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Abstract of document:

The current level of traffic differentiation and traffic-type awareness of the GPRS architecture shall be extended beyond APN and PDP Context level. It shall be possible to apply differentiated charging for the traffic flows belonging to different services (a.k.a. different service data flows) even if they use the same PDP Context.

Changes since last presentation to TSG SA Meeting:

This is the first presentation of this document.

Outstanding Issues:

The following architecture related issues are outstanding:

- Support for application level flows within an IP flow (for example, a HTTP flow)
- Other possible termination actions such as redirection of packets
- Location of the traffic plane function
- Identifying the different types of charging rules that can apply at the charging plane, and how the data (e.g. precedence) for them is received

In addition, there are a number of issues outstanding which are considered as related to the charging work required for the document. These aspects should be further investigated within subsequent charging investigation work:

- The relationship of the new Gy and Gz interfaces and the new charging entities to the existing on-line and off-line charging interfaces and entities.

Contentious Issues:

There are no known contentious issues at this time.

3GPP TR 23.825 V1.0.0 (2003-09)

Technical Report

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Overall Architecture Aspects of IP Flow Based Bearer Level Charging; Stage 2 (Release 6)

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Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

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

Introduction

This clause is optional. If it exists, it is always the second unnumbered clause.

1 Scope

The present document identifies the overall architecture aspects of IP flow based bearer level charging.

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

- Change requests against the architecture specifications [5] of SA2, clarifying the architecture implications of IP flow based bearer charging
- Change requests against the Charging Principles specification [3] of SA5, which contains the charging architecture and mechanisms.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document.*

[1] 3GPP TR 41.001: "GSM Release specifications".

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

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

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

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

[6] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Editor's note: terms shown in <angle brackets> are provisional.

Service data flow: aggregate set of packet flows. A packet flow can be an IP flow. It is for further study whether a packet flow may be an application flow within an IP flow such as the packets for a HTTP application.

In the case of GPRS, it shall be possible that a service data flow is more granular than a PDP context.

Service Data Flow Filter: a set of filter parameters used to identify one or more of the packet flows constituting a service data flow. The granularity of a service data flow filter (e.g. IP 5 tuple, or including additional parameters to identify a specific application flow such as HTTP) is FFS.

Charging rule: data that identifies the service data flow filters, charging key, and the associated charging actions, for a single service data flow.

Charging key: information used by the online and offline charging system for rating purposes. The charging key is an identifier associated with the charging rule that is unique within the charging rules for that users IP address/prefix.

Dynamic charging rules: Charging rules where some of the data within the charging rule (e.g. service data flow filter information) is assigned via real-time analysis which may use dynamic application derived criteria.

Static charging rules: Charging rules where all of the data within the charging rule describing the service data flow is permanently configured throughout the duration of a user's data session. Static charging rules may be activated dynamically.

There may be interactions between charging rules, whether static or dynamic.

3.2 Symbols

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

<symbol> <Explanation>

3.3 Abbreviations

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

BS	Billing System
CCF	Charging Collection Function
CDR	Charging Data Records
CGF	Charging Gateway Function
CSCF	Call Session Control Function
ECF	Event Charging Function
GCID	GPRS Charging ID
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
HPLMN	Home PLMN
HTTP	Hypertext Transfer Protocol
ICID	IMS Charging Identifier
IM	IP Multimedia
IM CN SS	IP Multimedia Core Network Subsystem
IMS	IP Multimedia Core Network Subsystem
IMSI	International Mobile Subscriber Identity
OCS	Online Charging System
P-CSCF	Proxy-CSCF
PDGw	Packet Data Gateway
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
QoS	Quality of Service
S-CSCF	Serving-CSCF
SGSN	Serving GPRS Support Node
SIP	Session Initiation Protocol
TPF	Traffic Plane Function
UE	User Equipment
WAP	Wireless Application Protocol
WLAN	Wireless LAN

4 General Charging Architecture Requirements

Editor's note: This clause is planned to contain the relevant architecture requirements related to IP flow level charging.

4.1 General

The current level of traffic differentiation and traffic-type awareness of the GPRS architecture shall be extended beyond APN and PDP Context level. It shall be possible to apply differentiated charging for the traffic flows belonging to different services (a.k.a. different service data flows) even if they use the same PDP Context.

Charging and tariffing models described in this Technical Report shall be possible to be applied to both prepaid and postpaid subscribers, i.e. to both online and offline charging.

The GPRS online charging solutions up to release 5 are built around CAMEL mechanisms that provide online access- and charging-control for GPRS - pertaining to PDP Contexts of an APN.

The evolved bearer charging architecture developed in this Technical Report shall use generic native IP charging mechanisms to the extent possible in order to enable the reuse of the same charging solution and infrastructure for different type of IP-Connectivity Networks.

Note: Providing differentiated service-data flow-based charging is a different function from providing differentiated traffic treatment on the IP-flow level. The operation of service-data flow-based charging shall not mandate the operation of service-based local policy. At the same time, the relationship of the PDP Context based service-based local policy mechanisms of the Go interface and the service data flow based charging mechanisms will have to be carefully studied.

The following new release 6 functions need to be provided by the network for service data flow based charging:

- Identification of the service data flows that need to be charged at different rates
- Provision and control of service data flow level charging rules
- Reporting of service data flow level packet counts for offline and online charging
- Event indication according to on-line charging procedures (e.g. sending AAA Accounting Stop) and, optionally, following this particular event, taking appropriate actions on service data flow(s) according to the termination action defined in the respective charging rule(s).

These new functions shall be compatible and coherent with the authentication, authorization, PDP context management, roaming and other functions provided by the existing architecture.

In addition charging based on specific application services or protocols shall be supported.

4.2 Traffic Plane Function

This refers to the filtering that identifies the service data flows that need to be charged at different rates. Basic example: look for packets to and from service A.

- Filtering with respect to service data flow based on the transport and application protocols used above IP, e.g. MMS, HTTP, WAP etc. shall be studied. This includes ability to differentiate between TCP, Wireless-TCP according to WAP 2.0, WDP, etc, in addition to differentiation at the application level.
- Different filtering and counting shall be supported for downlink and uplink.
- Different granularity for service data flow filters identifying the service data flow shall be possible e.g.
  - Filters based on the IP 5 tuple (source IP address, destination IP address, source port number, destination port number, protocol ID of the protocol above IP). Some of the filter parameters may be wildcarded..

- In the case of GPRS, the traffic plane function shall provide the ability to support simultaneous independent filtering on service data flows associated with all, and each individual active PDP contexts; that is, primary and secondary PDP contexts, of one APN.
- In case of no applicable filters for a service data flow, an operator configurable default charging should be applied.

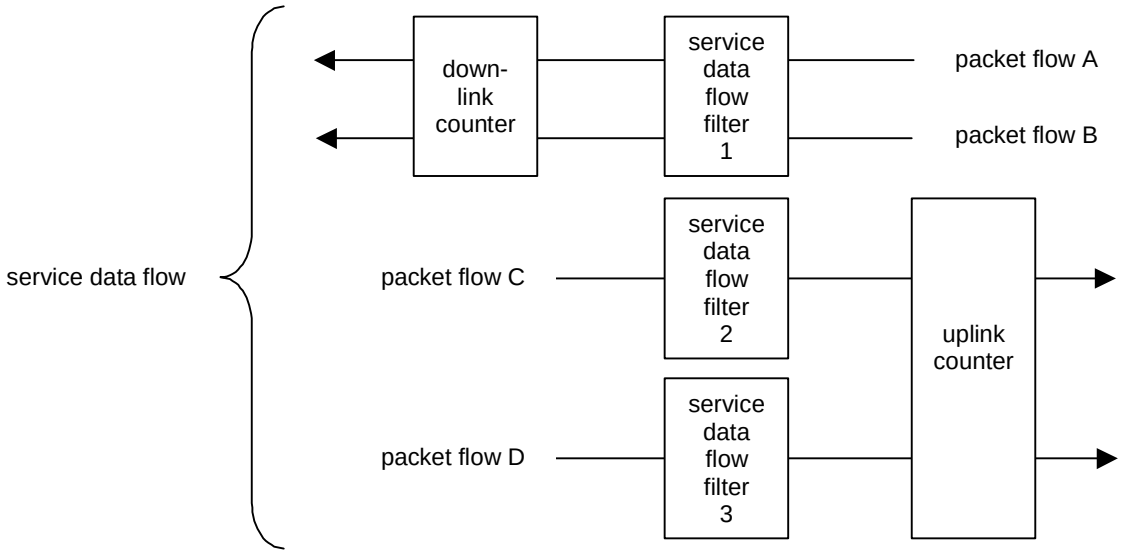

Figure 4.2 – Relationship of service data flow, packet flow and service data flow filter

4.3 Charging rules

Charging rules contain information that allow for filtering of traffic to identify the packets belonging to a particular service data flow, and allow for defining how the service data flow is to be charged. The following apply to charging rules:

- Charging rules for bearer charging shall be defined by the operator.
- These charging rules shall be made available to the Traffic Plane function for both offline and online charging.
- Multiple charging rules shall be supported.
- Filtering information within a charging rule is applied through filtering functionality at the Traffic Plane Function to identify the packets belonging to a particular service data flow.
- Charging rules with statically provisioned filtering information (i.e. pre-defined at the Traffic Plane Function) shall be supported
- Charging rules with dynamically provisioned filtering information (i.e. made available to the Traffic Plane Function) shall be supported in order to cover IP service scenarios where the filtering information is dynamically negotiated (e.g. negotiated on the application level (e.g. IMS)).
- Different techniques are available for installing charging rules in the traffic plane function. In all cases, a precedence shall be provided for the charging rule.

Editor's Note: Specifying the different techniques (eg. static rules for all users, static rules per user, dynamic rules) and how the precedence is obtained in each case is FFS.:

- There may be overlap between the charging rules that are applicable. Overlap can occur between:
  - multiple pre-defined TPF rules

- TPF pre-defined rules and rules from the Service Data Flow Based Charging Rules Function, which can overlay the TPF pre-defined rules

The precedence identified with each charging rule shall resolve all overlap between the charging rules.

- Charging rules contain information on
  - How a particular service data flow is to be charged: online/offline;
  - In case of offline charging whether to record volume- or time-based charging information;
  - In case of online charging, what termination action is to be applied
  - Charging key
  - Service data flow filter(s)
  - Precedence
- Elements of charging rules may either be statically configured at the Traffic Plane Function, or may be dynamically provisioned.
- Once the charging rule is determined it is applied to the service data flow at the Traffic Plane Function and packets are counted and categorised per the rule set in the charging rule.
- Different charging rules shall be supported in downlink and uplink.
- Charging rules shall be available for both user initiated and network initiated flows.
- Charging rules can change and be overridden, for a previously established PDP context in the GPRS case, based on specific events (e.g. IM domain events or GPRS domain events).
- It shall be possible to apply different charging rules for different users or groups of users.
- It shall be possible to apply different charging rules based on the location of the user (e.g. based on identity of the roamed to network).
- Overlap between charging rules (whether static or dynamic) applied for a user shall be identified, and resolved according to operator specified rules.
- For GPRS, charging rule assignment shall be possible at PDP context establishment.
- For GPRS, it shall be possible to have different charging rules depending on the APN used.

4.3.1 Termination Action

Termination Action applies in case of online credit control, each charging rule has a corresponding termination action defined for service data flows that are online charged. The termination action indicates the action which the Traffic Plane Function should perform when the on-line charging system causes the Diameter Credit Control Client to terminate a service data flow.

This clause defined the termination action at the Traffic Plane Function. Termination Actions may also be defined in the OCS.

The defined termination actions include:

- Drop the packets corresponding to a terminated service data flow as they pass through the Traffic Plane Function.

Additional termination actions such as re-directing packets corresponding to a terminated service data flow are to be investigated

No termination action means that the packets corresponding to a terminated service data flow will be allowed to pass through the Traffic Plane Function. The charging actions in this case are FFS.

The Termination Action may trigger other procedures, e.g. the deactivation of a PDP context or the termination of a WLAN session.

4.3.2 Credit management

In case of online charging, it shall be possible to:

1. have a pool of credit/resource used for multiple charging rules applied at the Traffic Plane Function.
2. have individual credit/resource limits for each charging rule applied at the Traffic Plane Function

Rating decisions shall be strictly controlled by the OCS for each service.

Note: 'credit' as used here does not imply actual monetary credit, but an abstract measure of resources available to the user. The relationship between this abstract measure, actual money, and actual network resources or data transfer, is controlled by the OCS.

4.4 Reporting

This refers to the differentiated charging information being reported to the existing charging architecture. Basic example: those 20 packets were in rating category A, include this in your global charging information.

- The Traffic Plane function shall report bearer charging information for online
- The Traffic Plane function shall report bearer charging information for offline
- It shall be possible to collect charging information based on the bearer charging rules (service data flow related charging information), and in the case of GPRS, release 5 charging rules (per PDP context)
- It shall be possible to report charging information showing usage for each user for each charging rule, e.g. a report may contain multiple containers, each container associated with a charging key.

4.5 Backwards compatibility

The enhanced architecture shall be backwards compatible with release 5 charging capabilities.

4.6 Charging models

When developing the charging solutions, the following charging models should be considered, even though the full solution to support the models may not be within the scope of this TR.

Shared revenue services shall be supported. In this case settlement for all parties shall be supported, including the third parties that may have been involved providing the services.

Charging models where service data flow charging depends on the volume of data or the duration of the session shall be supported, as well as those where service data flow charging depends on the time of day.

It shall be possible to restrict special rates to a specific service, e.g. allow the user to download a certain volume of data from one service for free, but this allowed volume is not transferable to other services.

In the case of online charging, and where information is available to enable service data flow packets to be associated with a specific PDP context, it shall be possible to perform rating and allocate credit depending on the characteristics of the resources allocated initially (in the GPRS case, the QoS of the PDP context).

5 Architectural Concept

5.1 Architecture and Reference Points

Editor's note: This clause is planned to contain the relevant part of the architecture impacted by IP flow level based charging.

5.1.1 Online service data flow-based bearer charging architecture

Figure 5.1 below presents the overall architecture for service data flow-based online bearer charging.

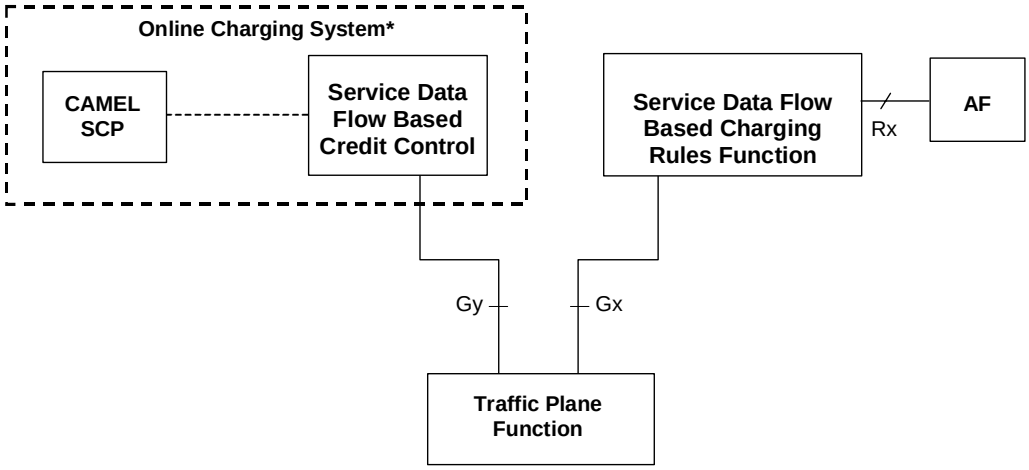

Figure 5.1 – Overall architecture for service data flow based online bearer charging

Note: No changes are foreseen on the CAMEL SCP. The relation of the new entities and interfaces described in this figure to existing entities and interfaces of the 3GPP system architecture (e.g. SGSN, GGSN) are FFS.

Note(*): The detailed functional entities of the Online Charging System are not shown in this figure. The details of the OCS are specified in TS 32.200, further internal details of the OCS for release 6 are expected to be specified by SA5.
The CAMEL-SCP depicted on the figure above performs the functions of the Rel-5 Bearer Charging Function defined in TS32.200.

5.1.2 Offline service data flow-based bearer charging architecture

Figure 5.2 below presents the overall architecture for service data flow-based offline bearer charging.

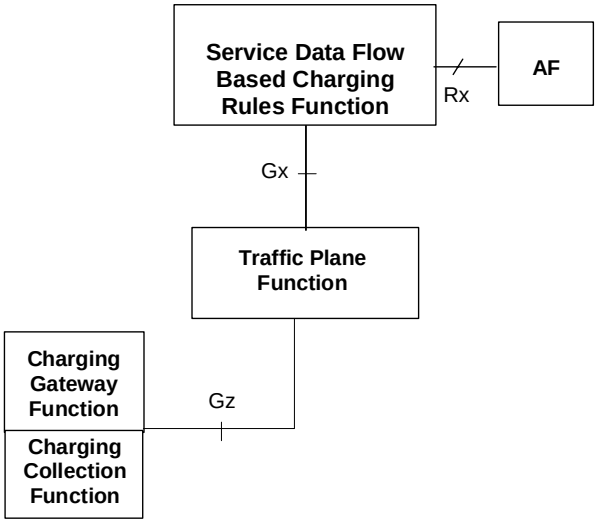

Figure 5.2 – Overall architecture for service data flow based offline bearer charging

Note: No changes are foreseen on the CCF. The relation of the new entities and interfaces described in this figure to existing entities and interfaces of the 3GPP system architecture (e.g. SGSN, GGSN) are FFS.

5.2 Functional Entities

Editor's note: This clause is planned to contain the description of new and modified functional entities.

5.2.1 Service Data Flow Based Charging Rules Function

This entity provides service data flow level charging rules. This same functionality is required for both offline and online charging. The charging rules function accesses information stored in the service data flow based charging rules data repository. An external interface to the charging rules data repository may be used for management of the charging rules within the data repository. Specification of interfaces to the data repository is out of scope of this TR.

The service data flow based charging rules function supports both static and dynamic charging rules.

The service data flow based charging rules function determines what charging rules including precedence to apply for a user.

The service data flow based charging rules function will receive information from the application function that allows the service data flow to be identified, and this information may be used within the charging rule (i.e. protocol, ip addresses and port numbers). Other information that is received by the service data flow based charging rules function (i.e. application identifier, type of stream) may be used in order to select the charging rule to be applied.

5.2.2 Service Data Flow Based Credit Control Function

The Service Data Flow-Based Credit Control Function performs online credit control functions together with the Online Charging System. It provides a new function within the release 5 Online Charging System.

The Online Charging System is specified in 3GPP TS 32.200. The Service Data Flow Credit Control Function is considered as a new functional entity for release 6 within the Online Charging System.

5.2.3 Charging Collection Function

The Charging Collection Function is specified in 3GPP TS 32.200.

The service data flow based charging requires no changes in the CCF.

5.2.4 Traffic Plane Function

The Traffic Plane Function shall be capable of differentiating user data traffic belonging to different service data flows for the purpose of collecting offline charging data and performing online credit control.

See section 4.2 for requirements of the Traffic Plane Function.

For online charging, the Traffic Plane Function shall be capable of managing the aggregation of the credit/resource used for some or all of the service data flows of a user. The Traffic Plane Function shall also be capable of managing the credit/resource of each individual service data flow of the user.

For GPRS, it shall be possible to provide these functions for different service data flows even if they are carried in the same PDP Context. The relationship of the Traffic Handling Function and the GGSN is FFS.

The Traffic Plane Function shall evaluate received packets against the service data flow filters in the order according to the precedence for the charging rules. When a packet is matched against a SDF filter, the packet matching process for that packet is complete, and the charging rule for that SDF filter shall be applied.

Editor's Note: The relationship of the Traffic Plane Function and WLAN interworking nodes (e.g. WLAN PDGw) is FFS.

5.2.5 Application Function

The application function provides information to the service data flow based charging rules function, which can then be used for selecting the appropriate charging rule, and also used for configuring some of the parameters for the charging rule. The operator configures the charging rules in the service data flow based charging rules function, and decides what data from the application function shall be used in the charging rule selection algorithm.

The Application Function shall provide information to allow the service data flow to be identified. The Application Function shall also provide some other information that may be used in the charging rule selection process.

The information provided by the application function is as follows:

- Information to identify the service data flow. This shall include the following fields:
  - Protocol
  - Source and destination IP address
  - Source and destination port number

  The application function may use wildcards to identify an aggregate set of IP flows.

- Information to support charging rule selection:
  - Application identifier
  - Type of Stream (e.g. audio, video) (optional)
  - Data rate of stream (optional)

Editor's Note: Additional information is FFS.

The "Application Identifier" is an identifier associated with each service that an AF provides for an operator (e.g. a PSS application function would have one application identifier for the PSS service).

5.3 Reference points

Editor's note: This clause is planned to contain the description of new and modified reference points.

5.3.1 New Reference points

5.3.1.1 Gx reference point

The Gx reference point enables the use of service data flow based charging rules such as counting number of packets belonging to a rate category in the IP-Connectivity Network. This functionality is required for both offline and online charging.

Editor's note(i): The functional relationship of these Gx functions and the existing Go interface has to be studied and specified. In particular, the control of dynamic service data flow based policies is available in Release 5 through service-based local policy.

Editor's note(ii): The functional relationship of the Gx function and further existing interfaces (e.g. the RADIUS-interface of the GGSN defined in TS 29.061) has to be studied and specified.

5.3.1.2 Gy reference point

The Gy reference point allows credit control for service data flow based online charging. The functionalities required across the Gy reference point use functionalities and mechanisms specified for the release 5 Ro interface.

5.3.1.3 Gz reference point

The Gz interface enables transport of service data flow based offline charging information.

For GPRS the relationship of the Gz interface and the existing Ga interface is FFS.

5.3.1.4 Rx reference point

The Rx reference point enables transport of information (e.g. dynamic media stream information) from the application function to the charging rules function. An example of such information would be filter information to identify the packet flow.

5.3.2 Existing reference points

The functionalities across the reference points described in this clause are not intended to be modified within the context of the concepts specified in this TR.

The Ro and Rf interfaces are specified for release 5 in TS 32.200 and TS 32.225.

The Ge interface is specified by TS 23.078 and TS 29.078.

6 Message Flows

Editor's note: This clause is planned to contain the description of new and modified information flows.

Annex A: Overall architectural impacts of IP flow based charging

A.1 GGSN in HPLMN

One of the underlying drivers for the IP flow charging work is to permit greater flexibility in PS domain charging, and, to control this flexibility in the HPLMN. This is a fairly fundamental change from the concepts that lead to development of the CAMEL 3 standards (which provide the capability for pre-pay charging on the SGSN) and some aspects of the IMS architecture (eg P-CSCF and I-CSCF).

This movement towards charging in the "GGSN arena" rather than "charging at the SGSN" leads to a few questions:

a) is all the information that the SGSN places on the S-CDR available at the GGSN? If not, what is missing, is it important, and, can GTP be upgraded to provide it to the GGSN?

b) when this information is passed to the GGSN, can it then be made available as extra Radius parameters?

c) does this information need to be sent on the Gx and/or Gy and/or Gz interfaces?

A.2 Comparison of S-CDR and G-CDR fields

The following fields are present in the S-CDR but absent from the G-CDR

Served IMEI

MS Network Capability

LAC/RAC/CI at "record opening"

Access Point Name Operator Identifier

System Type

CAMEL information

RNC unsent data volume

Further study is needed to analyse these parameters.

Annex B: Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2002-11					First draft		0.1.0
2003-02					Output version from SA2#29. Changes proposed in S2-030408rev2, S2-030409 and S2-030410are implemented. Primarily architecture requirements and descriptive text added.	0.1.0	0.2.0
2003-03					Updated with approved contributions from SA2#30 S2-030947, S2-030951, S2-030952, S2-030953r3, S2-030954, and S2-030851 Some editorial fixes (formats, blanks lines, etc)	0.2.0	0.3.0
2003-04					Updated with approved contributions from SA2#31	0.3.0	0.4.0

					S2-031523, S2-031524, S2-031525, S2-031526, S2-031608		
2003-04					Updated with minor editorial changes	0.4.0	0.4.1
2003-05					Updated with approved contributions from SA2#32 S2-032145, S2-032195 (was S2-032140 rev 1)	0.4.1	0.5.0
2003-07					Updated with approved contributions from SA2#33 S2-032581, S2-032715, S2-032716, S2-032717 Term “service flow” changed to “service data flow” throughout. Term “service filter” changed to “service data flow filter” throughout.	0.5.0	0.6.0
2003-07					Addditional editorial changes from “service flow” to “service data flow”	0.6.0	0.6.1
2003-08					Updated with approved contributions from SA2#34 (Brussels): S2-032989, S2-033155, S2-033156, S2-033157, S2-033158, S2-033159, S2-033257 (S2-033160 rev 1), S2-033161 Editorial fixes: - section 5.2.1 merged into what was 5.2.3. Sections 5.2.2 through 5.2.6 then renumbered to one lower eg 5.2.2 -> 5.2.1. - Introduced TPF in abbreviations - Fixing some paragraphs to use correct style	0.6.1	0.7.0
2003-09					First presentation for information to SA #21 plenary	0.7.0	1.0.0