ITU-T Recommendation Y.2111 Rev.1

Resource and admission control functions in next generation networks

Amendment 1

Annex A, RACF enhancement for supporting policy-based charging control

Summary
This amendment contains the extensions including policy-based charging and its associated control requirements and functional architecture to ITU-T Recommendation Y.2111 Rev.1.

A.1 Scope
This document specifies the extensions of policy-based charging and its associated control requirements and functional architecture to ITU-T Recommendation Y.2111 R1.

[Editor's Note: contributions on the further details are solicited]

A.2 References
The following ITU-T Recommendations and other references contain provisions that, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation 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.

[Editor's Note: contributions on the further details are solicited]

[ITU-T Y.2111] Recommendation ITU-T Y.2111, Resource and admission control functions in Next Generation Networks
[ITU-T Y.2233] Recommendation ITU-T Y.2223, Requirements and framework allowing accounting and charging capabilities in NGN release 1

A.3 Definitions
This Amendment defines the following terms:

[Editor's Note: contributions on the further details are solicited]

A.4 Abbreviations and Acronyms
[Editor's Note: contributions on the further details are solicited]
CCF Charging Collection Function
CTF Charging Triggering Function

OCF	Online Charging Function
PD-FE	Policy Decision Functional Entity
PE-FE	Policy Enforcement Functional Entity
SCF	Service Control Function

A.5 Conventions

None

A.6 Overview of Enhancements

Figure 1 shows the changes made from the functional architecture in [ITU-T Y.2233]. Description on the changes is given below:

1. Extension of PE-FE to interact with Charging Triggering Function and charging related policy management functions
2. Extension of PD-FE to create charging related control policies and deploy them in appropriate PD-FEs
3. Extension of Rw reference point to support delivery of charging and control policy
4. Creation of a new reference point Ce to support information exchange between PD-FE and CTF. This reference point is used to carry a session control request from CTF to PE-FE. This type of control requires real-time execution and direct interaction between CTF and PE-FE avoid unnecessary timing overhead compared to the case where the decision process has to go though a CTF to PD-FE and then PE-FE.

[Editor's Note: The following diagram has been changed based on the contribution C-526 and the discussion result in the joint meeting with Q.3/13. The description of the changes are not reflected in the above description yet. Further contributions in this regard are invited.]

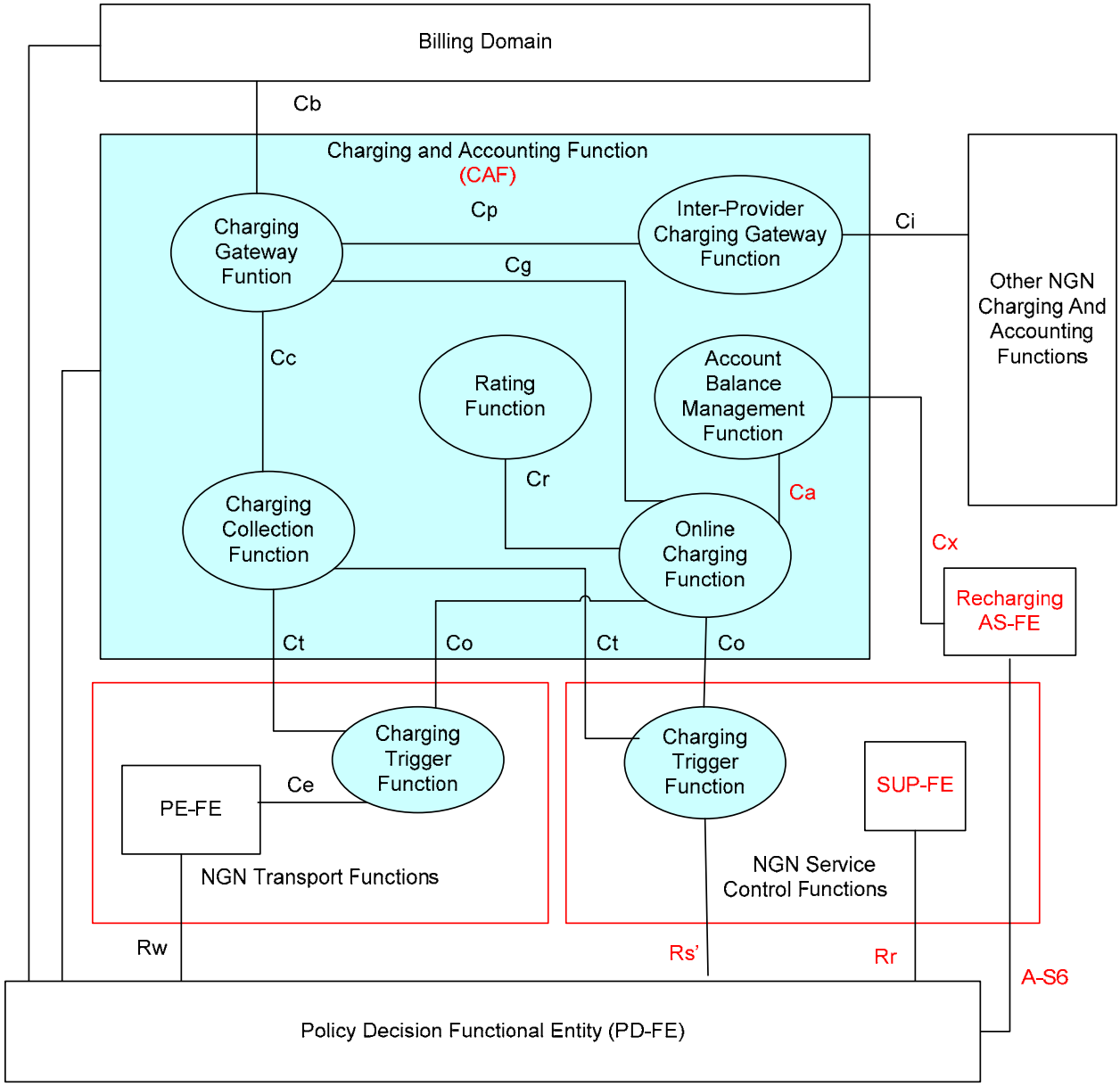

Figure A.1. Functional Architecture Supporting Policy-based Charging and Accounting

A.7 Functional architecture

In support of policy-based charging control, this clause specifies the needed enhancements to CTF specified in Y.2233 and enhancements to Y.2111 Rev.1.

A.7.1 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. The charging policies and rules are delivered by PE-FE and enforced in CTF. The CTF also sends session control requests to PE-FE. The CTF may be resident in network elements (NEs) or a separate measurement device if an NE doesn't support such functionality.
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 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 by PE-FE.
- Receive or retrieve user (end-point) profile data, service quality information, etc.
- Receive charging policies and rules from PE-FE.
- Process the collected data and convert them into a packet bundle or flow record appropriately
- Perform interim metering in appropriate occasions such that a metering device reboots or other network problems which prevents the reception of the data
- Send a session control request to PE-FE if a condition based on the enforced charging policy meets.
- 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. It 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.

A.7.2 Policy enforcement functional entity (PE-FE)

The PE-FE enforces the network policy rules instructed by the PD-FE on a per-subscriber and per-IP flow basis. It should be able to perform the following functions based on flow information such as classifier (e.g. IPv4 5-tuple) and flow direction, as well as transport interface identification information (e.g. VLAN/VPN ID, LSP Label) as needed. The functions of the PE-FE include:

- Opening and closing gate: enabling or disabling packet filtering for an IP media flow.

  A gate is unidirectional, associated with a media flow in either the upstream or downstream direction. When a gate is open, all of the packets associated the flow are allowed to pass through; when a gate is closed, all of the packets associated with the flow are blocked and dropped.

- Rate limiting and bandwidth allocation
- Traffic classification and marking
- Traffic policing and shaping
- Traffic policing and shaping based on the session control request received by CTF
- Mapping of IP-layer QoS information onto link layer QoS information based on pre-defined static policy rules (e.g. setting 802.1p priority values)
- Network address and port translation
- Media Relay (i.e. address latching) for NAT traversal
- Collecting and reporting resource usage information (e.g. start-time, end-time, octets of sent data)
- 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 by 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 by 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.
  - Delivering charging policies and rules received from PD-FE to CTF

A.7.3 Policy decision functional entity (PD-FE)

The PD-FE handles the QoS resource requests received from the SCF via the Rs reference point or from PE-FE via the Rw reference point. The PD-FE contains the following functions:

- Final Decision Point (FDP): This function first checks the QoS resource request based on service information, network policy rules and transport subscription information, and then interacts with the TRC-FE via the Rt reference point to detect and determine the requested QoS resource within the involved access and/or core transport networks.
  - The FDP makes the final admission decision for media flows of a given service based on network policy rules, service information, transport subscription information, and decision on resource availability.

  - The FDP indicates the loss of connectivity: It informs the SCF that the transport resource previously granted is lost. The SCF may request PD-FE to relinquish all resources associated with the session.

- QoS Mapping - Technology Independent (QMTI): This function maps the service QoS parameters and priority received from the SCF via the Rs reference point to network QoS parameters (e.g. Y.1541 class) and priority based on the network policy rules.
- Gate Control (GC): This function controls PE-FE to install and enforce the final admission decisions via the Rw reference point (e.g. opening or closing the gate). The action to pass or drop IP packets is based on a set of IP gates (packet classifiers, e.g. IP 5-tuple) and transport interface identification information (e.g. VLAN/VPN ID) as needed.
- IP Packet Marking Control (IPMC): This function takes decisions on packet marking and remarking of flows. The marking may consider the priority of the flow and traffic engineering parameters.
- NAPT control and NAT traversal (NAPTC): This function interacts with PE-FE and SCF to provide the address binding information for NAPT control and NAT traversal as needed.
- Rate Limiting Control (RLC): This function makes decisions on the bandwidth limits of flows (e.g. for policing).
- Firewall Working Mode Selection (FWMS): This function selects the working mode of the firewall based on the service information. Four packet inspection modes could be identified (static packet filtering, dynamic packet filtering, stateful inspection, deep packet inspection, cf. 7.2.4.1).
- Core Network Path Selection (CNPS): This function chooses the core network ingress and/or egress path for a media flow based on the service information and technology independent policy rules at the involved PD-FE.
- Network Selection (NS): This function locates core networks that are involved to offer the requested QoS resource. It locates the PE-FE instances that are involved to enforce the final admission decisions.
- Charging Policy Management: This function interacts with charging policy repository to retrieve charging policies and rules and transfer them to PE-FE. How such policies and rules are created and stored are out of scope of this function. Assumption is given that such policies and rules are managed by billing system.

The PD-FE shall make the final policy decisions based on the service information (e.g. service type, flow description, bandwidth, priority), transport network information (e.g. resource admission result, network policy rules) and transport subscription information (e.g. maximum upstream/downstream capacity). The policy decision shall provide sufficient information to make the PE-FE perform the resource control operation e.g. gate opening/closing, bandwidth allocation/rate limiting, packet marking, traffic policing/shaping, NAPT and address latching. The policy decisions may be composed of flow ID, IP addresses, bandwidth, gate status, time/volume limit, traffic descriptor etc.

The PD-FE can be stateful or stateless depending on the complexity of the specific network environment, application characteristics and deployment architecture.

- The stateless PD-FE only maintains the transaction state information, e.g. state held for the duration of a request-response operation. In order to be stateless, the PD-FE shall generate the resource control session information for each resource control request from the SCF, which can

be stored in the SCF, TRC-FE or PE-FE and used to retrieve the state information together with pertinent information flows.

- The stateful PD-FE may maintain a variety of resource control session information within PD-FE, such as the session duration, the resource control session information (e.g. the association between SCF and PD-FE, PD-FE and TRC-FE, PD-FE and PE-FE), the resource reservation limit (e.g. time limit/volume limit), resource reservation status (i.e. authorized, reserved, or committed) and physical/logical connection ID.

A.8 Reference points

A.8.1 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 event between the CTF and the PE-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 and many-to-one operation modes

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

A.8.2 Reference Point Rs'

The Rs' reference point is required to support interaction between the PD-FE and SUP-FE and PD-FE and CTF in service stratum. This reference point is the extension of Rs. 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 to the CTF in service stratum
- Acknowledgements for these event between the PD-FE and the CTF

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 and many-to-one operation modes

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

A.8.3 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.

[Editor's Note: This clause was added in this draft Recommendation as a result of the joint meeting with Q.3/13 for the completeness although the text was not a part of the contribution C-526. Contributions for the detailed information elements contained in the service user profile and policy information exchanged between the SUP-FE and PD-FE are invited.]

_____