Draft Recommendation ITU-T Y.2233 Rev.1

Requirements and framework allowing accounting and charging capabilities in NGN

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1. Scope

This Recommendation provides technical requirements and framework which allow for accounting and charging capabilities in NGN. It is intended to aid in standardizing protocols and mechanisms to enable accounting and charging for NGN.

In order to support advanced accounting and charging capabilitiesin NGN, it is important to support policy-based accounting and charging and its associated extensions in terms of requirements, architecture, scenarios and capabilities. Other areas needing extensions are requirements, in order to support advanced requirements such as dynamic rating, supporting hierarchy of customer accounts etc., and online and offline inter-provider settlements. This Recommendation provides such extensions to the previous Y.2233 (2008) version.

Non technical aspects of charging in NGN (which are under the responsibility of ITU-T SG3) and management aspects of accounting and charging in NGN (which are under the responsibility of SG2) are out of the scope of this Recommendation.

2. References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this Document. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Document are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2006), Functional requirements and architecture of the NGN release 1

[ITU-T Y.2021] Recommendation ITU-T Y.2021 (2006), IMS for Next Generation Networks

[ITU-T Y.2111] Recommendation ITU-T Y.2111 (2008), Resource and admission control functions in Next Generation Networks

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), Security requirements for NGN release 1.

[Editor's Note: Need to update Reference publication dates prior to publication of Recommendation Y.2233 (e.g. Y.2111Rev1 Amd1)]

3. Definitions

3.1. Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 usage metering [b-ITU-T Q.825]: The abstraction of activities that monitor the utilization of resources, for the purpose of accounting and controlling the recording of usage data.

3.2. Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 accounting: The process of collecting and analysing NGN service and NGN resource usage metrics for the purposes of capacity and trend analysis, cost allocation, auditing, and billing, etc.

Accounting management requires that resource consumption be measured, rated, assigned, and communicated between appropriate business entities.

3.2.2 bidirectional flow: A bidirectional flow is a flow which is composed of packets sent in both directions between two endpoints. A bidirectional flow is composed from two unidirectional flows.

3.2.3 billing: The process after rating in which the NGN transactions of NGN event usage are compiled and bills are produced.

3.2.4 billing domain: Part of the operator network, which is outside the NGN that receives and processes charging information from the NGN charging functions. It includes functions that can provide billing mediation and billing or other (e.g., statistical) end applications. It is only applicable to offline charging.

3.2.5 chargeable event: Activity utilizing NGN network resources and related services for:

– user-to-user communication (e.g., a single call, a data communication session or a short message); or

– user-to-network communication (e.g., service profile administration); or

– inter-network communication (e.g., transferring calls, signalling, or short messages); or

– mobility (e.g., roaming or inter-system handover); and

– any other types of service activities the network operator may want to charge for.

As a minimum, a chargeable event characterizes the resource/service usage and indicates the identity of the involved end user(s).

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

3.2.7 charging: Function within the NGN network and the associated OCS/BD components whereby information related to a chargeable event is collected, formatted, transferred and evaluated in order to make it possible to determine usage for which the charged party may be billed (offline charging) or the subscriber's account balance may be debited (online charging).

3.2.8 charging information record [based on b-ITU-T Q.1741.2]: Formatted collection of information about a chargeable event (e.g., time of call set-up, duration of the call, amount of data transferred, etc.) for use in billing and accounting. For each party to be charged for parts of or all charges of a chargeable event a separate CIR is required to be generated, i.e., more than one CIR may be generated for a single chargeable event, e.g., because of its long duration, because more than one charged party is to be charged, or because more than one content-type is to be charged.

3.2.9 charging event: Set of charging information forwarded by the CTF towards the CCF (offline charging) or towards the OCS (online charging). Each charging event matches exactly one chargeable event.

3.2.10 correlation: Capability to generate an aggregated CIR by combining and analyzing charging events collected from the same transport/service session.

3.2.11 flow: A flow is defined as a set of IP packets passing an observation point in the network during a certain time interval. All packets belonging to a particular flow have a set of common properties. Each property is defined as the result of applying a function to the values of:

1) One or more packet header fields (e.g., destination IP address), transport header fields (e.g., destination port number), or application header field (e.g., RTP header fields).

2) One or more characteristics of the packet itself (e.g., number of MPLS labels).

3) One or more fields derived from packet treatment (e.g., next hop IP address, output interface).

3.2.12 inter-provider settlement: Payment of amounts resulting from the accounting process.

3.2.13 metering: See usage metering.

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

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

3.2.16 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 resource/session/service control is required.

3.2.17 policy based charging and accounting: Charging and accounting capability based on different factors or factor group (e.g., access specific characteristics, QoS provided by the transport for the service, specific service types, time, user subscription information, etc)

3.2.18 rating: The process of calculating the charges for an NGN transaction.

3.2.19 real-time: Real-time charging and billing information is to be generated, processed, and transported to a desired conclusion in less than 1 second.

3.2.20 session: Logical connection between parties involved in a packet-switched based communication.

NOTE – This term is used for IP connections rather than the term "call" that is normally used for a connection over conventional (circuit switched) systems. A session can be composed of one or more unidirectional and/or bidirectional flows.

3.2.21 unidirectional flow: A unidirectional flow is a flow which is composed only of packets sent from a single endpoint to another single endpoint.

4. Abbreviations and acronyms

Editor's Note: Some of the acronyms listed are not used in this document, and should be removed prior to publication.

This Recommendation uses the following abbreviations:

AFE Accounting Functional Entity

ABMF Account balance management function

AOC Advice of Charge

BD Billing Domain

BFE Billing Functional Entity

BSS Business Support System

CAF Charging and Accounting Function

CC Credit Control

CCF Charging Collection Function

CDR Charging Data Record

CIR Charging Information Record

CFE	Charging Functional Entity
CGF	Charging Gateway Function
CS	Circuit Switched
CTF	Charging Triggering Function
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
FE	Functional Entity
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IPCGF	Inter-Provider Charging Gateway Function
IPDR	Internet Protocol Detail Record
ISP	Internet Service Provider
LCS	LoCation Services
MMS	Multimedia Messaging Service
NE	Network Element
NGN	Next Generation Network
NMS	Network Management System
OCF	Online Charging Function
OCS	Online Charging System
OS	Operating System
PCA	Policy based Charging and Accounting
PS	Packet Switched
PLMN	Public Land Mobile Network
QoS	Quality of Service
RADIUS	Remote Authentication Dial In User Service
RF	Rating Function
SMS	Service Management System
UMTS	Universal Mobile Telecommunications System
UTC	Coordinated Universal Time
WLAN	Wireless LAN

5. Conventions

For unique and convenient identification of requirements, the following abbreviations and convention are used in clauses 6 and 7:

A-B-R-00n:

A: Type of requirements (e.g., H: high-level requirements, F: functional requirements, P: protocol requirements, I: information model related requirements, M: charging Model related requirements etc.)

B: Subsystem functional requirements (e.g., A: accounting functional requirements, C: charging functional requirements, G: General functional requirements, Null: if not applicable)

R: stands for requirement

00n: a requirement serial number]

6. High-level requirements for mechanisms allowing policy-based accounting and charging capabilities in NGN

- H-R-001: NGNs are required to support an architecture with open-standard interfaces to provide charging and accounting capabilities for NGN release 2 services
- H-R-002: NGNs are required to support various charging policies (e.g., fixed rate charging and usage based per-session charging)
- H-R-003: NGNs are required to support accounting and charging functionality associated with the provision of both unicast and multicast based services. The accounting system is required to capture user information and resources used. Specifically the accounting system is required to identify which user used resources and the start and finish times associated with the use of the resources
- H-R-004: NGNs are required to support appropriate charging arrangement models for NGN release 2 services. It is required to consider multi-service environment in NGN including international interconnection. This may require a settlement between different types of service providers, for example, NGN network operators, content service providers, and/or application service providers. It includes transfer of accounting and charging information among them.
- H-R-005: NGNs may support flow-based accounting and charging functionality for various NGN release 2 services. Such functionality must be accurate, reliable, and scalable. Some examples of the functionality are:
  - Accounting and charging for uni-directional flow resource usage
  - Accounting and charging for bi-directional flow resource usage
  - Accounting and charging for session resource usage
- H-R-006: NGNs are required to support interfaces and protocols between network elements and accounting elements and between accounting and charging elements to collect and transport resource usage data. (e.g., accounting metrics and CIRs, etc.) These interfaces and protocols are required to comply with clause 7 of this Recommendation.
- H-R-007: NGNs are required to support management functionalities for the seamless operation of the accounting and charging functional elements
- H-R-008: NGNs are required to support policy-based charging, accounting and control for NGN services.
- H-R-009: NGNs are required to support an architecture with open-standard interfaces to provide policy-based charging and accounting capabilities and coordination with resource control, including RACF, for NGN Release 2 services.

- H-R-0010: NGNs are required to support interfaces and protocols between policy control functional entities and charging and accounting functional entities.
- H-R-0011: NGNs are required to support management functionalities for the seamless operation of the policy-based accounting and charging and its associated control functional elements.
- H-R-0012: NGNs are required to support secure, reliable, and scalable operations of policy-based charging and accounting for NGN services.
- H-R-0013: NGNs are required to support high availability architecture for seamless operations in case of any hardware and software failures.

7. Functional requirements for mechanisms allowing policy-based accounting and charging capabilities in NGN

7.1. Metering functional requirements

- F-M-R-001: NGN network elements (NEs) are required to support capabilities to collect resource usage related data in real-time.
- F-M-R-002: NGN NEs are recommended to support capabilities to collect resource usage related data without any loss and duplication.
- F-M-R-003: NGN NEs are required to support capabilities to collect resource usage related data based on different QoS levels.
- F-M-R-004: NGN NEs are required to support metering of resource usage with two types of units, packet count and byte count, resource usage duration and may support other units.
- F-M-R-005 NGN NEs are required to support metering of resource usage with various types of granularity such as 5-tuple flow count, content-aware count, message count (e.g., e-mail messages), content count (e.g., music, movie, etc.), and may support other granularity types.
- F-M-R-006: It is recommended that metering be able to differentiate traffic flowing inside an NGN provider domain and traffic flowing between two or more NGN provider domains.
- F-M-R-007: NGNs are recommended to support per-medium metering in the context of multimedia services.
- F-M-R-008: NGNs are recommended to support interim metering, which is a snapshot of metering.
- F-M-R-009: NGN NE metering is recommended to be fault-tolerant, that is, it should be recoverable as much as possible when NE failure occurs.

  NOTE 1: “fault-tolerant” does not mean 100% recoverability.
- F-M-R-010: NGNs may support non-NE-resident metering mechanism (e.g., metering by stand-alone metering device).
- F-M-R-011: NGNs are recommended to support metering policy configuration by its users (e.g., NMS, SMS or other application entities).
- F-M-R-012: It is recommended that NGN resource usage related data captured from NEs be held in a standard accounting metric.
- F-M-R-013: NGNs are required to support transfer of accounting metric to the charging functional entities in secure, reliable, and efficient manner.

NOTE 2: other requirements on transfer of accounting metric to the charging functional entities exist in clause 7.3.

- F-M-R-014: NGNs may support identification of a charging session by metered flow inspection without receiving charging start indication from an external associated functional entity such as RADIUS server
- F-M-R-015: NGNs are required to support either in-line or passive metering functionality. If in-line metering functionality is supported, metered traffic control may also be supported if such charging policy is applied
- F-M-R-016: NGNs are required to support packet processing capabilities (e.g., correlation identification, call reference administration, or deep packet inspection) required to accurately identify a session
- F-M-R-017: NGNs are required to support filtering capability to filter out a specific set of data packets based on a filtering rule (e.g., filtering based on terminal IP address or a range of IP addresses, service server IP address or a range of IP addresses, service server Port numbers, and any combination of them)
- F-M-R-018: NGNs are required to support per-service metering (examples)
- F-M-R-019: NGNs are required to support metering usage of payload only from a service traffic
- F-M-R-020: NGNs are required to support capabilities to identify service termination (e.g., normal termination by TCP FIN or abrupt termination by some network failure, etc.)
- F-M-R-021: NGNs are recommended to support activation and deactivation of QoS downgrade capabilities for certain types of traffic
- F-M-R-022: NGNs are required to support metering the usage of customer traffic in terms of layers 3, 4, and 7.

7.2. Charging functional requirements

- F-C-R-001: NGNs are required to support off-line charging and on-line charging per user.
- F-C-R-002: NGNs are required to support off-line and on-line per service.
- F-C-R-003: NGN charging functional entities are required to be able to generate charging detail records for all charges incurred between NGN customer and NGN service provider and between NGN service providers. This includes difference types of service provider relationships.
- F-C-R-004: NGNs are recommended to support both service level and transport level charging.
- F-C-R-005: NGNs are recommended to support both per-service charging (e.g., multimedia communications) and per-medium charging (e.g., voice, video, data).
- F-C-R-006: NGNs are recommended to support charging per flow direction. For example, incoming or outgoing flows of a particular session may be charged separately.
- F-C-R-007: NGNs are recommended to support charging for different levels of QoS (including network resource usage, e.g., bandwidth used) including when QoS is to be applied for each type of service or medium.
- F-C-R-008: NGNs are recommended to support per-service charging irrespective of the underlying technology to deliver the service.

- F-C-R-009: NGNs are required to support per-service charging based on the underlying technology to deliver the service.
- F-C-R-010: NGNs are recommended to support charging based on the use of extra resources.
- F-C-R-011: NGNs are recommended to support capabilities which allow for excluding charging for certain types of contents (e.g., advertisement).
- F-C-R-012: NGNs are recommended to support charging based on other criteria (e.g., location, presence, etc.).
- F-C-R-013: NGNs are required to support transfer of charging information to billing domain with a standard-based protocol that satisfies the requirements specified in clause 7.3.
- F-C-R-014: NGNs are recommended to support AOC (advice of charge), (i.e., AOC prior to service/product consumption, AOC during service/product consumption, and AOC post service/product consumption).
- F-C-R-015: NGNs are recommended to support dynamic rating.
- F-C-R-016: NGNs are recommended to support customer account hierarchy.
- F-C-R-017: [deleted]
- F-C-R-018: NGNs are required to support policy-based charging and its associated control on a per session basis.
- F-C-R-019: NGNs may support adjustable charging rate on a per session as a result of events related to the service.
- F-C-R-020: NGNs may support identification of charging event initiation and termination of a session without receiving information from application support functions.
- F-C-R-021: NGNs may support capabilities which allow for charging specific permitted services and blocking any other services with appropriate notice on the blocking.
- F-C-R-022: NGNs are recommended to support 3rd party charging for certain services.
- F-C-R-023: NGNs are recommended to support real-time credit refill for on-line charging either by user or service provider.
- F-C-R-024: NGNs are required to support real-time selection and modification of accounting policies according to customer requirements.

7.3. Accounting and charging protocol high level requirements

- F-P-R-001: NGN charging and accounting protocol is required to support a wide range of billing models (e.g., post paid, pre paid, pay per view, pay per click and sponsored campaigns).
- F-P-R-002: NGN charging and accounting protocol is required to be efficient, for example it should efficiently utilize the network bandwidth as well as introduce minimal processing and memory overheads to the network and service resources.
- F-P-R-003: NGN charging and accounting protocol is required to support minimization of delays and latencies in the delivering and in the processing of the usage data.
- F-P-R-004: NGN charging and accounting protocol is required to ensure that all usage records are reliably received.
- F-P-R-005: NGN charging and accounting protocol is required to allow high availability of the data collection system.

- F-P-R-006: NGN charging and accounting protocol is required to include or support integration of proper security mechanisms in order to avoid tampering and eavesdropping.
- F-P-R-007: NGN charging and accounting protocol is required to be scalable.
- F-P-R-008: NGN charging and accounting protocol is required to be easy to deploy and manage even in heterogeneous OS environments.
- A cache function is recommended to be supported. When link is broken, CIRs can be kept in the CCF. And when link is resumed, CCF can resend CIRs to CGF.

7.4. Accounting and charging information model high level requirements

- F-I-R-001: NGNs are recommended to support standardized and extensible charging and accounting information model for NGN release 1 services.

7.5. Charging policy and rule requirements

- F-P-R-01: NGNs are required to support policy based charging and accounting.
- F-P-R-02: NGNs are recommended to support different charging policies for the different QoS-related transport resources within packet networks and at the network boundaries in accordance with their capabilities.
- F-P-R-03: NGNs are recommended to support different charging polices for different access and core transport technologies (e.g., xDSL, UMTS, CDMA2000, cable, LAN, WLAN, Ethernet, MPLS, IP, ATM).
- F-P-R-04: NGNs are recommended to support rule repository to deploy, configure and distribute policies more flexibly.
- F-C-R-xxx: NGNs are recommended to support charging policy management for abnormal service termination.
- F-C-R-xxx: NGNs are recommended to support QoS downgrade policy charging.

7.6. Charging model related requirements

[Editor's note: This clause has been reserved for further comments. Unless contributions are received to provide content, clause 7.6 will be removed prior to publication of Recommendation Y.2233.]

8. Architectural framework for mechanisms allowing policy-based accounting and charging capabilities in NGN

[Editor's Note: The extended architecture will cover policy-based charging, dynamic rating, inter-provider online/offline charging. The architecture also provides relevant relationship with other NGN functional entities which are associated with the extended architecture. Some functional entities which may be involved are NACF and RACF.]

8.1. Overall architectural framework

The high-level and functional requirements of policy-based accounting and charging in NGN are provided in clauses 6 and 7. In order to meet such requirements, an appropriate architecture should be established. This architecture includes overall and subsystem functional architectures. These architectures define functional components and their inter-relationships given by various reference points.

This clause describes an overall functional architectural for policy-based accounting and charging in NGN. This architecture provides a relationship with other NGN components in the highest level point of view. It intends to cover policy-based accounting and charging in NGN.

In order to fulfil the requirements for policy-based accounting and charging in NGN, accounting information should be collected from the charging associated NGN functional entities or other proxies when FEs lack accounting capabilities and transferred securely and reliably to appropriate charging FEs.

[Editor's note: Recommendation Y.2233 [2008] includes a figure showing the NGN functional architecture from ITU-T Y.2012. Consideration should be given to including an updated version of this diagram in Y.2233 Revision 1 when the document is ready for publication.]

8.2. Functional architecture

This clause provides the functional architecture including functional entities grouped based on common capabilities, their relationships, and interfaces. The functional architecture includes functional entities that are dedicated to NGN Charging and Accounting, referred to as the Charging and Accounting Function (CAF), and other functional entities that interact with the CAF. A description of each functional entity within the CAF follows.

[Editor's Note: Further contributions are invited regarding policy-based charging and control architecture, in order to establish a fully agreed functional architecture representation]

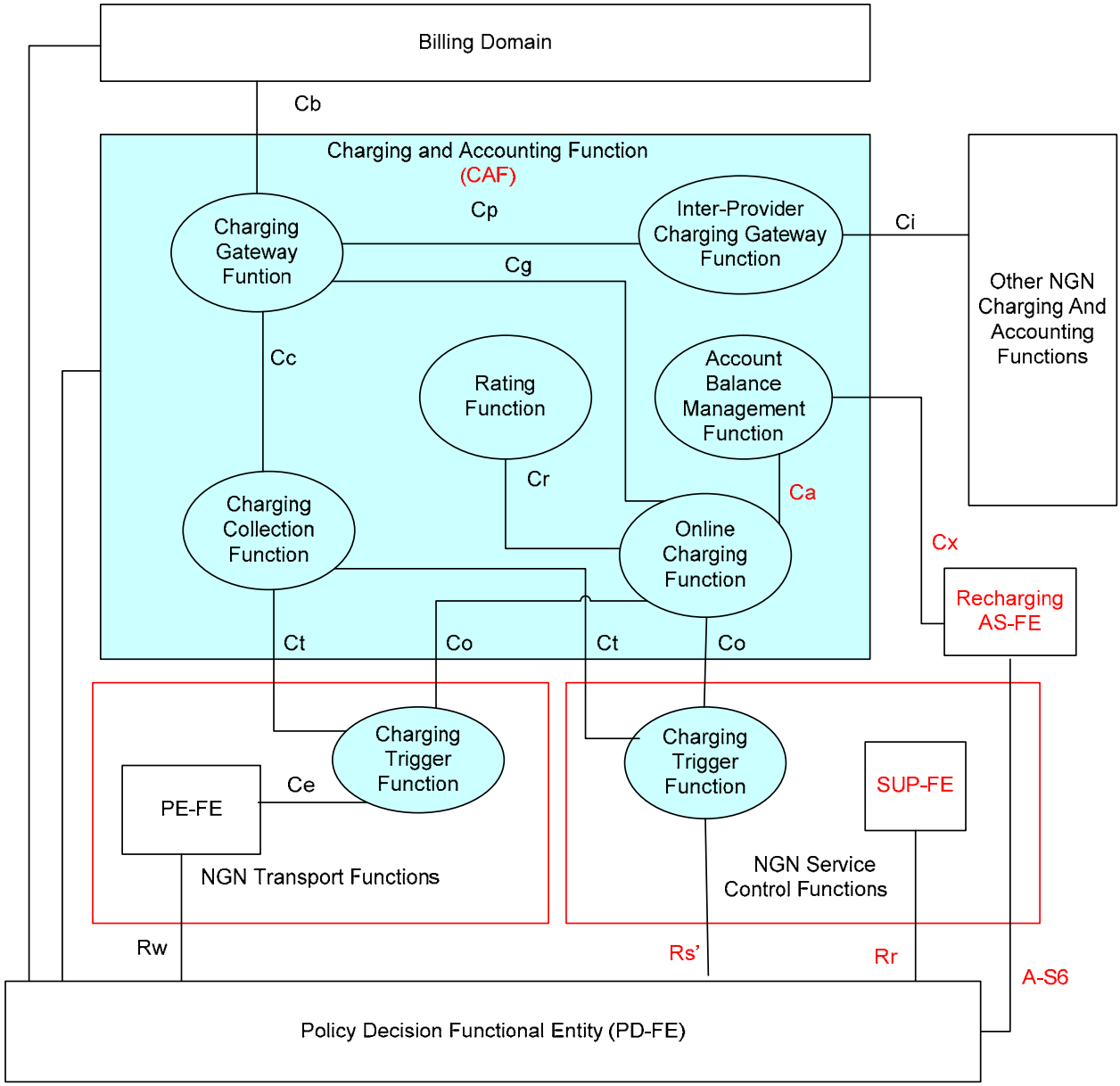


Figure 1. Policy-based charging and accounting functional architecture

NOTE: CTFs are part of CAF, as indicated by the blue shading in Figure 1.

8.2.1. Charging trigger function (CTF)

As described in [ITU-T Y.2012] the CTF generates charging events based on the observation of network resource usage. In every network and service element that provides charging information, the CTF is the focal point for collecting information pertaining to chargeable events within the network element, assembling this information into matching charging events, and sending these charging events to the charging collection function. The CTF is therefore a necessary component in all network elements that provide offline-charging functionality.

The CTF also creates the charging events used for online charging. The charging events are forwarded to the online charging function (OCF) in order to obtain authorization for the chargeable event or network resource usage requested by the user. It must be possible to delay the actual resource usage until permission has been granted by the OCF. The CTF must be able to track the

availability of resource usage permissions (i.e., quota supervision) during the network resource usage. It must also be able to enforce termination of the end user's network resource usage when permission by the OCF is not granted or expires.

The CTF also supports functionality beyond event-based and session-based charging. For some NGN services which cannot be mapped into a simple event or session, more thorough analysis (e.g., application layer deep packet inspection) may be required. For example, an IPTV service which consists of normal content stream and advertisement stream can be charged in different rates depending on its content type. The CTF collects a set of packets and creates accounting data based on the charging policy and rules. Within the Transport Layer, charging policies and rules are delivered by PE-FE and enforced in CTF. The CTF also sends session control requests to PE-FE. How such policy and rules are defined and provisioned into the CTF are out of scope of this Recommendation. The CTF may be resident in network elements (NEs) or a separate measurement device if an NE doesn't support such functionality. For content and service transaction charging, the CTF may be resident within the Service Control Layer, thereby allowing direct measurement of usage of the application resources.

CTF meters user traffic and creates charging information according to charging policy. CTF is required to be capable of processing metering by using default charging information without receiving further detailed charging information. When a customer starts a service, CTF requests a charging policy of the subscriber to PD-FE and buffers its packets until receiving the charging policy. If CTF fails to get the charging policy from PD-FE, it releases the requested customer's traffic session.

Besides functionality described above, the CTF has the following functionalities:

- Meter the data by either receiving or retrieving traffic usage data from traffic measurement functions of the access and core transport (or the usage data measurement functions of the Service Layer) without loss and in real-time if on-line charging is used.
- Meter traffic usage data via a standalone traffic measurement system from access and transport networks without loss and in real-time if on-line charging is used. Standalone accounting function is performed when traffic measurement function is not embedded in the access and core transport equipment.
- Metering should be performed based on the metering policy. It may include static or dynamic metering, scope of metering (all flows or subset), flow granularity, metered flow attributes, meter accuracy, etc. The metering policies and rules are delivered from the PD-FE to the CTF by PE-FE. If the CTF is located in the Service Layer, the metering policies and rules are controlled by the Service Control Functions (SCF).
- Receive or retrieve user (end-point) profile data, service quality information, etc.
- Receive charging policies and rules from PD-FE via the PE-FE, or from the SCF.
- Process the collected data and convert them into a packet bundle or flow record appropriately
- Perform interim buffering of usage data in event of a metering device reboot or other network problems which prevent the reception of the data
- Send a media flow control request to PE-FE if a condition based on the enforced charging policy is met.
- Transfer the metered data (packet bundles or flow records) to the CCF via Ct reference point.

The generated charging events are transferred to the CCF via Ct reference point and the OCF via Co reference point. The CTF also exchanges network resource usage authorization information via Co reference point.

CTF should support metering functional requirements defined in clause 7.1, Metering functional requirements.

8.2.2. Charging collection function (CCF)

As described in [ITU-T Y.2012] the CCF receives charging events from the CTF via the reference point Ct. It then uses the information contained in the charging events to construct Charging Information Records (CIRs). The CCF also supports NGN services which cannot simply be charged by event-based or session-based charging schemes. Some examples of additional charging schemes are data volume-based, flow-based, QoS-based, content-type-based, etc. The received data from the CTF is a flow record of a particular flow of user traffic which needs to be charged. Based on the received data, the CCF performs necessary analysis functions. The analysis function may include deep packet inspection and others to identify the chargeable events beyond simple events and sessions. The results of the CCF tasks are CIRs with well-defined content and format. The CIRs are later transferred to the billing domain through the CGF via the reference points Cc and Cb. The CCF is used for off-line charging.

- Receive metered data from the CTF via Ct reference point in real-time.
- Construct CIRs by performing detailed packet or flow analysis functions based on charging scheme.
- CIRs may be constructed from single charging events, i.e., a 1:1 relation between event and CIR.
- CIRs may be constructed from a set of several charging events, i.e., a n:1 relation between event and CIR.
- Each charging event is used for exactly one CIR, i.e., a 1:n relation between event and CIR (with n>1) is not possible within the CCF.
- Multiple charging events that are used to create a single CIR may not necessarily be of the same type.
- There is no requirement or assumption of any synchronization between the reception of the charging event(s) and the creation of the resulting CIR. However, the CCF is required to be capable of receiving and processing charging events and generating the resulting CIR in near real-time.
- The relationship between CCF and CTF may be 1:1 (integrated CCF), 1:n or n:1 (separated CCF). This includes the possibility of NEs of different types feeding charging events into the same CCF and one NE providing the same charging event into several CCF.
- The charging events used to build a CIR may originate from different NEs, (i.e., there is cross-NE correlation of charging events in the CCF) if and only if the charging events contain explicit information to enable correlation.

  Note: It is therefore possible for the CCF to create a CIR based on the correlation of charging events that are generated by the same CTF or different CTFs which may reside in different networks.

- Various types of CIRs can be: per data volume (e.g., data volume for a particular whole or part of service session), per-flow (e.g., per-medium (e.g., voice, video, data), per-QoS, and etc.
- Transfer CIRs to the CGF via the Cc reference point while satisfying the requirement listed in clause 7.3.

8.2.3. Online charging function (OCF)

As described in [ITU-T Y.2012] the OCF receives charging events from the CTF via Co reference point and executes in near real time to provide authorization for the chargeable event or network resource usage requested by the authorized user. The CTF must be able to delay the actual resource usage until permission has been granted by the OCF. The OCF provides a quota for resource usage, which must be tracked by the CTF. Subsequent interactions may result in an additional quota being provided according to the subscriber's account balance, or they may result in no additional quota being provided, in which case the CTF must enforce termination of the end user's network resource usage.

The OCF allows more than one user to share the same subscriber's account simultaneously. The OCF responds to the charging requests from various users at the same time and provides a certain quota to each user. The quota is determined by default or by certain policies. Users can resend requests for larger quotas during the same session. The maximum available quota, however, will not exceed the subscriber's account balance.

The OCF is required to have the capability to construct CIRs for delivery to the CGF per the requirements described for the CCF in Clause 8.2.2

The OCF supports session-based, event-based, and flow-based charging functions.

8.2.4. Rating function (RF)

[Editor's Note: Reference point between RF and CCF is for further study. Contribution is invited.]

As described in [ITU-T Y.2012] the RF determines the value of the network resource usage (described in the charging event received by the OCF from the network) on behalf of the OCF. To this end, the OCF furnishes the necessary information to the RF and receives the rating output.

The RF also works with the offline charging module, and it determines the value of the network resource usage (described in the charging event received by the CCF from the network). For this, it calculates and reserves a number of non-monetary units such as service units, data volume, flow volume, time and events. It then determines price by calculating monetary units for a given number of non-monetary units. Finally, it determines tariff information based on the subscribers contractual terms and service being requested.

8.2.5. Account balance management function (ABMF)

As described in [ITU-T Y.2012] the ABMF stores the subscriber's account balance within the online charging system.

The subscriber's account balance could be represented by the remaining available traffic volume (e.g., bytes), time (e.g., minutes for calling), or content (e.g., a movie), as well as credit. ABMF checks, updates, and reserves the account balance. It may also manage counters for on-line charging.

As described in [ITU-T Y.2012] the ABMF stores the subscriber's account and service provider's account for 3rd party accounting within the online charging system. Service provider's account balance could be represented by the remaining available traffic volume (e.g., bytes), duration (e.g.,

minutes for calling), or content (e.g., a movie), as well as credit. ABMF checks, updates, and reserves the account balance.

Security and robustness should be emphasized by encrypting key data, providing backup and failure alarm capabilities, keeping detailed logs, and so forth.

8.2.6. Charging gateway function (CGF)

The CGF receives CIRs generated by the CCF via Cc reference point. It plays a gateway role between NGN network and the Billing Domain or another NGN CGF. It uses the Cb reference point to transfer CIRs to Billing Domain and Cp reference point to transfer CIRs to IPCGF which will further use that information for inter-provider charging information exchanges.

The CGF entity has the following functionalities:

- Receive CIRs from the CCF and OCF via reference points, Cc, and Cg respectively in near-real time.
- Perform validation, consolidation, correlation, formatting, and error handling of CIRs.
- Perform CIR file lifecycle management such as CDR file creation, deletion, and modification.
- Perform selection of CIRs for inter-provider charging settlement per NGN provider and transfer them to IPCGF via the reference point Cp.
- Perform standard-based transfer that satisfies the requirement listed in clause 7.3, of charging information to the BD and IPCGF.

8.2.7. Inter-provider charging gateway function (IPCGF)

The IPCGF receives CIRs and other processed information from the CGF via Cp reference point. It adds any additional information needed for inter-provider charging information exchanges. It uses Ci reference point to transfer further processed CIRs to another NGN IPCGF. The Ci reference point is used to communicate CIRs for the settlement of accounting rate between NGN providers. It allows NGN providers to exchange CIRs in real-time over standardized interface.

The IPCGF entity has the following functionalities:

- Receive CIRs from the CGF via reference points Cp
- Construct CIRs for inter-provider charging settlement. CIRs are constructed per provider basis. The CIRs can be various types (duration-based, volume-based, event-based, etc.) depending on the settlement policy between the involved providers
- Perform standard-based transfer, that satisfies the requirements listed in clause 7.3, of charging information to the IPCFG in other NGN providers

8.3. Reference points

8.3.1. Reference point Ct

The Ct reference point is required to support interaction between the CTF and the CCF. The following information flows across this reference point in real-time:

- Charging events for offline charging from the CTF to the CCF
- Flow-based charging events for offline charging from the CTF to the CCF
- Acknowledgements for these events from the CCF to the CTF

The protocol(s) crossing this reference point is required to support the following capabilities:

- Real-time transactions
- Stateless mode ("event based charging") and stateful mode ("session based charging") of operation
- Reliable and secure transport based on the protocol requirements in clause 7.3 Accounting and charging protocol high level requirements

The protocol(s) crossing this reference point may support the following capability:

- Many-to-one operation modes. Multiple CTF may interact with a CCF. It is recommended the CTF interacts with a single CCF to avoid potential double-billing.

The Ct reference point is an intra-domain reference point.

The detailed information elements contained in the charging events and the relevant chargeable events will be specified in an interface and protocol specification and are out of scope of this Recommendation.

8.3.2. Reference point Co

The Co reference point is required to support interaction between the CTF and the OCF. The following information flows across this reference point in real-time:

- Charging events for online charging from the CTF to the OCF
- Flow-based charging events for online charging from the CTF to the OCF
- Response for these events from the OCF to the CTF. The response grants or rejects the network resource usage requested in the charging event, according to the decision taken by the OCF

The protocol(s) crossing this reference point is required to support the following capabilities:

- Real-time transactions
- Stateless mode ("event based charging") and stateful mode ("session based charging") of operation
- Reliable and secure transport based on the protocol requirements in clause 7.3
- Many-to-one operation modes. Multiple CTF may interact with an OCF. It is recommended the CTF interacts with a single OCF to avoid potential double-billing.

The Co reference point is an intra-domain reference point.

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.3. Reference point Cc

The Cc reference point supports interaction between the CCF and the CGF. The following information flows across this reference point:

- CIRs are sent from the CCF to the CGF

- Acknowledgements for these CIRs are returned from the CGF to the CCF

The protocol(s) crossing this reference point is required to support the following capabilities:

- Near real-time transactions;
- Send one or more CIRs in a single request message
- Changeover to secondary destinations (alternate CGFs) in case of the primary CGF not being reachable
- Reliable and secure transport based on the protocol requirements in clause 7.3

The Cc reference point is an intra-domain reference point.

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.4. Reference point Cg

The Cg reference point supports interaction between the OCF and the CGF. The following information flows across this reference point:

- CIRs are sent from the OCF to the CGF
- Acknowledgements for these CIRs are returned from the CGF to the OCF

The protocol(s) crossing this reference point is required to support the following capabilities:

- Near real-time transactions
- Send one or more CIRs in a single request message
- Changeover to secondary destinations (alternate CGFs) in case of the primary CGF not being reachable
- Reliable and secure transport based on the protocol requirements in clause 7.3

The Cg reference point is an intra-domain reference point.

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.5. Reference point Cr

The Cr reference point supports interaction between the OCF and the RF in order to determine the value of chargeable events in terms of monetary or non-monetary units. The following information flows across this reference point:

- Price request message is sent from the OCF to the RF
- Reply including price and counter information is returned from the RF to the OCF

The protocol(s) crossing this reference point is required to support the following capabilities:

- Real-time transactions
- Reliable and secure transport based on the protocol requirements in clause 7.3

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.6. Reference point Ca

The Ca reference point allows the interaction between the OCF and the ABMF in order to access the account of the subscriber on the OCF.

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.7. Reference point Cb

The Cb reference point supports interaction between a charging gateway function and the billing domain. The information crossing this reference point is comprised of CIR files. A common, standard file transfer protocol (e.g., FTAM, FTP) is required to be used, including the transport mechanisms specified for the selected protocol.

The Cb reference point is an inter-domain reference point.

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.8. Reference point Cp

The Cp reference point is required to support interaction between the CGF and the IPCGF. The following information flows across this reference point in real-time:

- CIRs are sent from the CGF to the IPCGF
- Acknowledgements for these CIRs are returned from the IPCGF to the CGF

The protocol(s) crossing this reference point is required to support the following capabilities:

- Near real-time transactions
- Stateful mode of operation
- Reliable and secure transport based on the protocol requirements in clause 7.3
- Many-to-one operation modes. Multiple CGF can interact with a single IPCGF

The Cp reference point is an intra-domain reference point.

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.9. Reference point Ci

The Ci reference point supports interaction between two IPCGFs in different NGN provider domains. The information crossing this reference point is comprised of CIR files which are additionally processed for inter-provider settlement. A common, standard file transfer protocol or real-time protocols is required to be used, including the transport mechanisms specified for the selected protocol.

The Ci reference point is an inter-domain reference point.

The detailed information elements contained in the charging events and the relevant chargeable events are out of scope of this Recommendation.

8.3.10. Reference point Ce

The Ce reference point is required to support interaction between the CTF and the PE-FE. The following information flows across this reference point in real-time:

- Charging policies and rules from the PE-FE to the CTF
- Charging control request from the CTF to the PE-FE
- Acknowledgements for these interactions between the CTF and the PE-FE

The protocol(s) crossing this reference point is required to support the following capabilities:

- Real-time transactions
- Stateless mode ("event based charging") and stateful mode ("session based charging") of operation
- Reliable and secure transport based on the protocol requirements in clause 7.3 Accounting and charging protocol high level requirements

The protocol(s) crossing this reference point may support the following capability:

- One-to-many operation modes. A PE-FE may interact with multiple CTF. It is recommended the CTF interacts with a single PE-FE to avoid the need to reconcile policy information received from multiple, potentially conflicting, sources.

The Ce reference point is an intra-domain reference point.

The detailed information elements contained in the relevant events will be specified in an interface and protocol specification and are out of scope of this Recommendation.

8.3.11. Reference point Cx

The Cx reference point allows the interaction between the Recharging AS-FE and the ABMF in order to allow charging account balance information to be updated in real-time.

The detailed information elements contained in the recharging messages and events are out of scope of this Recommendation.

8.3.12. Reference point Rw

The Rw reference point is defined in [ITU-T Y.2111]. This reference point allows the final admission and charging decisions to be installed (either pushed or pulled) to the PE-FE from the PD-FE.

The Rw reference point is an intra-domain reference point.

8.3.13. Reference point Rs'

The Rs' reference point is required to support interaction between the PD-FE and CTF in service stratum. This reference point is the extension of the Rs defined in [ITU-T Y.2111]. The current Rs reference point lacks communication from PD-FE to SCF. The Rs' reference point extends such capability to support delivery of charging policies and rules. The following information flows across this reference point in real-time:

- Charging policies and rules from the PD-FE (and obtained from the SUP-FE) to the CTF in service stratum

- Acknowledgements for charging policies and rules from the CTF to the PD-FE

This reference point is required to support the following capabilities:

- Real-time transactions
- Stateless mode ("event based charging") and stateful mode ("session based charging") of operation
- Reliable and secure transport based on the protocol requirements in clause 7.3 of Y.2233

This reference point may support the following capability:

- One-to-many operation modes. A PD-FE can interact with multiple CTF in the Service stratum. It is recommended the CTF interacts with a single PD-FE to avoid the need to reconcile policy information received from multiple, potentially conflicting, sources.

The Rs' reference point is an intra-domain reference point.

8.3.14. Reference point Rr

The Rr reference point is required to support interaction between the PD-FE and SUP-FE in service stratum.

The Rr reference point is an intra-domain reference point.

The detailed information elements contained in the service user profile and policy information exchanged between the SUP-FE and PD-FE are out of scope of this Recommendation.

8.4. Relationship with other NGN functional entities

The NGN CAF described in clause 8.2 depends on interactions with several other NGN functional entities that are generally described in [ITU-T Y.2012]. The following provides a summary of the functional entities and the relationship each has to the CAF.

8.4.1. Policy decision functional entity (PD-FE)

The PD-FE is a component of the Resource and Admission Control Functions (RACF) of the NGN, and is defined in [ITU-T Y.2111]. The PD-FE handles the QoS resource requests received from the SCF via the Rs reference point. Among other functions, the PD-FE makes the final admission decision for media flows of a given service based on network policy rules, service information, transport subscription information, and resource availability. The PD-FE controls can impact QoS parameters, bandwidth limits of flows, firewall packet inspection and filtering modes, core network ingress/egress path selections, etc.

The charging policy management function of the PD-FE interacts with charging policy repository to retrieve charging policies and rules and transfer them to CTF (via the PE-FE for CTF within the Transport function). How such policies and rules are created and stored are out of scope of this Recommendation. Assumption is given that such policies and rules are managed by the billing system.

8.4.2. Policy enforcement functional entity (PE-FE)

The PE-FE resides in the transport layer, as defined in [ITU-T Y.2111]. It acts as the conduit for information from the PD-FE to the CTF. More generally, it acts as a packet-to-packet gateway at the boundary of different NGN networks and/or between the customer premises network and the NGN access network. The gate functions performed by the PE-FE are based on the PD-FE controls that are exerted at a per-flow level.

PE-FE functions that apply to charging and accounting include:

- Delivering charging policies and rules received from PD-FE to CTF
- Traffic policing and shaping based on the session control request received from CTF, and
- Packet-filtering-based firewall: inspecting and dropping packets based on pre-defined static security policy rules and gates installed by PD-FE.

  There are four packet inspection modes for packet-filtering-based firewall:

  - Static packet filtering: inspecting packet header information and dropping packets based on static security policy rules or the session control request received from CTF. This is the default packet inspection mode applied for all flows.
  - Dynamic packet filtering: inspecting packet header information and dropping packets based on static security policy rules, dynamic gate status, and/or the session control request received from CTF.
  - Stateful inspection: inspecting packet header information as well as TCP/UDP connection state information and dropping packets based on static security policy rules and dynamic gate status.
  - Deep packet inspection: inspecting packet header information, TCP/UDP connection state information and the content of payload together, and dropping packets based on static security policy rules and dynamic gate status.

8.4.3. Other NGN charging and accounting functions

This group of functional entities represents CAF for other NGN operators. When usage measurements are shared with other NGN operators, the IPCGF ensures that CIRs are properly formatted based on the settlement policy between the involved providers.

8.4.4. Service user profile functional entity (SUP-FE)

SUP-FE is defined in [ITU-T Y.2012]. This FE is responsible for storing user profiles, subscriber-related location data, and presence status data in the Service stratum. It performs basic data management and maintenance functions.

While the SUP-FE has broader capabilities, a user profile is required to be provided in support of charging. It provides information on permitted services, subscriber mobility, location and presence information that can be relevant for charging, authentication, and authorization. Most notably, the profile information on charging provides subscriber's charging plans.

When PD-FE requests a charging plan of the customer to SUP-FE, it gives subscriber's information to PD-FE. PD-FE chooses an appropriate accounting policy based on the subscriber's charging plan and delivers it to CTF via PE-FE.

8.4.5. Recharging AS-FE

This FE is responsible for providing connection points to a customer or 3rd party who needs to change charging policy and to update their account in real-time. Customers can choose and change charging policy and refill their account with this function. 3rd party can also update their account via this function. The Recharging AS-FE is a specialized instance of AS-FE to support charging. A general definition of AS-FE is provided in [ITU-T Y.2012].

8.5. Billing domain

The Billing Domain is the part of the operator network that receives and processes charging information from the NGN charging functions. As a business support function, the Billing Domain is outside the NGN functional Architecture. It includes functions that can provide billing mediation

and billing end applications such as invoicing (including determination of adjustments, discounts, rebates and credits), payment processing, and collection management.

9. Security consideration

This Recommendation aligns with the security requirements in [ITU-T Y.2701].

Appendix I

Offline and online charging scenarios

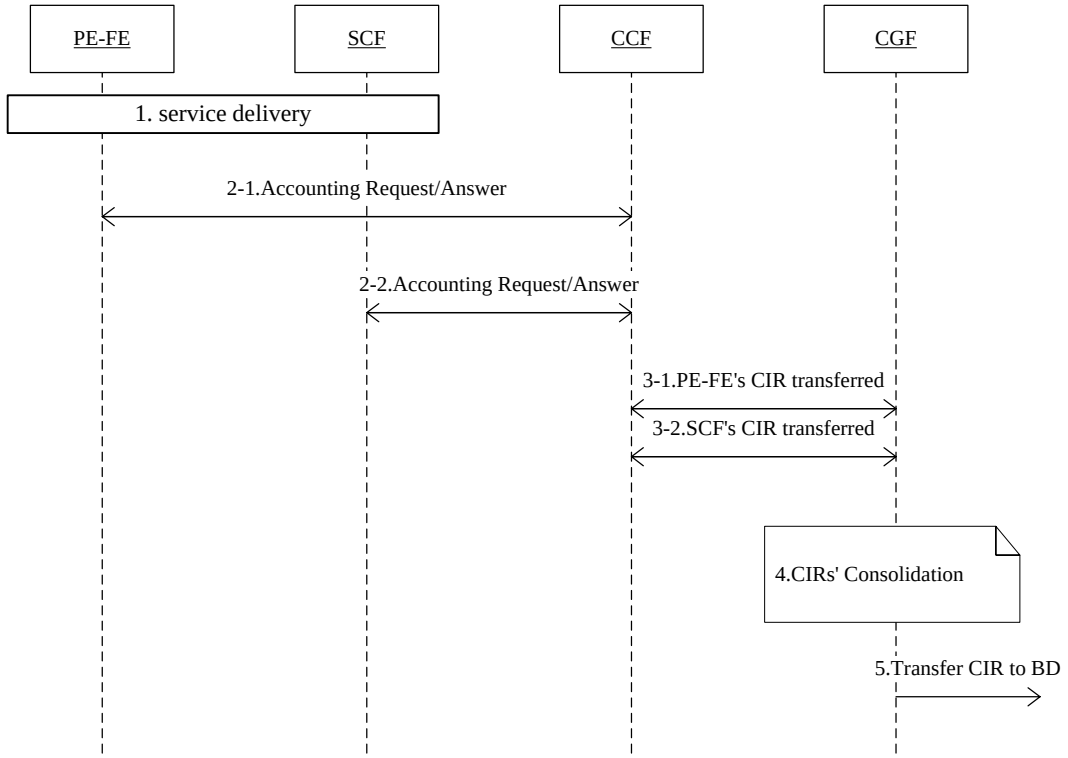
(This appendix does not form an integral part of this Recommendation)

In these scenarios, a customer connects to an NGN network and uses an IP transport service and a session-based service like VoIP.

[Editor's Note: These scenarios should be enhanced to indicate more clearly its relationship with policy-based charging and accounting.

At least one use case should be added demonstrating CTF in the Service stratum]

I.1. Offline Charging Scenario based on Event



1. The request service is delivered;

2-1. CTF inside PE-FE is triggered and then sends ACR, including an Event-Based indication to CCF; CCF shall generate a CIR including charging information from PE-FE into a CIR and send ACA to PE-FE;

2-2. CTF inside SCF is triggered and then sends ACR, including an Event-Based indication to CCF; CCF shall generate a CIR including charging information from SCF into a CIR and send ACA to SCF;

3-1. CCF sends CIR including PE-FE's charging data to CGF; CGF return ACA to CCF;

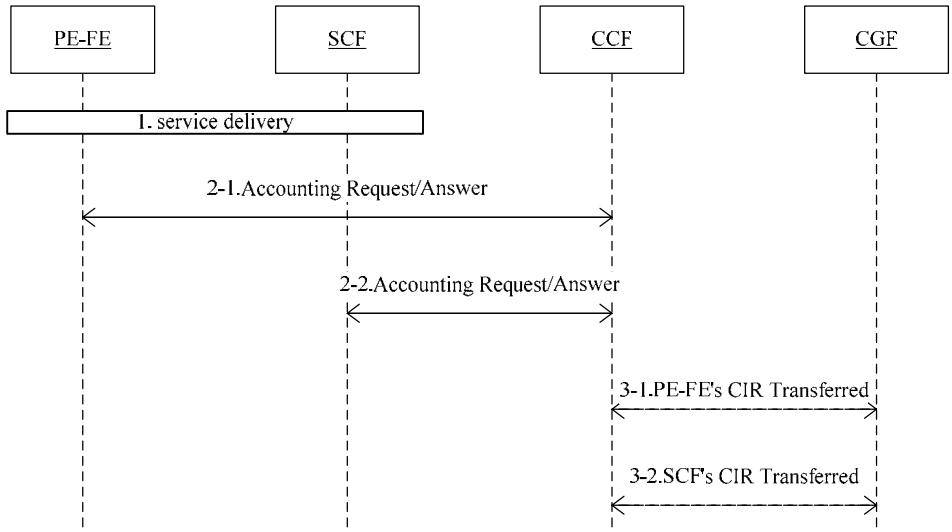
3-2. CCF sends CIR including SCF’s charging data to CGF; CGF return ACA to CCF;

4. CGF shall execute the CIR’s consolidation and generate a new CIR including transport stratum and service stratum after receiving the all CIR generated during this service delivery;

5. CGF sends the consolidated CIR to BD (Billing Domain).

I.2. Offline Charging Scenario based on Session

I.2.1 Procedure for Session Initiation



1. The requested service starts to delivery;

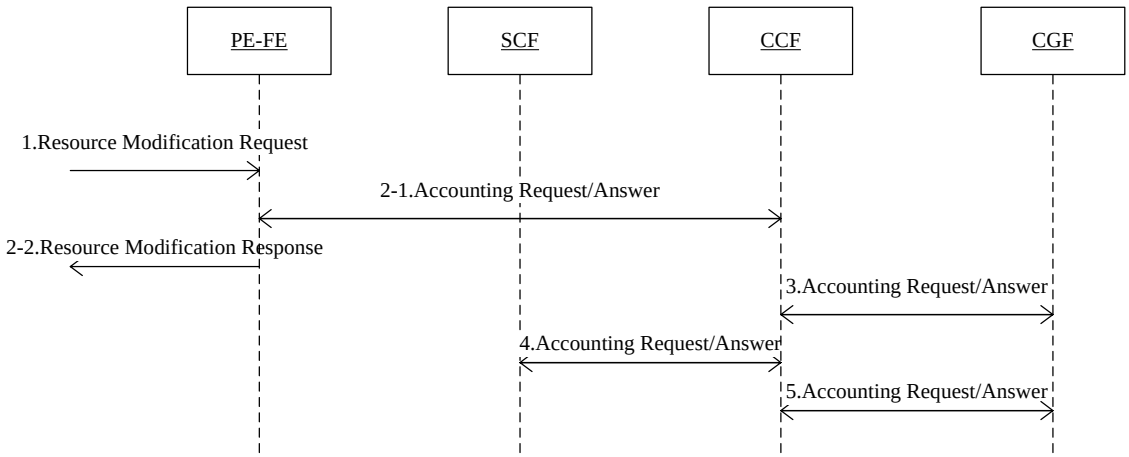
2-1. CTF inside PE-FE is triggered and then sends Accounting Request (ACR)/start to CCF; CCF shall open a CIR to collect charging information from PE-FE and send Accounting Answer (ACA) to PE-FE;

2-2. CTF inside SCF is triggered and then sends ACA/start to CCF; CCF shall open a CIR to collect charging information from SCF and send ACA to PE-FE;

3-1. CCF shall send CIR including PE-FE’s charging information to CGF if threshold is reached (volume or Timer, etc);

3-2. CCF shall send CIR including SCF’s charging information to CGF if threshold is reached (volume or Timer, etc).

I.2.2 Procedure for Session Modification



1. RACF indicates PE-FE to enforce the new policy by sending RMR (Resource Modification Request) if some changes (band width, etc) happened during the service delivery.

2-1. CTF inside PE-FE is triggered and then sends ACR(Accounting Request)/interim to CCF; CCF shall close the previous CIR and open a new CIR to collect charging information from PE-FE and send ACA(Accounting Answer) to PE-FE;

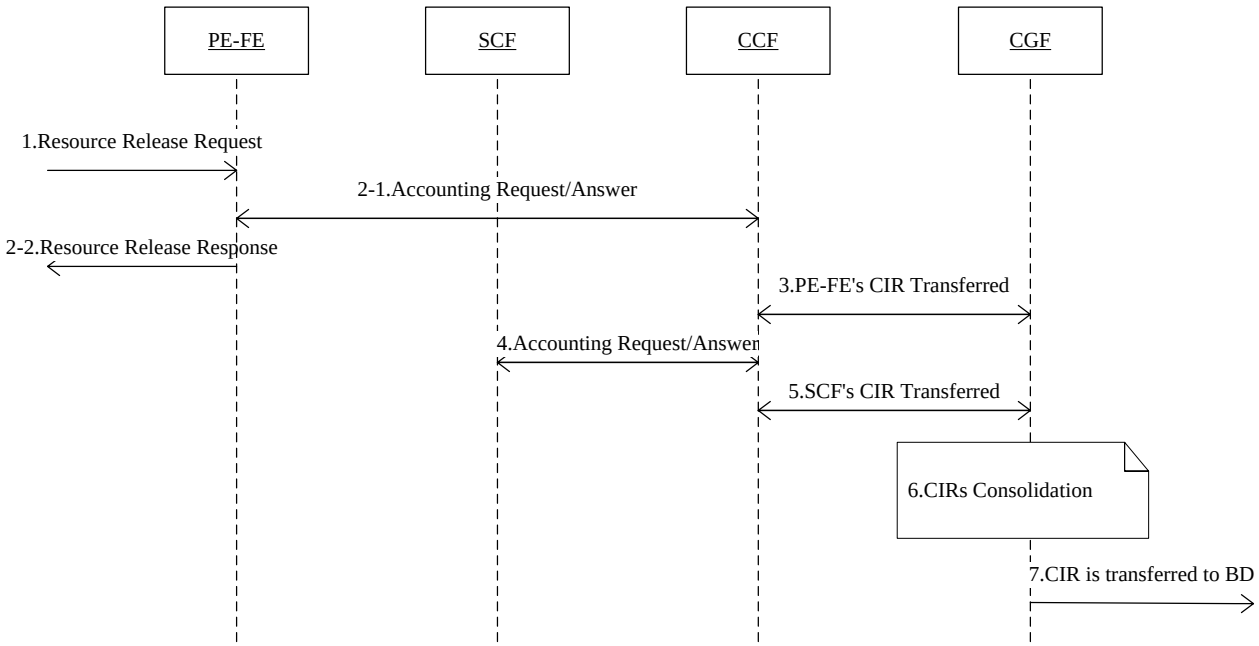
2-2. PE-FE returns Resource Modification Response to RACF;

3. CCF shall send the closed CIR including PE-FE’s charging information to CGF; CGF shall cache this CIR after receiving the ACR and then return ACA to CCF;

4. CTF inside SCF is triggered and then sends ACR/interim to CCF; CCF shall close the previous CIR and open a new CIR to collect charging information from SCF and send ACA to SCF;

5. CCF shall send the closed CIR including SCF’s charging information to CGF; CGF shall cache this CIR after receiving the ACR and then return ACA to CCF.

I.2.3 Procedure for Session Release



1. RACF sends RRR(Resource Release Request) to PE-FE when the requested service is released;

2-1. PE-FE sends ACR(Accounting Request)/stop to CCF; this ACR shall include indication that this is final charging data;

2-2. PE-FE sends Resource Release Response to RACF;

3. CCF shall send PE-FE's CIR to CGF by sending ACR/stop; this ACR shall include an indication that this is final CIR;

4. SCF sends ACR/stop to CCF; this ACR shall include indication that this is final charging data;

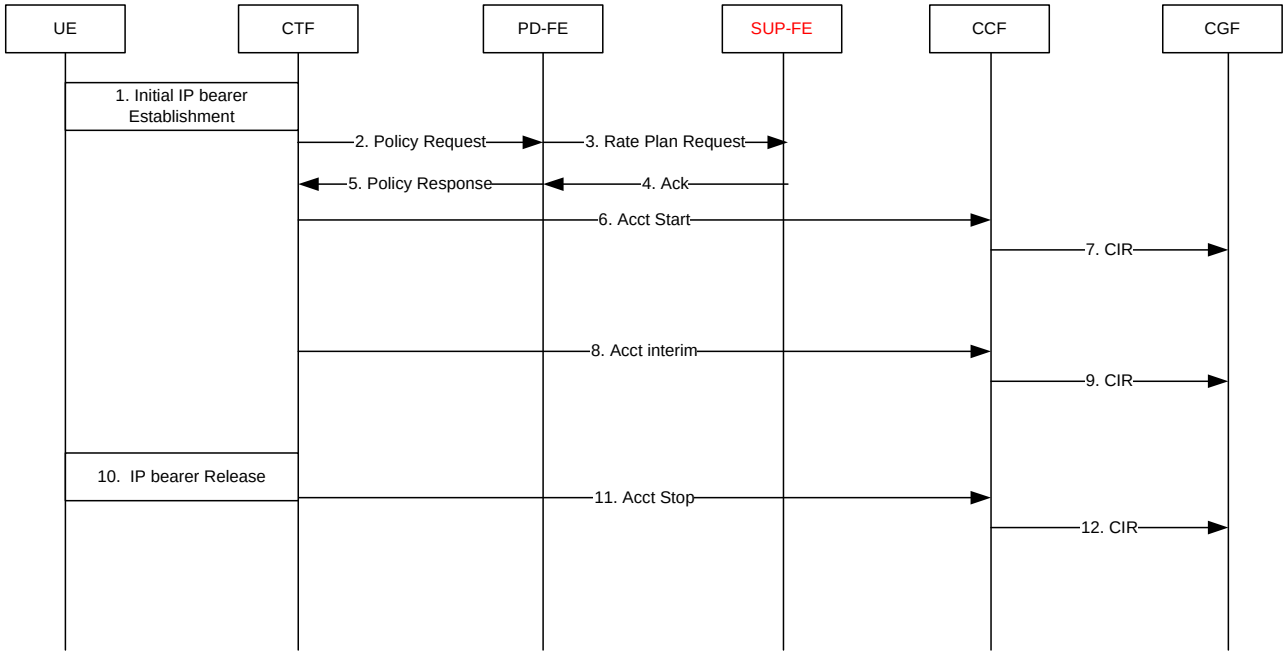
5. CCF shall send SCF's CIR to CGF by sending ACR/stop; this ACR shall include an indication that this is final CIR;

6. CGF shall execute the CIR's consolidation and generate a new CIR including transport stratum and service stratum after receiving the all CIR generated in this session;

7. CGF sends the consolidated CIR to BD(Billing Domain).

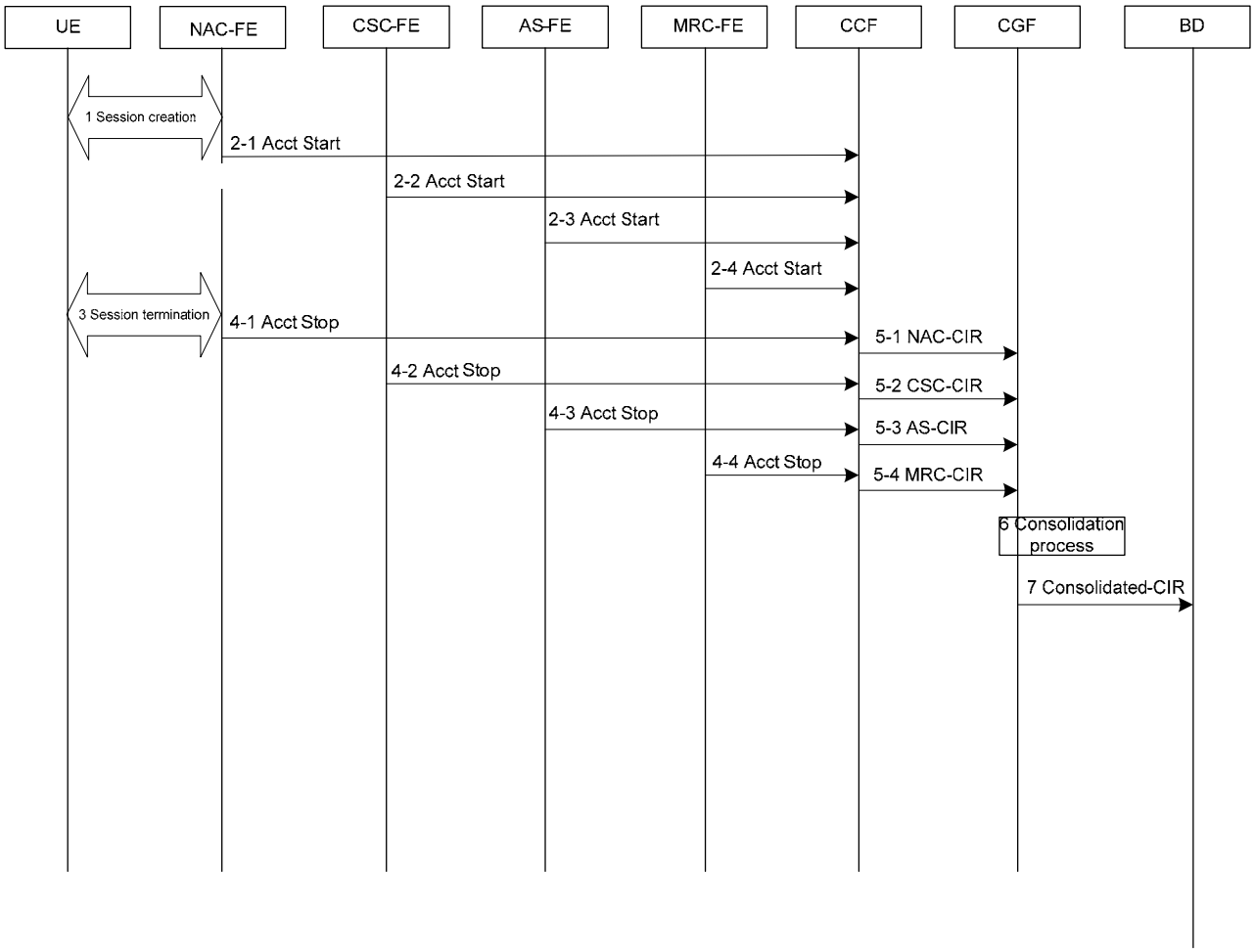
9.2.4 Offline Charing based on Dynamic Charging Policy

[Editor's Note: this scenario has been partially reviewed in the meeting (NGN-GSI, May 2009) and doesn't represent full agreement. It needs further detailed review in a future meeting]



1. UE first makes a connection to the Internet via its NGN service provider. During this process, UE is allocated with new IP address by an authentication and authorization function. UE then either initiates best-effort Internet applications like web, FTP, and/or e-mails, etc.
2. Such application services trigger the involved CTF to request subscriber's policy to PD-FE
3. PD-FE queries the subscriber's charging policy to SUP-FE
4. SUP-FE responds with the requested information
5. PD-FE sends the charging policy which is created according to subscriber's Charging Policy to CTF via PE-FE
6. CTF starts to meter the customer traffic with the enforced charging policy and sends Acct Start message to CCF
7. CCF then creates a CIR and transfers them into CGF
8. CTF creates an interim Acct according to specific criteria (limited volume, limited time or etc.,) and transfers it into CCF
9. CCF then creates a CIR and transfers them to CGF
10. UE finishes its service and IP connection is closed
11. CTF finishes to meter the customer traffic and send Acct stop to CCF
12. CCF generates CIR and gives it to CGF; CGF correlates CIRs and generates final charging information

I.3. Scenario for CIRs aggregation



1. UE initializes a session

2-1~4. Network elements involved in this session send message ‘Acct_Start’ to CCF and start accounting.

3. UE terminates the session

4-1~4. Net elements involved in this session send message ‘Acct_Stop’ to CCF and stop accounting.

5-1~4. CCF collects CIRs transferred by different NEs and transfer all CIR to CGF.

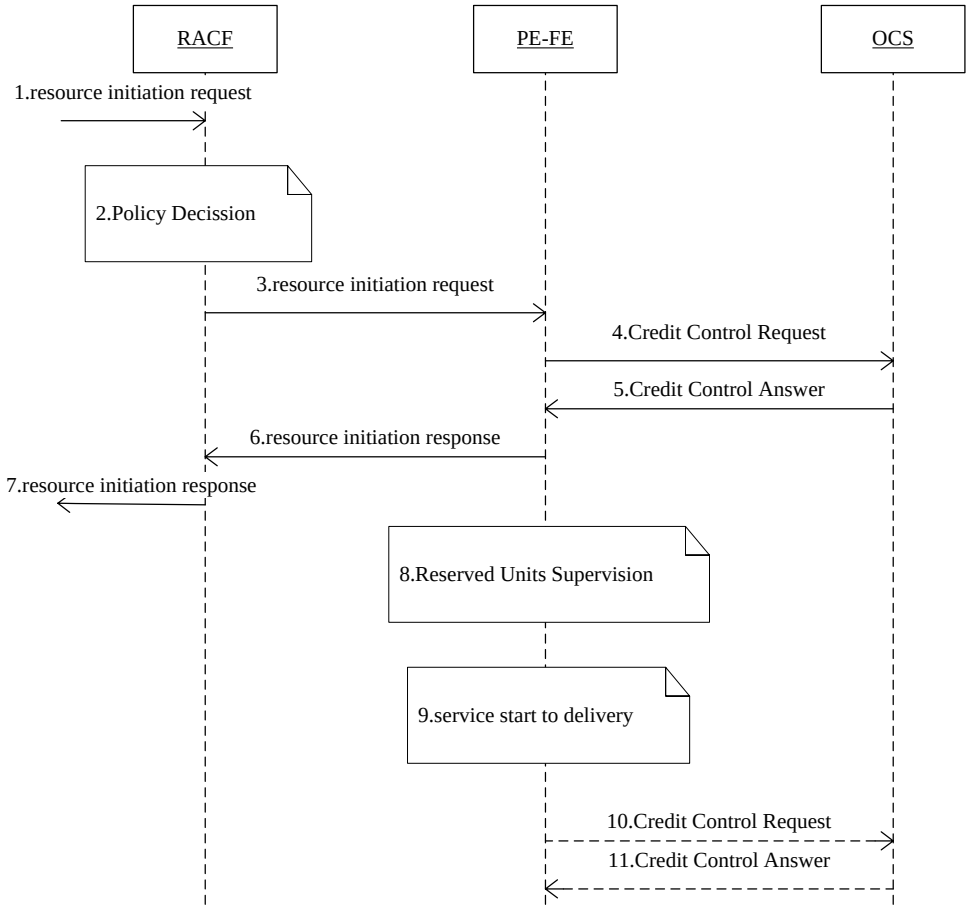
6. CGF consolidates all CIRs into a new CIR which includes all charging information in the session.

7. CGF transfers this new CIR to BD.

I.4. Online Charging Scenario based on Policy

[Editor’s Note: The first three scenarios in this section are based on 3GPP charging architecture. These scenarios need to be modified to show that communication between the PE-FE and OCF is via the CTF.]

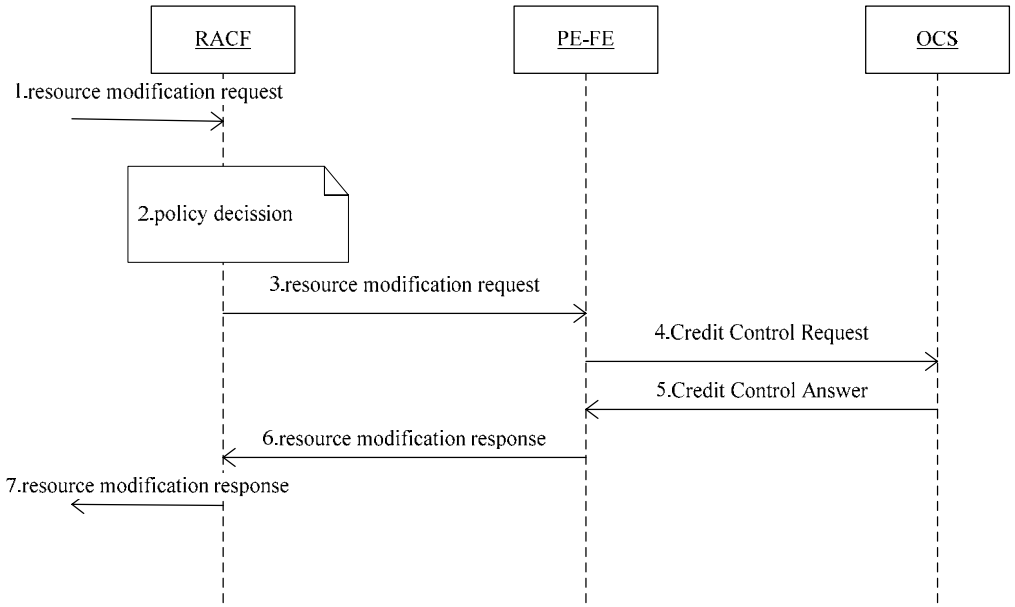
I.4.1 procedure for session initialization:



1. RACF receives the RIR (Resource Initiation Request) from service stratum for the requested service;
2. RACF makes policy decision per the service information (service class, etc);
3. RACF indicates PE-FE to enforce the policy;
4. PE-FE shall send CCR (Credit Control Request) to OCS to authorize after receiving the RIR from RACF: if authorization is failed, OCS shall indicate PE-FE to terminate this session; else OCS shall reserve some units for this service.
5. OCS returns CCA (Credit Control Answer) back to PE-FE; this message includes the result of OCS's authorization;
6. PE-FE shall enforce the final policy per the CCA message from OCS: if authorization is failed, PE-FE shall notify RACF that resource can not be reserved. PE-FE returns the resource initiation response to RACF;
7. RACF returns the resource initiation response to service stratum;
8. PE-FE shall start reserved units function if the requested service starts normally;
9. The requested service starts to delivery;

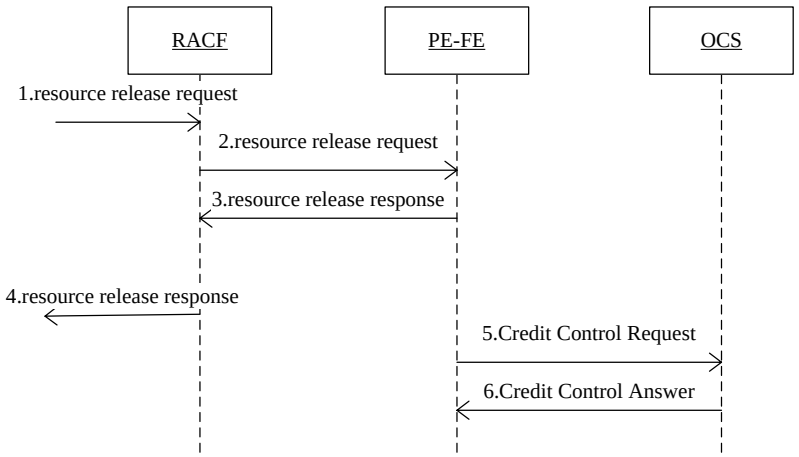
10-11: PE-FE may request more units from OCS if the reserved units are not enough for the requested service and OCS shall response the PE-FE's request per user's account information.

I.4.2 procedure for session modification



1. The service stratum shall notify the RACF by sending RMR (Resource Modification Request) if some changes (band width, etc) happened during the service delivery;
2. RACF shall make policy decision per new service information;
3. RACF sends the new policy to PE-FE to enforce;
4. PE-FE shall send CCR (Credit Control Request) to OCS to re-authorize after receiving the RMR from RACF: if authorization is failed, OCS shall indicate PE-FE to terminate this session; else OCS shall reserve some units for this service. (Notes: this CCR shall include unconsumed units before the service is modified);
5. OCS returns CCA (Credit Control Answer) back to PE-FE; this message includes the result of OCS's authorization;
6. PE-FE shall enforce the final policy per the CCA message from OCS: if authorization is failed, PE-FE shall notify RACF that resource can not be reserved. PE-FE returns the resource modification response to RACF;
7. RACF returns the resource modification response to service stratum.

I.4.3 procedure for session release



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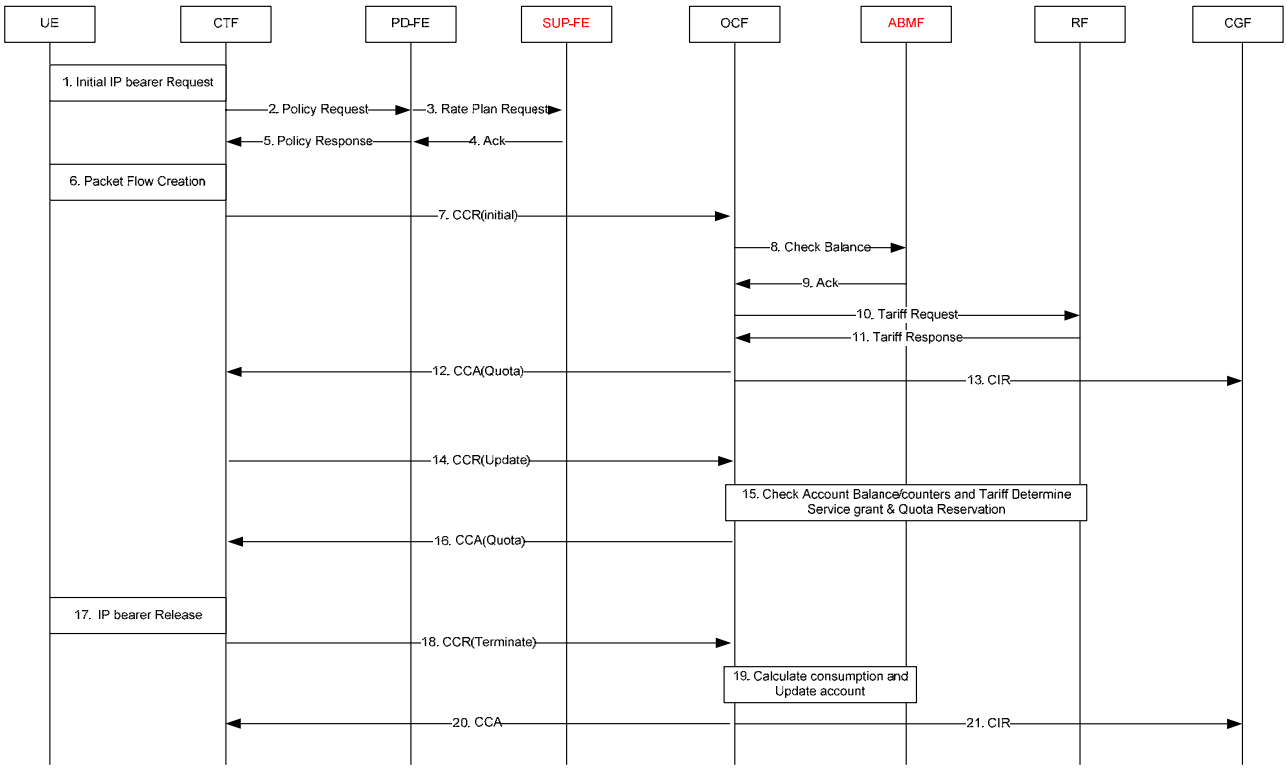
1. The service stratum sends RRR (Resource Release Request) to RACF when the requested service is released;
2. RACF sends RRR to PE-FE;
3. PE-FE shall remove the related policy and then return resource release response to the RACF;
4. RACF shall send resource release response to the service stratum;
5. PE-FE shall send CCR (Credit Control Request) to OCS; this CCR shall report final consumed units;
6. OCS shall complete the operations related to user account, for example Debit,

I.4.4 Online Charging based on Dynamic Charging Policy

[Editor's Note: this scenario has been partially reviewed in the meeting (NGN-GSI, May 2009) and doesn't represent full agreement. It needs further detailed review in a future meeting]

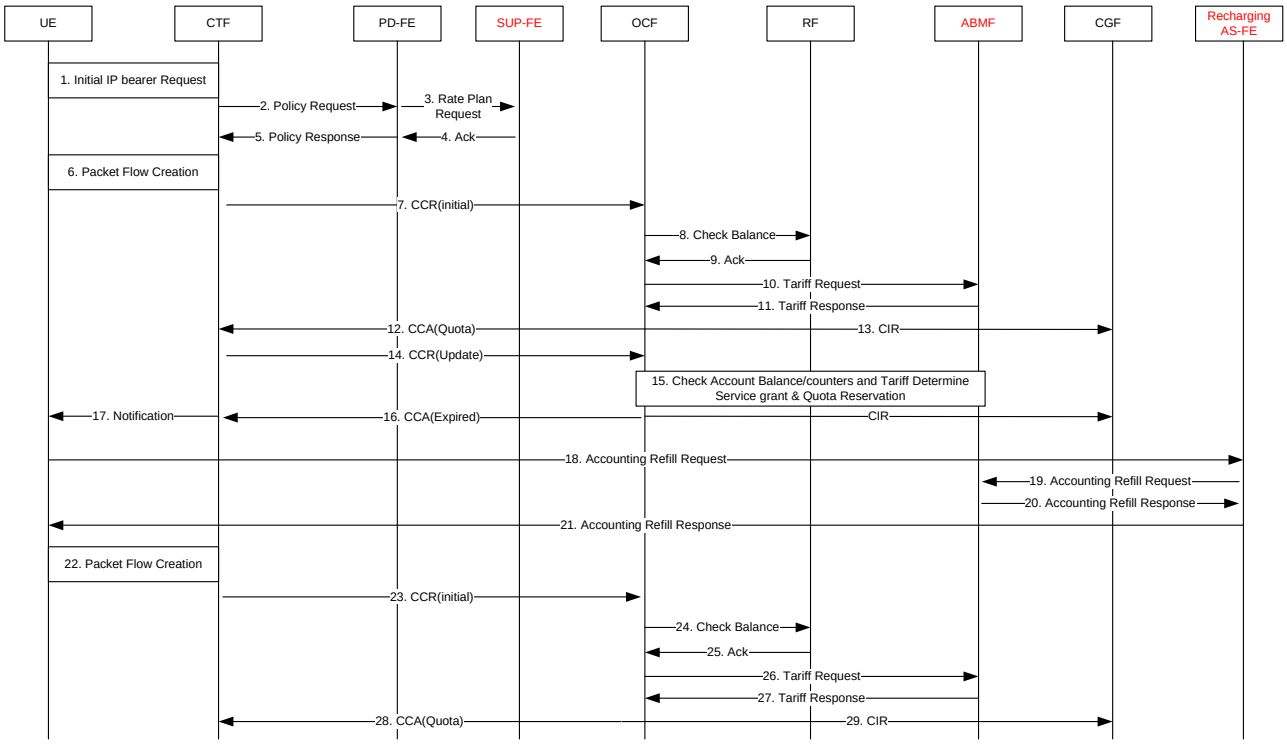


1. UE first makes a connection to the Internet via its NGN service provider. During this process, UE is allocated with new IP address by an authentication and authorization function. UE then either initiates best-effort Internet applications like web, FTP, and/or e-mails, etc.
2. Such application services trigger the involved CTF to request subscriber's policy to PD-FE
3. PD-FE queries the subscriber's charging policy to SUP-FE
4. SUP-FE responds with the requested information if available
5. PD-FE sends the charging policy which is created according to subscriber's rate plan to CTF. CTF recognizes the subscriber's service which needs to be charged online through its charging policy.
6. When the subscriber's service is initiated, CTF starts to meter its traffic
7. CTF buffers the service packet at the beginning phase while sending CC (credit control) Request initial message to OCF
8. OCF requests customer's credit balance to ABMF. If the service is supposed to be charged with Service provider's account, OCF requests Service provider's credit balance.
9. OCF receives a result of credit balance from ABMF
10. OCF requests tariff information applicable for this transport/service session to RF. If the service is supposed to be charged with Service provider's account, OCF requests service provider's tariff information.
11. OCF receives tariff from RF. Then OCF determines customer's quota after rating and account/counter control.
12. OCF generates CCA message including customer's quota, validity-time, and tariff-time-change to CTF
13. OCF sends CIR to CGF

14. CTF generates CC request update message including used unit to OCF, when customer's quota is exhausted or validly-time/tariff-time-change are triggered.
15. OCF adjusts tariff and credit balance information with the similar procedure as the case of (8)-(11) process.
16. OCF generates CC answer update message including quota, validity-time, and tariff-time-change to CTF, and sends CIR to CGF simultaneously.
17. IP connection termination requested.
18. CTF sends CC Request termination message including used unit to OCF.
19. OCF performs final rating for the consumed session resources and adjusting the account/counter.
20. OCF generates CC answer termination message
21. OCF sends CIR to CGF.

I.4.5 Scenario of Refilling Accounts by a customer in Online Charging

[Editor's Note: this scenario has been partially reviewed in the meeting (NGN-GSI, May 2009) and doesn't represent full agreement. It needs further detailed review in a future meeting]

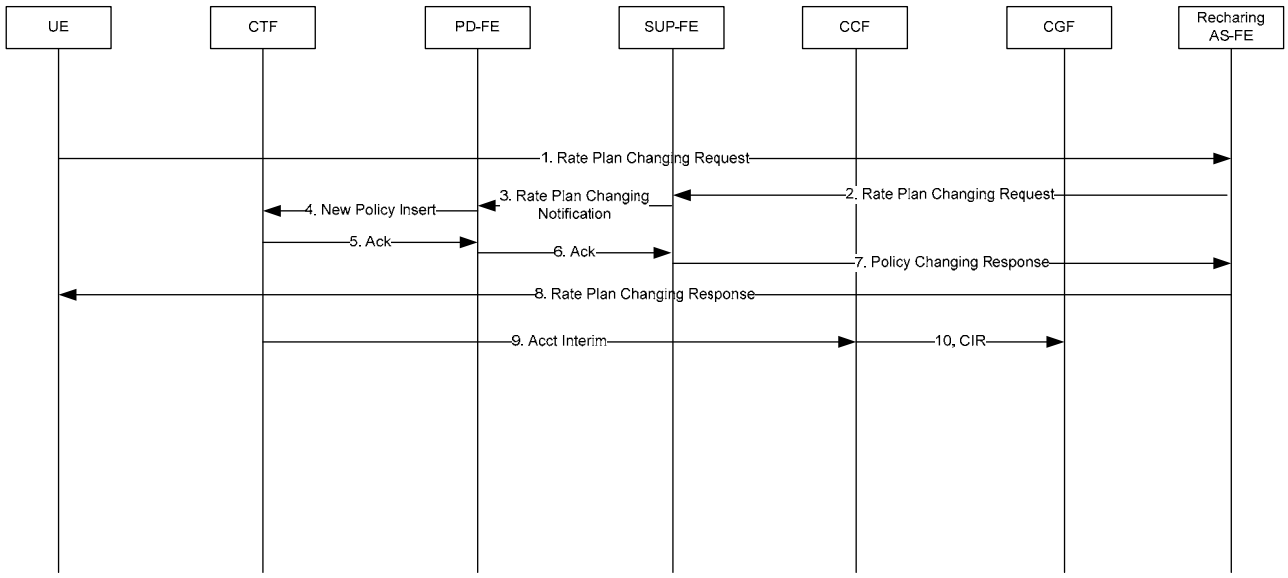


1. UE first makes a connection to the Internet via its NGN service provider. During this process, UE is allocated with new IP address by an authentication and authorization function. UE then either initiates best-effort Internet applications like web, FTP, and/or e-mails, etc.
2. Such application services trigger the involved CTF to request subscriber's policy to PD-FE
3. PD-FE queries the subscriber's rate plan to SUP-FE
4. SUP-FE responds with the requested information if available
5. PD-FE sends the charging policy which is created according to subscriber's rate plan to CTF. CTF recognizes the subscriber's service which needs to be charged online through its charging policy.
6. When the subscriber's service is initiated, CTF starts to meter its traffic
7. CTF buffers the service packet at the beginning phase while sending CC (credit control) Request initial message to OCF
8. OCF requests customer's credit balance to ABMF. If the service is supposed to be charged with 3rd party account, OCF requests 3rd party's credit balance.
9. OCF receives a result of credit balance from ABMF
10. OCF requests tariff information applicable for this transport/service session to RF. If the service is supposed to be charged to a 3rd party account, OCF requests 3rd party's tariff information.
11. OCF receives tariff and tariff-time-change result from RF. Then OCF determines customer's quota after rating and account/counter control.
12. OCF generates CC answer initial message including customer's quota, validity-time, and tariff-time-change to CTF
13. OCF sends CIR to CGF simultaneously

14. CTF generates CC request update message including used unit to OCF, when customer's quota is exhausted or validly-time/tariff-time-change are triggered.
15. OCF adjusts tariff and credit balance information with the similar procedure as the case of (8)-(11) process.
16. When customer's account is expired, OCF generates CC answer update message notifying expiration of account to CTF, and sends CIR to CGF simultaneously.
17. CTF announces the subscriber's account status to UE
18. If the subscriber wants to refill its account, UE asks Recharging AS-FE to refill account.
19. Recharging AS-FE requests refilling the subscriber's account to ABMF
20. ABMF sends a result of request to Recharging AS-FE
21. The subscriber receives a result of the request for account refill
22. After the subscriber recognizes that its account is refilled, a new service flow starts. Before the completion of the account refill, all customers' traffic is blocked.
23. OCF requests customer's credit balance to ABMF. If the service is supposed to be charged to a 3rd party account, OCF requests 3rd party's credit balance.
24. OCF receives a result of credit balance from ABMF
25. OCF requests tariff information applicable for this transport/service session to RF. If service which user use is charged is a 3rd party account, OCF requests 3rd party's tariff information.
26. OCF receives tariff and tariff-time-change result from RF. Then OCF determines customer's quota after rating and account/counter control.
27. OCF generates CC answer initial message including customer's quota, validity-time, and tariff-time-change to CTF
28. OCF sends CIR to CGF simultaneously

I.4.6 Scenario of Changing Charging Policy by a Customer

[Editor's Note: this scenario has been partially reviewed in the meeting (NGN-GSI, May 2009) and doesn't represent full agreement. It needs further detailed review in a future meeting]



1. When a customer wants to change its charging policy during a service, the customer asks AF to change the charging policy.
    1. Recharging AS-FE requests SUP-FE to change user's charging policy
    2. SUP-FE then sends an notification charging policy changes to PD-FE
    3. PD-FE inserts new charging policy which is created with changed rate plan to CTF
    4. CTF sends a result of request of PD-FE
    5. Recharging AS-FE receives the result from PD-FE
    6. The subscriber finally receives the response from Recharging AS-FE
    7. CTF obsoletes the previous charging information and meters the customer's traffic according to the new charging policy. CTF sends Acct interim to CCF
    8. CCF creates CIR and sends it to CGF

I.5. Additional Policy-based Charging and Accounting Scenarios

The following are additional policy based charging and accounting scenarios. .

I.5.1 **Scenario 1: IPTV service flow**

This following describes a general accounting and charging scenario for offline charging of NGN Release 1 services. Editor's note: previous sentence should remove relationship with NGN Releases. In this scenario, a customer connects to NGN network and uses some IP data service and session-based service like VoIP.

An operator has a specific charging rate for the traffic of IPTV whose QoS requirement maybe different from other services.

For example, for the default broadband access services, the operator using flat-rate for accounting, but for IPTV service,

Editor's note: Need to complete the sentence above concerning IPTV service flow.

I.5.2 Scenario 2: Different uplink flow and downlink flow

A subscriber is surfing online, for some interaction services, his uplink flow and downlink flow maybe have different QoS requirement and tariff rates.

The following is a general

I.5.3 Scenario 3: Advertisements in VOD service

A VOD user is watching TV, and then there are some advertisements, these kinds of ads can be free and have different even better QoS levels than normal VOD flows.

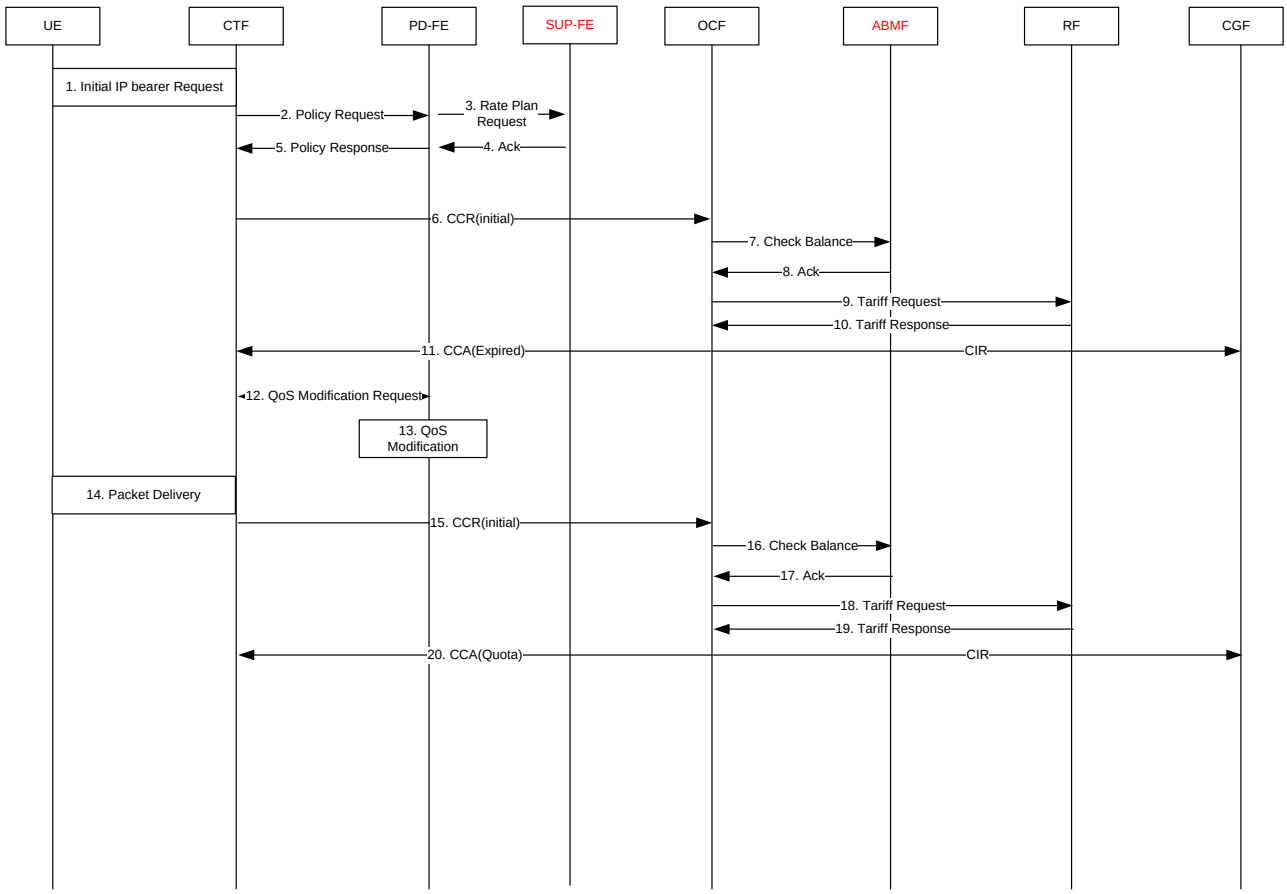
I.5.4 Scenario 4: Different QoS provision at different time

A silver user have a silver QoS provision on the daytime, but at the night because total call traffic of the system is getting small, then the silver user can have a golden QoS provision with the same tariff.

I.5.5 **Scenario 5:** Scenario of Real-time QoS Modification by Charging Rule

[Editor's Note: this scenario has been partially reviewed in the meeting (NGN-GSI, May 2009) and doesn't represent full agreement. It needs further detailed review in a future meeting]

This is a scenario that QoS is modified according to charging rule in real-time. When some factors (e.g., time, volume or etc.,) approach a threshold, QoS is being processed automatically. For this charging policy, Online charging mechanism is used to check in real-time whether some factor is limited.



1. UE first makes a connection to the Internet via its NGN service provider. During this process, UE is allocated with new IP address by an authentication and authorization function. UE then either initiates best-effort Internet applications like web, FTP, and/or e-mails, etc.
2. Such application services trigger the involved CTF to request subscriber's policy to PD-FE
3. PD-FE queries the subscriber's charging policy to SUP-FE
4. SUP-FE responds with the requested information if available
5. PD-FE sends the charging policy which is created according to subscriber's charging policy to CTF. CTF recognizes the subscriber's service which needs to be charged online through its charging policy.
6. If the user's service is started again, CTF sends CC (credit control) Request initial message to OCF
7. OCF requests customer's credit balance to ABMF. If the service is supposed to be charged to a 3rd party account, OCF requests service provider's credit balance.
8. OCF receives a result of credit balance from ABMF
9. OCF requests tariff information applicable for this service to RF. If service which user uses is charged to a service provider account, OCF requests service provider's tariff information.
10. OCF requests tariff information applicable for this transport/service session to RF. If the service is supposed to be charged to a 3rd party account, OCF requests service provider's tariff information.
11. When customer's account is expired, OCF generates CC answer update message notifying expiration of account to CTF, and sends CIR to CGF simultaneously.
12. CTF requests QoS modification to PD-FE according the subscriber's charging policy
13. PD-FE modifies the subscriber's QoS with it's own process and sends a result to CTF
14. Then new service traffic is served with new QoS policy which is predefined.
15. CTF requests to OCF to get quota sending CCR (initial)
16. OCF requests customer's credit balance to ABMF. If service is supposed to be charged to a 3rd party account, OCF requests service provider's credit balance.
17. OCF receives a result of credit balance from ABMF
18. OCF requests tariff information applicable for this service to RF. If service is supposed to be charged to a service provider account, OCF requests service provider's tariff information.
19. OCF receives tariff and tariff-time-change result from RF. Then OCF determines customer's quota after rating and account/counter control.
20. OCF generates CCA including customer's quota, validity-time, and tariff-time-change to CTF and sends CIR to CGF simultaneously

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