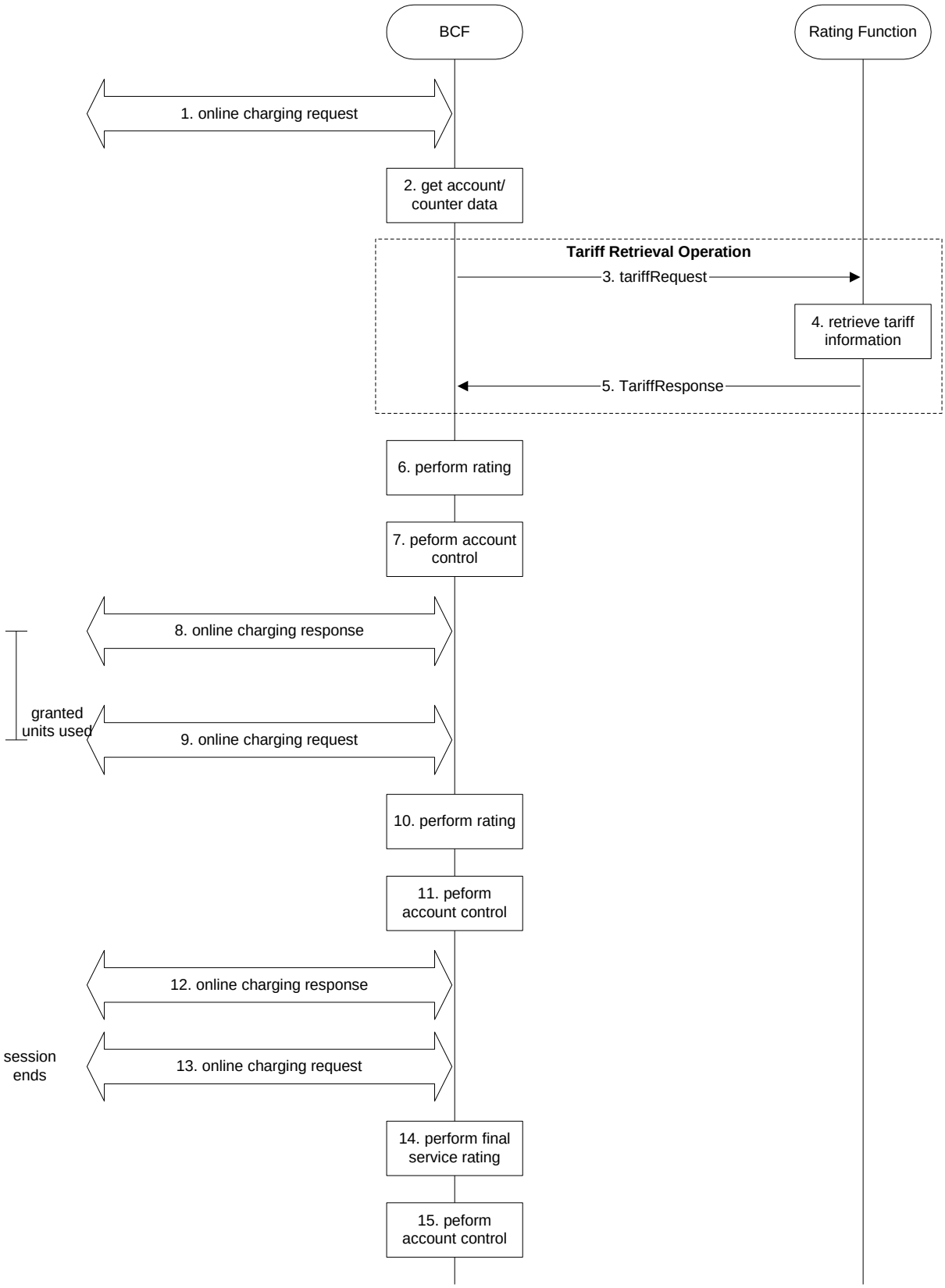


NOTE 1: The ECF receives an online charging request for a certain event/service.
NOTE 2:. The ECF requests account and counter information for the subscriber from the Account Balance Management Function. Upon receipt of this data,
NOTE 3: the ECF sends a rating request to the Rating Function in order to determine the price of the desired service. Please note that this scenario assumes that the ECF has not received any service cost information in the online charging request.
NOTE 4: The Rating Function calculates the price for the given service according to the service and subscriber specific information included in the request.
NOTE 5:. The calculated price is returned to the ECF.
NOTE 6:. The ECF continues event charging.

Figure 6-1: Rating operation

6.1.2 Scenario with tariffRequest operation

Figure 6-2 shows an example message flow for the tariff request operation. The scenario describes the case where the BCF invokes the tariffRequest operation.



NOTE 1: The BCF receives an online charging request referring to an MS's bearer usage.
NOTE 2: The BCF requests account and counter information for the subscriber from the Account Balance Management Function. Upon receipt of this data,
NOTE 3: it requests tariff information applicable for this bearer.
NOTE 4: The Rating Function retrieves the appropriate tariff to be applied for the bearer.
NOTE 5: The Rating Function returns the tariff information to the BCF.
NOTE 6: Based on the received tariff information, the BCF performs rating, i.e. determine the unit price.
NOTE 7: The BCF continues bearer charging and performs account control.
NOTE 8: It returns the granted units to the requesting network element.
NOTE 9: The granted units are used and a new request is send to the BCF.
NOTE 10: This time the BCF can directly perform the rating, i.e. determine the unit price, and
NOTE 11 perform account control.
NOTE 12: Again, assuming successful account control,
NOTE 13: a positive acknowledgment is returned to the network entity.
NOTE 14: The MS terminates bearer usage. The used units are send to the BCF.
NOTE 15: The BCF performs final rating for the consumed bearer resources and adjusts the account accordingly.

Figure 6-2: Tariff request operation

In this scenario due to the use of the tariffRequest operation only one request to the Rating Function is needed during the whole bearer "session". However, there can also be scenarios, in which more than one tariffRequest is necessary (e.g. if the tariff expires; in the example above, a 2nd tariffRequest could occur between steps 9 and 10).

6.2 Rc message flow examples

To be defined in a later release.

7 Conclusions and recommendations

The purpose of the present document is to serve as a basis for detailed specification of OCS interfaces in 3GPP.

The present document provides a description of the functionality of Re reference point, which is mature enough to start detailed specification of this reference point. It is therefore recommended to have a TS specifying the Re reference point (New Release 6 TS 32.296: Telecommunication management; Charging management; On-line Charging System (OCS): Applications and interfaces).

Later versions of the present document will be extended with descriptions of the other OCS interfaces, which then will act as basis for corresponding TS. This work will progress in later 3GPP releases.

Annex A:
Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
Jun 2003	SA_20	SP-030274	--	--	Submitted to TSG SA#20 for Information	1.0.0	
Sep 2003	SA_21	SP-030409	--	--	Submitted to TSG SA#21 for Approval	2.0.0	6.0.0
Jun 2005	SA_28	SP-050273	0001	--	Correction on the use of “reference point” and “interface” – Align with TR 21.905	6.0.0	6.1.0