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### **Presentation of Technical Specification to TSG SA**

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**Abstract of document:**

Work done against the WIDs contained in [SP-030047](#) (Charging Management: Work Item ID: CH) and in SP-030048 (Charging Management for Bearer Level: Work Item ID: CH-BC).

This is a Technical Specification on the Packet Switched (PS) domain charging. The TS specifies the GPRS Offline and Online Charging functions based on the functional stage 2 description of the GPRS in 3GPP TS 23.060. This charging description includes the GPRS specific charging architecture and scenarios. It specifies the structure and content of the CDRs for offline charging as well as the charging events for online charging.

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**Changes since last presentation to TSG-SA:**

- New

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**Outstanding Issues:**

- Inclusion of Rel-6 functionality.
- alignment with SA5's 32.298 (Charging Data Record (CDR) encoding rules description)

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**Contentious Issues:**

- None.

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*Technical Specification*

**3rd Generation Partnership Project;  
Technical Specification Group Services and System Aspects;  
Telecommunication management;  
Charging management;  
Packet Switched (PS) domain charging  
(Release 6)**



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Keywords

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UMTS, charging, accounting, management,  
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## Foreword

This Technical Specification has been produced by the 3<sup>rd</sup> 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

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- x the first digit:
  - 1 presented to TSG for information;
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- 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.

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# 1 Scope

The present document is part of a series of documents specifying charging functionality and charging management in GSM/UMTS networks. The GSM/UMTS core network charging architecture and principles are specified in 3GPP TS 32.240 [1], which provides an umbrella for other charging management documents that specify:

- the content of the CDRs per domain and subsystem (offline charging);
- the content of real-time charging messages per domain / subsystem (online charging);
- the functionality of online and offline charging for those domains and subsystems;
- the interfaces that are used in the charging framework to transfer the charging information (i.e. CDRs or charging events).

The complete document structure for these TSs is defined in 3GPP TS 32.240 [1].

The present document specifies the GPRS Offline and Online Charging functions based on the functional stage 2 description of the GPRS in 3GPP TS 23.060 [61]. This charging description includes the GPRS specific charging architecture and scenarios. It specifies the structure and content of the CDRs for offline charging as well as the charging events for online charging. The parameters, abstract syntax and encoding rules for the GPRS-CDR types used for GPRS offline charging are specified in 3GPP TS 32.298 [41]. The 3GPP Diameter application that is used for GPRS online charging is specified in 3GPP TS 32.299 [40]. The mechanisms used to transfer the CDRs from the generating network node (i.e. the GPRS SGSN and GGSN) to the collecting node in the operator's billing domain (e.g. the billing system or a mediation device) are specified in 3GPP TS 32.297 [42].

Note that the CAMEL based prepaid function and protocol is specified in 3GPP TS 23.078 [66] and 3GPP TS 29.078 [62] respectively. CAMEL entities and functions are outside the scope of the present document.

All references, abbreviations, definitions, descriptions, principles and requirements, used in the present document, that are common across 3GPP TSs, are defined in 3GPP TR 21.905 [50]. Those that are common across charging management in GSM/UMTS domains or subsystems are provided in the umbrella document 3GPP TS 32.240 [1] and are copied into clause 3 of the present document for ease of reading. Finally, those items that are specific to the present document are defined exclusively in the present document.

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# 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*.

**a) The 3GPP charging specifications**

- |         |   |
|---------|---|
| [1]     | 3GPP TS 32.240: "Telecommunication management; Charging management; Charging architecture and principles".  |
| [2]-[9] | Void.   |
| [10]    | 3GPP TS 32.250: "Telecommunication management; Charging management; Circuit Switched (CS) domain charging". |
| [11]    | Void.   |

- [12] 3GPP TS 32.252: "Telecommunication management; Charging management; Wireless Local Area Network (WLAN) charging".
- [13]-[19] Void.
- [20] 3GPP TS 32.260: "Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging".
- [21]-[29] Void.
- [30] 3GPP TS 32.270: "Telecommunication management; Charging management; Multimedia Messaging Service (MMS) charging".
- [31] 3GPP TS 32.271: "Telecommunication management; Charging management; Location Services (LCS) charging".
- [32]-[39] Void.
- [40] 3GPP TS 32.299: "Telecommunication management; Charging management; Diameter charging application".
- [41] 3GPP TS 32.298: "Telecommunication management; Charging management; Charging Data Record (CDR) encoding rules description".
- [42] 3GPP TS 32.297: "Telecommunication management; Charging management; Charging Data Records (CDR) file format and transfer".
- [43]-[49] Void.
- b) Common 3GPP specifications**
- [50] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [51] 3GPP TS 22.101: "Service aspects; Service principles".
- [52] 3GPP TS 22.115 "Service aspects; Charging and billing".
- [53]-[59] Void.
- c) other Domain and Service specific 3GPP / ETSI specifications**
- [60] 3GPP TS 22.060: "General Packet Radio Service (GPRS); Service description; Stage 1".
- [61] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".
- [62] 3GPP TS 29.078: "Customized Applications for Mobile network Enhanced Logic (CAMEL); CAMEL Application Part (CAP) specification".
- [63] 3GPP TS 49.031: "Location Services (LCS); Base Station System Application Part LCS extension (BSSAP-LE)".
- [64] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".
- [65] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp interface".
- [66] 3GPP TS 23.078: "Customized Applications for Mobile network Enhanced Logic (CAMEL); Stage 2".
- [67] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core network protocols; Stage 3".
- [68] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS)".
- [69] 3GPP TS 32.215: "Telecommunication management; Charging management; Charging data description for the Packet Switched (PS) domain (Release 5)". Not propagated beyond Release 5.

## 3 Definitions, abbreviations and symbols

### 3.1 Definitions

For the purposes of the present document, the terms and definitions defined in 3GPP TR 21.905 [50], 3GPP TS 32.240 [1] and 3GPP TS 22.060 [60], and the following apply:

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

**Packet Switched domain:** domain within UMTS and GSM in which data is transferred in packet mode

**2G-/3G-:** the terms 2G and 3G, and the prefixes 2G- and 3G- refer to functionality that supports only GSM or UMTS, respectively, e.g. 2G-SGSN refers only to the GSM functionality of an SGSN

When the term/prefix is omitted, reference is made independently from the GSM or UMTS functionality.

**Charging Data Record (CDR):** record generated by a network element for the purpose of billing a subscriber for the provided service

It includes fields identifying the user, the session and the network elements as well as information on the network resources and services used to support a subscriber session. In the traditional circuit domain, CDR has been used to denote "Call Detail Record", which is subsumed by "Charging Data Record" hereafter.

**CDR field Categories:** the CDR fields are defined in the present document. They are divided into the following categories:

- **Mandatory:** field that shall be present in the CDR.
- **Conditional:** field that shall be present in a CDR if certain conditions are met.
- **Operator Provisionable: Mandatory:** A field that operators have provisioned to be included in the CDR for all conditions.
- **Operator Provisionable: Conditional:** A field that operators have provisioned to be included in the CDR if certain conditions are met.

**GTP':** GPRS protocol used for CDR transport. It is derived from GTP with enhancements to improve transport reliability necessary for CDRs.

NOTE: This protocol is not used for tunnelling.

**Fully qualified Partial CDR (FQPC):** partial CDR that contains a complete set of the fields specified in the present document

This includes all the mandatory and conditional fields as well as those fields that the PLMN operator has provisioned to be included in the CDR. The first Partial CDR shall be a Fully qualified Partial CDR.

**partial CDR:** CDR that provides information on part of a subscriber session

A long session may be covered by several partial CDRs. Two formats are considered for Partial CDRs. One that contains all of the necessary fields; the second has a reduced format.

**Reduced Partial CDR (RPC):** partial CDRs that only provide mandatory fields and information regarding changes in the session parameters relative to the previous CDR

EXAMPLE: Location information is not repeated in these CDRs if the subscriber did not change its location.

### 3.2 Abbreviations

For the purposes of the present document, the abbreviations defined in 3GPP TR 21.905 [50] and the following apply:

APN	Access Point Name
BD	Billing Domain
BMD	Billing Mediation Device
BS	Billing System
CAMEL	Customized Applications for Mobile network Enhanced Logic



CDR Charging Data Record

NOTE 1: Replaces the previous definition of Call Detail Record.

CDCF Charging Data Collection Function  
 CDGF Charging Data Generation Function  
 CG Charging Gateway  
 CGF Charging Gateway Function  
 CI Cell Identity  
 CS Circuit Switched  
 CSE CAMEL Service Environment  
 DRP Data Record Packet  
 EM Element Management  
 FCI Furnish Charging Information  
 FQPC Fully Qualified Partial CDR  
 G-CDR GGSN generated - CDR  
 GGSN Gateway GPRS Support Node  
 GPRS General Packet Radio Service  
 GSN GPRS Support Node (either SGSN or GGSN)  
 GTP GPRS Tunnelling Protocol  
 GTP' The GPRS protocol used for CDR transport. It is derived from GTP with enhancements to improve transport reliability necessary for CDRs.

NOTE 2: This protocol is not used for tunnelling.

IE Information Element  
 IHOOSS:OSP Internet Hosted Octet Stream Service: Octet Stream Protocol  
 IMEI International Mobile Equipment Identity  
 IMSI International Mobile Subscriber Identity  
 IP Internet Protocol  
 IPv4 Internet Protocol version 4  
 IPv6 Internet Protocol version 6  
 LAC Location Area Code  
 LR Location Request  
 M-CDR Mobility management generated - Charging Data Record  
 MCC Mobile Country Code (part of IMSI)  
 ME Mobile Equipment  
 MLC Mobile Location Center  
 MNC Mobile Network Code (part of IMSI)  
 MO-LR Mobile Originated - Location Request  
 MS Mobile Station  
 MSISDN Mobile Station ISDN number  
 MT-LR Mobile Terminated - Location Request  
 NA-ESRD North American - Emergency Service Routing Digits  
 NA-ESRK North American - Emergency Service Routing Key  
 NE Network Element  
 NI Network Identifier (part of the APN)  
 NI-LR Network Induced - Location Request  
 OI Operator Identifier (part of the APN)  
 PDP Packet Data Protocol (e.g. IP)  
 PDU Packet Data Unit  
 PLMN Public Land Mobile Network  
 PPP Point-to-Point Protocol  
 PS Packet Switched  
 PT Protocol Type (Field in GTP' header)  
 RAB Radio Access Bearer  
 RAC Routing Area Code  
 RPC Reduced Partial CDR  
 S-CDR SGSN (PDP context) generated - CDR  
 SAC Service Area Code  
 SGSN Serving GPRS Support Node  
 S-SMO-CDR SGSN delivered Short message Mobile Originated - CDR  
 S-SMT-CDR SGSN delivered Short message Mobile Terminated - CDR

TID	Tunnel Identifier
TLV	Type, Length, Value (GTP header format)
TV	Type, Value
UMTS	Universal Mobile Telecommunications System
URA	UTRAN Registration Area
USIM	Universal Subscriber Identity Module
UTRAN	UMTS Terrestrial Radio Access Network

### 3.3 Symbols

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

Bp	Reference point for the CDR file transfer e for the PS domain to the BD, i.e. between a CGF and a BD
Ga	Interface between a GSN transmitting CDRs (i.e. GGSN or SGSN) and a CDR receiving functionality (CGF)

## 4 Architecture considerations

This clause describes the functional entities involved in the packet switched charging network architecture. The present document deals specifically with the Ga interface.

It should be noted that the architecture diagram defines only logical functional entities. The physical implementation of these functional entities is vendor specific and outside the scope of the present document.

The following nodes may generate accounting metrics sets for PS domain CDRs:

- the SGSN, to record a user's access to PLMN resources, mobility management activities, and SMS usage;
- the GGSN, to record a user's access to external networks.

Each GSN has an integrated CDGF. If the CGF is also integrated in the GSN, then the open Ga interface does not exist, there is only an internal interface between the CDGF and the CGF. The relationship between GSN/CDGF and CGF is 1:1. If the CGF is external to the GSN, then the CDGF forwards the usage data records to the CGF across the Ga interface. In this case, the relationship between GSN/CDGF and CGF is m:n, with  $m \geq n$ .

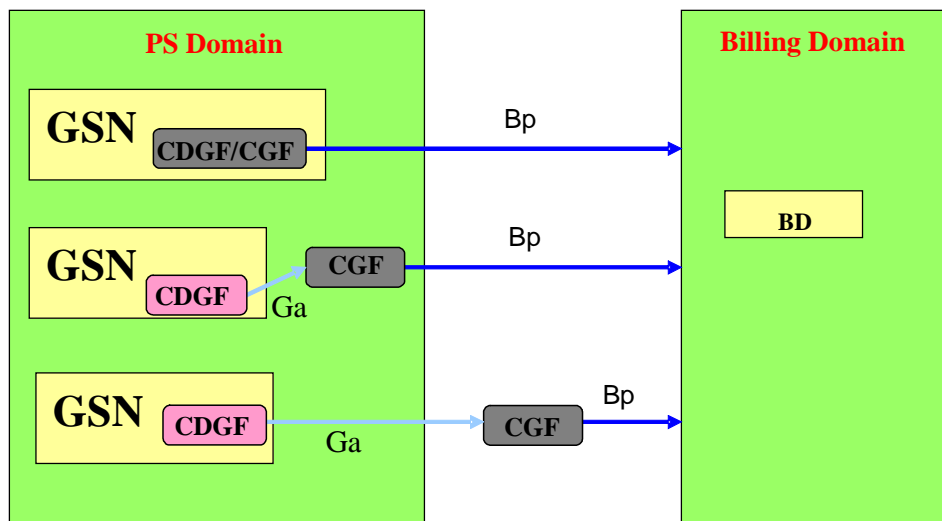


Figure 4.1: PS domain charging architecture

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## 5 PS domain charging scenarios

### 5.1 PS charging principles

#### 5.1.1 Requirements

The following are high-level requirements specific to the packet domain, derived from the requirements in 3GPP TS 22.115 [52].

- 1) Every PDP context shall be assigned a unique identity number for billing purposes. (i.e. the charging id).
- 2) Data volumes on both the uplink and downlink direction shall be counted separately. The data volumes shall reflect the data as delivered to and from the user.
- 3) The charging mechanisms shall provide the duration of the PDP context with date and time information.
- 4) The UMTS operator may define a subset of the charging information specified by Packet-Switched domain charging standards. This means that it shall be possible to configure the SGSN and GGSN for the CDR information generated.
- 5) The GSNs shall be capable of handling the charging characteristics.
- 6) SGSN shall support charging of CAMEL services.

#### 5.1.2 Charging information

Charging information in the PS domain network is collected for each MS by the SGSNs and GGSNs, which are serving that MS. The information that the operator uses to generate an invoice to the subscriber is operator-specific. Billing aspects, e.g. a regular fee for a fixed period, are outside the scope of the present document.

The SGSN collects charging information for each MS related with the radio network usage, while the GGSN collects charging information for each MS related with the external data network usage. Both GSNs also collect charging information on usage of the PS domain network resources.

The GSNs shall collect the following charging information:

1. usage of the radio interface: the charging information shall describe the amount of data transmitted in MO and MT directions categorized with QoS and user protocols;
2. usage duration: duration of PDP context is counted as the time interval from PDP Context activation to PDP Context Deactivation;
3. usage of the general PS domain resources: the charging information shall describe the usage of other PS domain-related resources and the MSs PS domain network activity (e.g. mobility management);
4. destination and source: the charging information shall provide the actual source addresses used by the subscriber for the PDP context. The charging information shall describe the destination addresses with a level of accuracy as determined by the Access Point Name (APN);
5. usage of the external data networks: the charging information shall describe the amount of data sent and received to and from the external data network.

External networks can be identified by the Access Point Name (APN).

6. location of MS: HPLMN, VPLMN, plus optional higher-accuracy location information. The highest accuracy location information available in a GGSN is a GGSN address.

## 5.2 PS offline charging scenarios

In order to provide the data required for the management activities outlined in the previous subclauses (billing, accounting, statistics etc.), the SGSN and GGSN shall be able to produce a CDRs for each of the following:

- Charging Data in the SGSN (S-CDR);
- Charging Data in the GGSN (G-CDR);
- Mobile Station Mobility Management Data in SGSN (M-CDR);
- SMS Mobile Originated Data in SGSN (S-SMO-CDR);
- SMS Mobile Terminated Data in SGSN (S-SMT-CDR).

The contents and purpose of each of these records are described in the following subclauses. A detailed formal description of the data defined in the present document is to be found in 3GPP TS 32.215 [69].

### 5.2.1 Charging Data Record generation

The S-CDR, M-CDR G-CDR, S-SMO-CDR and S-SMT-CDR are generated by the SGSN and GGSN to collect charging information such that they may be subsequently transferred to the Charging Gateway Function (CGF).

The generation of CDRs, partial CDRs and coherent trigger conditions (e.g. "maximum number of charging conditions changes") depend on the charging characteristics profile data, which is determined via the charging characteristics profile index. The mechanism of conveying the charging characteristics data item (HLR -> SGSN -> GGSN) and determining the appropriate profile data by the GSNs is specified in 3GPP TS 32.215 [69]. In the GSNs it shall be possible to activate and deactivate CDR generation for each Charging Characteristics profile. If CDR generation is activated, it shall be possible to define separate trigger conditions values per Charging Characteristics profile for the following triggers:

- data volume limit;
- time (duration limit);
- maximum number of charging conditions changes (QoS change, Tariff Time change).

The following subclauses describe the trigger conditions for collection of charging information and CDR generation by the SGSN/GGSN.

#### 5.2.1.1 Triggers for S-CDR charging information collection

An S-CDR is used to collect charging information related to the PDP context data information for a mobile in the SGSN.

If according to the Charging Characteristics profile data, CDR generation is activated an S-CDR shall be opened at PDP context activation. The record includes details such as Record Type, Served IMSI, Sequence Number etc. Not all of the charging information to be collected is static, and other charging information is directly depending on dynamic Packet-Switched service usage.

The subsequent subclauses identify the conditions for adding information to, and closing the S-CDR for generation towards the CGF.

##### 5.2.1.1.1 Triggers for S-CDR Charging Information Addition

The "List of Traffic Volumes" attribute of the S-CDR consists of a set of containers, which are added when specific trigger conditions are met, and identify the volume count separated for uplink and downlink traffic on encountering that trigger condition. Table 5.1 identifies which conditions are supported to trigger S-CDR charging information addition.

**Table 5.1: Triggers for S-CDR charging information addition**

Trigger Conditions	Description/Behaviour
QoS Change	A change in the QoS shall result in a "List of Traffic Data Volumes" container being added to the CDR.
Tariff Time Change	On reaching the Tariff Time Change a "List of Traffic Data Volumes " container shall be added to the CDR.
CDR Closure	A list of "List of Traffic Data Volumes" container shall be added to the S-CDR.

#### 5.2.1.1.2 Triggers for S-CDR closure

The S-CDR shall be closed on encountering some trigger conditions. Table 5.2 identifies which conditions are supported to permit closure of the S-CDR.

**Table 5.2: Triggers for S-CDR closure**

Closure Conditions	Description/Behaviour
End of PDP Context within the SGSN	Deactivation of the PDP context in the SGSN shall result in the CDR being closed. The trigger condition covers: <ul style="list-style-type: none"> <li>- termination of PDP context;</li> <li>- SGSN change (inter-SGSN routing area update including intersystem change);</li> <li>- any abnormal release.</li> </ul>
Partial Record Reason	O&M reasons permit the closure of the CDR for internal reasons. The trigger condition covers: <ul style="list-style-type: none"> <li>- data volume limit;</li> <li>- time (duration) limit;</li> <li>- maximum number of charging condition changes;</li> <li>- management intervention;</li> <li>- Intra-SGSN intersystem change (change of radio interface from GSM to UMTS or vice versa).</li> </ul>

The Partial Record generation trigger thresholds are those associated with the Charging Characteristics profile data.

The Partial Record generation trigger thresholds are GSN configuration parameters defined per charging characteristics profile by the operator through O&M means (refer to 3GPP TS 32.215 [69]).

In the event that the S-CDR is closed and the PDP context remains active, a further S-CDR shall be opened with an incremented Sequence Number in the SGSN.

#### 5.2.1.2 Triggers for M-CDR charging information collection

An M-CDR is used to collect charging information related to the mobility management of a mobile in the SGSN.

An M-CDR shall be opened for each mobile upon GPRS Attach, and record details such as Record Type, Served IMSI, Sequence Number etc. Not all of the charging information to be collected is static, and other charging information is directly dependent on the mobility of the MS as provided by the Radio Access Network (RAN). Subsequent partial records may be opened if the M-CDR is closed and the MS is still attached to the network.

The subsequent subclasses identify the conditions for adding information to, and closing of the M-CDR for generation towards the CGF.

##### 5.2.1.2.1 Triggers for M-CDR charging information addition

The "Change of Location" attribute of the M-CDR consists of a set of containers, which are added when specific trigger conditions are met, and identify the time stamped routing area on encountering that trigger condition. Table 5.3 identifies which conditions are supported to trigger M-CDR charging information addition.

**Table 5.3: Triggers for M-CDR charging information addition**

Trigger Conditions	Description/Behaviour
Mobility Change	A change in the Routing Area shall result in a "Change of Location" container being added to the M-CDR.

### 5.2.1.2.2 Triggers for M-CDR closure

The M-CDR shall be closed on encountering some trigger conditions. Table 5.4 identifies which conditions are supported to permit closures of the M-CDR.

**Table 5.4: Triggers for M-CDR closure**

Closure Conditions	Description/Behaviour
End of MM Context within SGSN	Deactivation of the MM context in the SGSN shall result in the CDR being closed. The trigger condition covers: <ul style="list-style-type: none"> <li>- SGSN change (inter-SGSN routing area update including intersystem change);</li> <li>- GPRS detach;</li> <li>- any abnormal release.</li> </ul>
Partial Record Reason	O&M reasons permit the closure of the CDR for internal reasons. The trigger condition covers: <ul style="list-style-type: none"> <li>- time (duration) limit;</li> <li>- maximum number of mobility changes; and</li> <li>- Management intervention;</li> <li>- Intra-SGSN intersystem change (change of radio interface from GSM to UMTS or vice versa).</li> </ul>

In the event that the M-CDR is closed and the mobile is still known to the SGSN, a further logical M-CDR shall be opened with an incremented Sequence Number in the SGSN.

### 5.2.1.3 Triggers for G-CDR charging information collection

A G-CDR is used to collect charging information related to the packet data information for a mobile in the GGSN.

If, according to the Charging Characteristics profile data, CDR generation is activated a G-CDR shall be opened at PDP context activation. The record includes details such as Record Type, Served IMSI, Sequence Number etc. Not all of the charging information to be collected is static, and other charging information is directly dependent on dynamic Packet-Switched service usage.

The "List of Traffic Data Volumes" attribute of the G-CDR consists of a set of containers, which are added following specific trigger conditions, and identify the volume count on encountering that trigger condition. The trigger conditions are as for the S-CDR (see clause 5.2.2.1 on "Triggers for S-CDR Charging Information Collection") with exception that an SGSN change will not close the G-CDR. Subsequent partial records may be opened if the G-CDR is closed and the PDP context is still active.

The Partial Record generation trigger thresholds are those associated with to the determined Charging Characteristics profile data. The Charging Characteristics profile data is determined as defined in 3GPP TS 32.215 [69].

The Partial Record generation trigger thresholds are GSN configuration parameters defined per charging characteristics profile by the operator through O&M means (refer to 3GPP TS 32.215 [69]).

In the event that the G-CDR is closed and the PDP context remains active, a further G-CDR is opened with an incremented Sequence Number in the GGSN.

### 5.2.1.4 Triggers for LCS-CDR charging information collection

[editor's note: to be added]

## 5.2.2 Charging scenarios

This clause contains a number of example scenarios illustrating the purpose and practical usage of the various types of records defined in the previous subclauses. These examples are by no means exhaustive.

For the purpose of these examples the following assumptions have been made:

- the CDRs are sent to a CGF;
- the generation of all of the CDR types has been enabled.

The following conventions have been used for the figures 5.1 to 5.4 below:

- 1) Network connections and signalling transactions are illustrated by means of solid lines and referenced by number e.g. (1).
- 2) Operation & Maintenance actions, such as the transfer of CDRs, are represented by means of dotted lines and referenced by letter e.g. (A).

NOTE: Visiting scenarios are excluded.

### 5.2.2.1 Mobile to PDN Context

Figure 5.1 illustrates a simple outgoing Packet-Switched context from a PLMN Packet-Switched service subscriber "A" to a mainframe "B" via a PDN (1).

The respective PDP context is activated in the SGSN and GGSN and PDP PDUs are routed in MO and MT direction. The SGSN shall create an S-CDR and the GGSN shall create a G-CDR for subscriber "A".

The records generated are subsequently transferred to the CGF (A). The CGF transfers the CDRs to the BS.

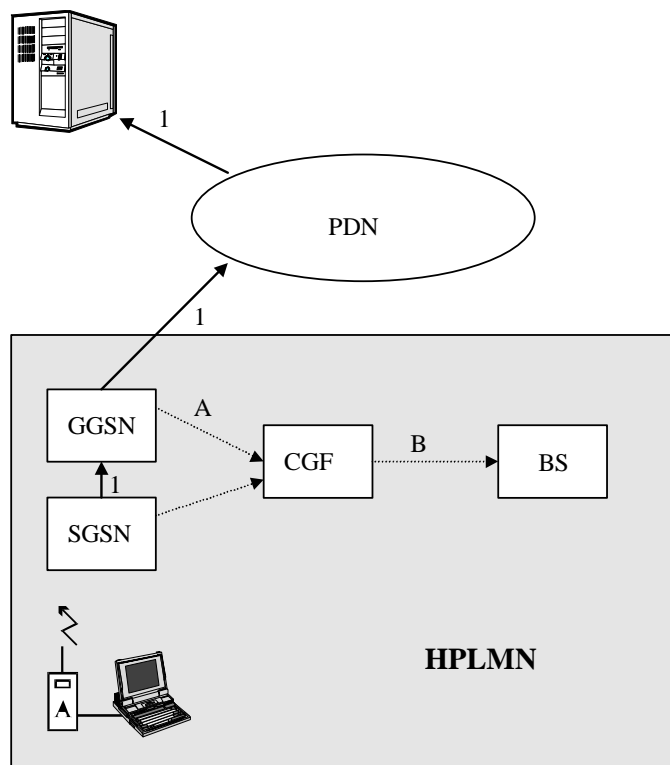


Figure 5.1: Mobile to PDN context

### 5.2.2.2 Mobile to mobile context

Figure 5.2 illustrates a simple Packet-Switched mobile-to-mobile context within the same HPLMN.

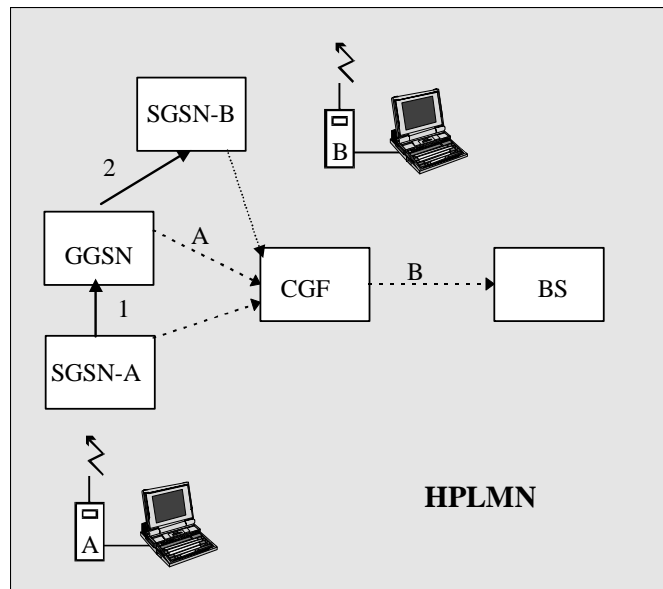
The respective A-party related PDP context is activated in the SGSN-A and the GGSN (1).

After the location of subscriber "B" is determined, the B party related PDP context is activated (2) in the SGSN-B and the GGSN and PDP PDUs are routed in MO and MT direction. The SGSN-A shall create an S-CDR and the GGSN shall create a G-CDR for subscriber A, the SGSN-B shall create an S-CDR and the GGSN shall create a G-CDR for subscriber "B".

If subscriber "A" and subscriber "B" use the same GGSN, both G-CDRs are produced at that GGSN.

If session leg (2) requires a PDP context activation the respective PDP records will contain a network initiated PDP context activation-flag.

The records generated are subsequently transferred to the CGF (A). The CGF transfers the CDRs to the BS.



**Figure 5.2: Packet-switched mobile to mobile context**

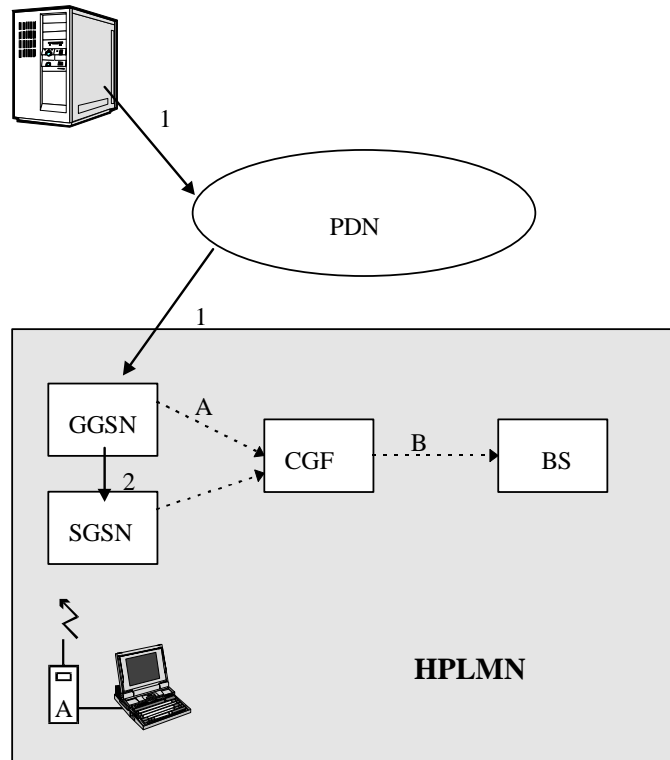
### 5.2.2.3 PDN to mobile context

Figure 5.3 illustrates a simple incoming Packet-Switched domain context from a mainframe "A" to mobile subscriber "B" via a PDN (1). After the location of subscriber "B" is determined, the PDP context is activated (2).

The GGSN receiving the PDUs shall generate a G-CDR whereas the SGSN currently serving subscriber "B" creates an S-CDR. These records contain a flag that the PDP context is activated due to network request.

The records generated are subsequently transferred to the CGF (A). The CGF transfers the CDRs to the BS.





**Figure 5.3: PDN to mobile context**

#### 5.2.2.4 Mobile to PDN context while roaming, GGSN in HPLMN

Figure 5.4 illustrates an outgoing Packet-Switched context from a roaming mobile subscriber "A" to mainframe "B" via Boarder Gateway, inter PLMN backbone and GGSN of the HPLMN (1).

The respective a-party related PDP context is activated in the SGSN and GGSN and PDUs are routed in MO and MT direction. The SGSN shall create an S-CDR (VPLMN) and a G-CDR is generated at the used GGSN (HPLMN) for subscriber "A". From the GGSN the packets are sent via the PDN to the mainframe "B".

The records generated in the HPLMN and the VPLMN are subsequently transferred to the CGFs (A). The CGFs transfer the CDRs to the BS. (B)

Later on the records created in the VPLMN are transferred from the BS to the BS of the HPLMN via TAP procedure (C).

Note that this scenario is an example, representing only one case of roaming CDR generation.

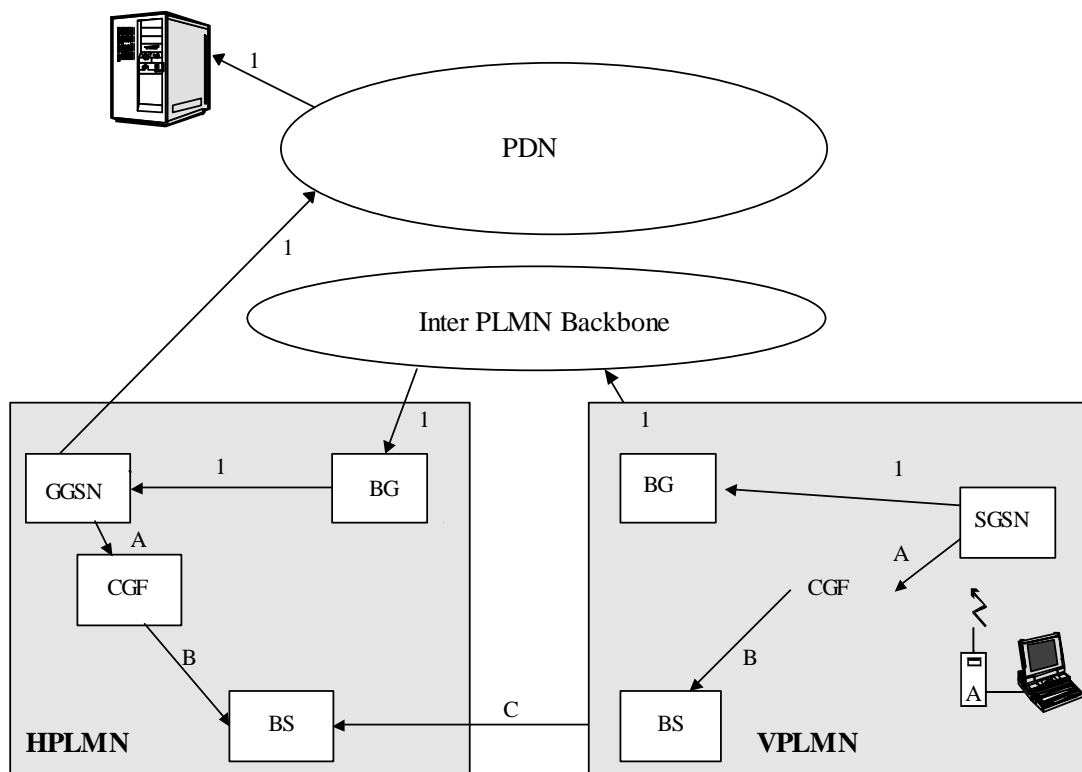


Figure 5.4: Mobile to PDN Context whilst roaming via BG

### 5.2.3 Relationship between Ga and Bp CDRs

CDRs are comprised of the parameters as defined in clause 6. The size of the CDRs could be optionally reduced by allowing a reduced format for *Partial CDRs* (see definitions in 3GPP TS 32.240 [1]), implying that some information can be eliminated rather than repeated in all the partial CDRs. This means that only changes from one CDR to the next, in addition to mandatory information, is reported. All the missing information can be reconstructed from fields in previous partial CDRs.

**EXAMPLE:** If a subscriber did not change location, the Reduced Partial CDR would not include any location information.

Therefore, two formats are considered for Partial CDRs:

- a *Fully Qualified Partial CDR* that contains the Complete CDR Fields, and
- a *Reduced Partial CDR* that contains all the Mandatory fields (**M**) and ONLY the changes that occurred in any other field relative to the previous Partial CDR.

The first CDR generated when a session is opened shall be a Fully qualified Partial CDR. Subsequent partial CDRs may be *Reduced Partial CDRs*.

Thus, the convention is that when any non-mandatory field is missing from a Reduced Partial CDR, it should be interpreted that the same field as in the previous partial CDR could be used. Only Mandatory (**M**) and changed fields **MUST** always be included.

The GSNs and the CGF from all vendors that comply with the present document shall always be able to generate or receive Fully Qualified Partial CDRs. Generation and reception of Reduced Partial CDRs on the Ga interface is optional. However, if Reduced Partial CDRs are transmitted on the Ga interface they must comply with the rules specified in this clause.

If the GSNs are generating Reduced Partial CDRs on the Ga interface, the CGF must be able to convert the CDRs into Fully qualified Partial CDRs. However, if the BS can support Reduced Partial CDRs, no conversion to the fully-qualified partial CDR format is required.

The possible charging configurations that can be supported on both the Ga and the Bp interfaces are illustrated in figure 5.5.

Configuration a) is the default arrangement that **MUST** be supported by all systems. The other configurations are optional that may be supported **IN ADDITION** to configuration a).

Configuration b) illustrates the case where the CGF is converting Reduced to Fully Qualified Partial CDRs.

Configuration c) depicts the case where Reduced Partial CDRs can be received in the billing domain and no conversion is needed.

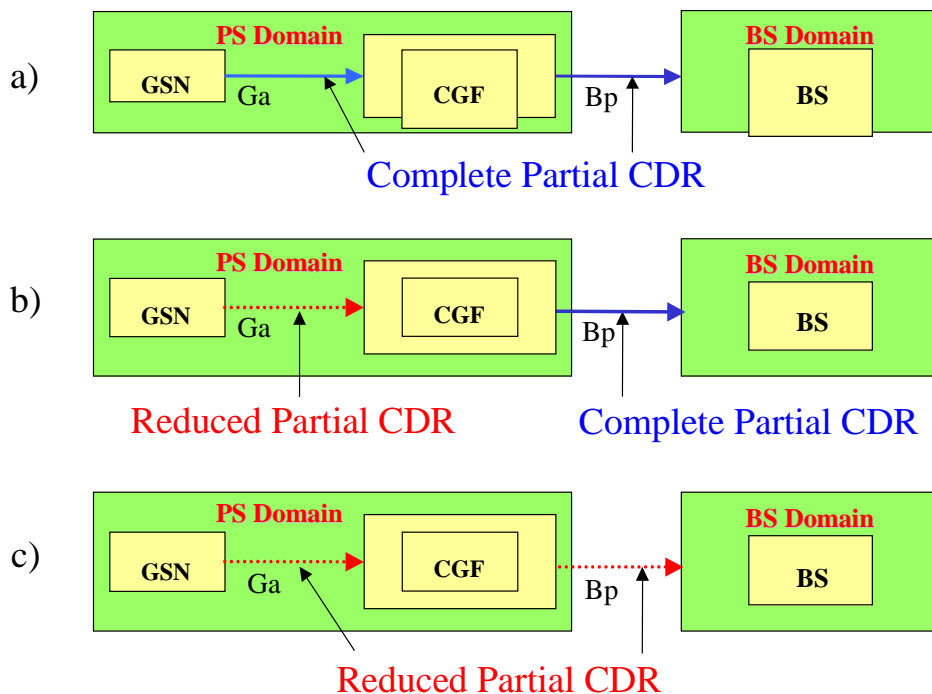


Figure 5.5: Possible Configurations of Ga and Bp CDR Formats.

### 5.3 PS Online charging scenarios

[Editor's note: This is a placeholder for future DIAMETER based online charging]

## 6 Definition of charging information

### 6.1 Data description for PS offline charging

The tables in the subsequent parts of clause x specify the Mandatory (M), Conditional (C) and Operator optional ( $O_M$  or  $O_C$ ) designations. The category of a CDR parameter can have one of two primary values:

- M** This parameter is **Mandatory** and shall always be present in the CDR.
- C** This parameter shall be present in the CDR only when certain **Conditions** are met. These **Conditions** are specified as part of the parameter definition.

All other parameters are designated as Operator (**O**) provisionable, which replaced the "Optional" category, specified in earlier releases. Using network management functions or specific tools provided by an equipment vendor, operators may choose if they wish to include or omit the parameter from the CDR. Once omitted, this parameter is not generated in a CDR. To avoid any potential ambiguity, a CDR generating element **MUST** be able to provide all these parameters. Only an operator can choose whether or not these parameters should be generated in their system.

Those parameters that the operator wishes to be present are further divided into a mandatory and conditional categories:

- O<sub>M</sub>** This is a parameter that, if provisioned by the operator to be present, shall always be included in the CDRs. In other words, an O<sub>M</sub> parameter that is provisioned to be present is a mandatory parameter.
- O<sub>C</sub>** This is a parameter that, if provisioned by the operator to be present, shall be included in the CDRs when the required conditions are met. In other words, an O<sub>C</sub> parameter that is configured to be present is a conditional parameter.

The following tables provide a brief description of each CDR parameter. Full definitions of the parameters, sorted by the parameter name in alphabetical order, are provided in 3GPP TS 32.298 [41].

### 6.1.1 Charging data in SGSN (S-CDR)

If the collection of CDR data is enabled then the SGSN data specified in table 6.1 shall be available for each PDP context.

**Table 6.1: SGSN PDP context data (S-CDR)**

Field	Category	Description
Record Type	M	SGSN PDP context record.
Network Initiated PDP Context	O <sub>C</sub>	A flag that is present if this is a network initiated PDP context.
Served IMSI	M	IMSI of the served party.
Served IMEI	O <sub>C</sub>	The IMEI of the ME, if available.
SGSN Address	O <sub>M</sub>	The IP address of the current SGSN.
MS Network Capability	O <sub>M</sub>	The mobile station Network Capability.
Routing Area Code (RAC)	O <sub>M</sub>	RAC at the time of "Record Opening Time".
Location Area Code (LAC)	O <sub>M</sub>	LAC at the time of "Record Opening Time".
Cell Identifier	O <sub>M</sub>	Cell identity for GSM or Service Area Code (SAC) for UMTS at the time of "Record Opening Time".
Charging ID	M	PDP context identifier used to identify this PDP context in different records created by GSNs.
GGSN Address Used	M	The control plane IP address of the GGSN currently used. The GGSN address is always the same for an activated PDP context.
Access Point Name Network Identifier	O <sub>M</sub>	The logical name of the connected access point to the external packet data network (network identifier part of APN).
PDP Type	O <sub>M</sub>	PDP type, i.e. IP, PPP, IHOSS:OSP.
Served PDP Address	O <sub>C</sub>	PDP address of the served IMSI, i.e. IPv4 or IPv6. This parameter shall be present except when both the PDP type is PPP and dynamic PDP address assignment is used.
List of Traffic Data Volumes	O <sub>M</sub>	A list of changes in charging conditions for this PDP context, each change is time stamped. Charging conditions are used to categorize traffic volumes, such as per QoS/tariff period. Initial and subsequently changed QoS and corresponding data volumes are listed.
Record Opening Time	M	Time stamp when PDP context is activated in this SGSN or record opening time on subsequent partial records.
Duration	M	Duration of this record in the SGSN.
SGSN Change	C	Present if this is first record after SGSN change.
Cause for Record Closing	M	The reason for closure of the record from this SGSN.
Diagnostics	O <sub>M</sub>	A more detailed reason for the release of the connection.
Record Sequence Number	C	Partial record sequence number in this SGSN. Only present in case of partial records.

Field	Category	Description
Node ID	O <sub>M</sub>	Name of the recording entity.
Record Extensions	O <sub>C</sub>	A set of network operator/manufacture specific extensions to the record. Conditioned upon the existence of an extension.
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
APN Selection Mode	O <sub>M</sub>	An index indicating how the APN was selected.
Access Point Name Operator Identifier	O <sub>M</sub>	The Operator Identifier part of the APN.
Served MSISDN	O <sub>M</sub>	The primary MSISDN of the subscriber.
Charging Characteristics	M	The Charging Characteristics applied to the PDP context.
System Type	O <sub>C</sub>	Indicates the type of air interface used, e.g. UTRAN. This field is present when either the UTRAN or GERAN air-interface is used. It is omitted when the service is provided by a GSM air interface.
CAMEL Information	O <sub>C</sub>	Set of CAMEL information related to PDP context. For more information see Description of Record Fields. This field is present if CAMEL service is activated.
RNC Unsent Downlink Volume	O <sub>C</sub>	The downlink data volume, which the RNC has not sent to MS. This field is present when the RNC has provided unsent downlink volume count at RAB release.
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected.
Dynamic Address Flag	O <sub>C</sub>	Indicates whether served PDP address is dynamic, which is allocated during PDP context activation. This field is missing if address is static.

## 6.1.2 Charging data in GGSN (G-CDR)

If the collection of CDR data is enabled then the GGSN data specified in table 6.2 shall be available for each PDP context.

**Table 6.2: GGSN PDP context data (G-CDR)**

Field	Category	Description
Record Type	M	GGSN PDP context record.
Network initiated PDP context	O <sub>C</sub>	A flag that is present if this is a network initiated PDP context.
Served IMSI	M	IMSI of the served party.
GGSN Address used	M	The control plane IP address of the GGSN used.
Charging ID	M	PDP context identifier used to identify this PDP context in different records created by GSNs
SGSN Address	M	List of SGSN addresses used during this record.
Access Point Name Network Identifier	O <sub>M</sub>	The logical name of the connected access point to the external packet data network (network identifier part of APN).
PDP Type	O <sub>M</sub>	PDP type, i.e. IP, PPP, or IHOSS:OSP.
Served PDP Address	O <sub>C</sub>	PDP address, i.e. IPv4 or IPv6. This parameter shall be present except when both the PDP type is PPP and dynamic PDP address assignment is used.
Dynamic Address Flag	O <sub>C</sub>	Indicates whether served PDP address is dynamic, which is allocated during PDP context activation. This field is missing if address is static.
List of Traffic Data Volumes	O <sub>M</sub>	A list of changes in charging conditions for this PDP context, each change is time stamped. Charging conditions are used to categorize traffic volumes, such as per tariff period. Initial and subsequently changed QoS and corresponding data values are listed.
Record Opening Time	M	Time stamp when PDP context is activated in this GGSN or record opening time on subsequent partial records.
Duration	M	Duration of this record in the GGSN.
Cause for Record Closing	M	The reason for the release of record from this GGSN.
Diagnostics	O <sub>M</sub>	A more detailed reason for the release of the connection.
Record Sequence Number	C	Partial record sequence number, only present in case of partial records.
Node ID	O <sub>M</sub>	Name of the recording entity.
Record Extensions	O <sub>C</sub>	A set of network operator/manufacture specific extensions to the record. Conditioned upon the existence of an extension.

Field	Category	Description
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
APN Selection Mode	O <sub>M</sub>	An index indicating how the APN was selected.
Served MSISDN	O <sub>M</sub>	The primary MSISDN of the subscriber.
Charging Characteristics	M	The Charging Characteristics applied to the PDP context.
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected.
IMS Signalling Context	O <sub>C</sub>	Included if the PDP context is used for IMS signalling
External Charging Identifier	O <sub>C</sub>	A Charging Identifier received from a none-GPRS, external network entity
SGSN PLMN Identifier	O <sub>M</sub>	SGSN PLMN Identifier (MCC and MNC) used during this record.

### 6.1.3 Mobile station mobility management data in SGSN (M-CDR)

If the collection of MS mobility management data is enabled then the SGSN shall start collecting the information specified in table 6.3 each time the mobile is attached to the SGSN.

**Table 6.3: SGSN Mobile Station mobility management data (M-CDR)**

Field	Category	Description
Record Type	M	SGSN mobility management record.
Served IMSI	M	IMSI of the MS.
Served IMEI	O <sub>C</sub>	The IMEI of the ME, if available.
SGSN Address	O <sub>M</sub>	The IP address of the current SGSN.
MS Network Capability	O <sub>M</sub>	The mobile station network capability.
Routing Area Code	O <sub>M</sub>	Routing Area at the time of the Record Opening Time.
Local Area Code	O <sub>M</sub>	Location Area Code at the time of Record Opening Time.
Cell Identifier	O <sub>M</sub>	The Cell Identity for GSM or Service Area Code (SAC) for UMTS at the time of the Record Opening Time.
Change of Location	O <sub>C</sub>	A list of changes in Routing Area Code, each with a time stamp. This field is not required if partial records are generated when the location changes.
Record Opening Time	M	Timestamp when MS is attached to this SGSN or record opening time on following partial record.
Duration	O <sub>M</sub>	Duration of this record.
SGSN Change	C	Present if this is first record after SGSN change.
Cause for Record Closing	M	The reason for the closure of the record in this SGSN.
Diagnostics	O <sub>M</sub>	A more detailed reason for the release of the connection.
Record Sequence Number	C	Partial record sequence number in this SGSN; only present in case of partial records.
Node ID	O <sub>M</sub>	Name of the recording entity.
Record Extensions	O <sub>C</sub>	A set of network operator/manufacture specific extensions to the record. Conditioned upon the existence of an extension.
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Served MSISDN	O <sub>M</sub>	The primary MSISDN of the subscriber.
Charging Characteristics	M	The Charging Characteristics used by the SGSN.
CAMEL Information	O <sub>C</sub>	Set of CAMEL information related to Attach/Detach session. For more information see Description of Record Fields. This field is present if CAMEL service is activated.
System Type	O <sub>C</sub>	Indicates the type of air interface used, e.g. UTRAN. This field is present when either the UTRAN or GERAN air-interface is used. It is omitted when the service is provided by a GSM air interface.
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected.

## 6.1.4 SMS-MO data in SGSN (S-SMO-CDR)

If enabled, an S-SMO-CDR SGSN Mobile originated SMS record shall be produced for each short message sent by a mobile subscriber via the SGSN. The fields in the record are specified in table 6.4.

**Table 6.4: SGSN Mobile originated SMS record (S-SMO-CDR)**

Field	Category	Description
Record Type	M	SGSN Mobile Originated SMS.
Served IMSI	M	The IMSI of the subscriber.
Served IMEI	O <sub>C</sub>	The IMEI of the ME, if available.
Served MSISDN	O <sub>M</sub>	The primary MSISDN of the subscriber.
MS Network Capability	O <sub>M</sub>	The mobile station network capability.
Service Centre	O <sub>M</sub>	The address (E.164) of the SMS-service centre.
Recording Entity	O <sub>M</sub>	The E.164 number of the SGSN.
Location Area Code	O <sub>M</sub>	The Location Area Code from which the message originated.
Routing Area Code	O <sub>M</sub>	The Routing Area Code from which the message originated.
Cell Identifier	O <sub>M</sub>	The Cell Identity for GSM or Service Area Code (SAC) for UMTS from which the message originated.
Message Reference	M	A reference provided by the MS uniquely identifying this message.
Event Time Stamp	M	The time at which the message was received by the SGSN from the subscriber.
SMS Result	C	The result of the attempted delivery if unsuccessful.
Record Extensions	O <sub>C</sub>	A set of network operator/ manufacturer specific extensions to the record. Conditioned upon the existence of an extension.
Node ID	O <sub>M</sub>	Name of the recording entity.
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	M	The Charging Characteristics flag set used by the SGSN.
System Type	O <sub>C</sub>	Indicates the type of air interface used, e.g. UTRAN. This field is present when either the UTRAN or GERAN air-interface is used. It is omitted when the service is provided by a GSM air interface.
Destination Number	O <sub>M</sub>	The destination short message subscriber number.
CAMEL Information	O <sub>C</sub>	Set of CAMEL information related to SMS session. For more information see Description of Record Fields. This field is present if CAMEL service is activated.
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected.



## 6.1.5 SMS-MT data in SGSN (S-SMT-CDR)

If enabled, an SGSN Mobile terminated SMS record shall be produced for each short message received by a mobile subscriber via the SGSN. The fields in the record are specified in table 6.5.

**Table 6.5: SGSN Mobile terminated SMS record (S-SMT-CDR)**

Field	Category	Description
Record Type	M	SGSN Mobile Terminated SMS.
Served IMSI	M	The IMSI of the subscriber.
Served IMEI	O <sub>C</sub>	The IMEI of the ME, if available.
Served MSISDN	O <sub>M</sub>	The primary MSISDN of the subscriber.
MS Network Capability	O <sub>M</sub>	The mobile station network capability.
Service Centre	O <sub>M</sub>	The address (E.164) of the SMS-service centre.
Recording Entity	O <sub>M</sub>	The E.164 number of the SGSN.
Location Area Code	O <sub>M</sub>	The Location Area Code to which the message was delivered.
Routing Area Code	O <sub>M</sub>	The Routing Area Code to which the message was delivered.
Cell Identifier	O <sub>M</sub>	The Cell Identity for GSM or Service Area Code (SAC) for UMTS to which the message was delivered.
Event Time Stamp	M	Delivery time stamp, time at which message was sent to the MS by the SGSN.
SMS Result	C	The result of the attempted delivery if unsuccessful.
Record Extensions	O <sub>C</sub>	A set of network operator/manufacturer specific extensions to the record. Conditioned upon the existence of an extension.
Node ID	O <sub>M</sub>	Name of the recording entity.
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	M	The Charging Characteristics flag set used by the SGSN.
System Type	O <sub>C</sub>	Indicates the type of air interface used, e.g. UTRAN. This field is present when either the UTRAN or GERAN air-interface is used. It is omitted when the service is provided by a GSM air interface.
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected.
CAMEL Information	O <sub>C</sub>	Set of CAMEL information related to SMS session. For more information see Description of Record Fields. This field is present if CAMEL service is activated.

## 6.1.6 Mobile terminated location request (LCS-MT-CDR)

If enabled, an SGSN Mobile terminated LCS record shall be produced for each mobile a terminated location request is performed via the SGSN. The fields in the record are specified in table 6.6.

**Table 6.6: SGSN Mobile terminated LCS record (SGSN-LCS-MT)**

Field	Category	Description
Record Type	M	SGSN Mobile Terminated LCS.
Recording Entity	M	The E.164 number of the SGSN.
LCS Client Type	M	The type of the LCS client that invoked the LR.
LCS Client Identity	M	Further identification of the LCS client.
Served IMSI	M	The IMSI of the subscriber.
Served MSISDN	O <sub>M</sub>	The primary MSISDN of the subscriber.
SGSN Address	O <sub>M</sub>	The IP address of the current SGSN.
Location Type	M	The type of the estimated location.
LCS QoS	C	QoS of the LR, if available.
LCS Priority	C	Priority of the LR, if available.
MLC Number	M	The E.164 address of the requesting GMLC.
Event Time stamp	M	The time at which the Perform_Location_Request is sent by the SGSN.
Measurement Duration	O <sub>M</sub>	The duration of proceeding the location request.

Field	Category	Description
Notification To MS User	C	The privacy notification to MS user that was applicable when the LR was invoked, if available.
Privacy Override	C	This parameter indicates the override MS privacy by the LCS client, if available.
Location	O <sub>M</sub>	The LAC and CI when the LR is received.
Routing Area Code	O <sub>M</sub>	The Routing Area Code to which the LCS terminated.
Location Estimate	O <sub>C</sub>	The location estimate for the subscriber if contained in geographic position and the LR was successful.
Positioning Data	C	The positioning method used or attempted, if available.
LCS Cause	O <sub>C</sub>	The result of the LR if any failure or partial success happened as known at radio interface.
Cause for Record Closing	M	The reason for closure of the record from this SGSN.
Diagnostics	C	A more detailed information about the Cause for Record Closing if any failure or partial success happened.
Node ID	O <sub>M</sub>	Name of the recording entity.
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	M	The Charging Characteristics used by the SGSN. (always use the subscribed CC).
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected. (only subscribed/home default/visited default).
System Type	O <sub>C</sub>	Indicates the type of air interface used, e.g. UTRAN. This field is present when either the UTRAN or GERAN air-interface is used. It is omitted when the service is provided by a GSM air interface.
Record Extensions	O <sub>C</sub>	A set of network operator/manufacture specific extensions to the record. Conditioned upon the existence of an extension.

### 6.1.7 Mobile originated location request (LCS-MO-CDR)

If enabled, an SGSN Mobile originated LCS record shall be produced for each mobile an originated location request is performed via the SGSN. The fields in the record are specified in table 6.7.

**Table 6.7: SGSN Mobile originated LCS record (SGSN-LCS-MO)**

Field	Category	Description
Record Type	M	SGSN Mobile Originated LCS.
Recording Entity	M	The E.164 number of the SGSN.
LCS Client Type	C	The type of the LCS client that invoked the LR, if available.
LCS Client Identity	C	Further identification of the LCS client, if available.
Served IMSI	M	The IMSI of the subscriber.
Served MSISDN	O <sub>M</sub>	The primary MSISDN of the subscriber.
SGSN Address	O <sub>M</sub>	The IP address of the current SGSN.
Location Method	M	The type of the location request.
LCS QoS	C	QoS of the LR, if available.
LCS Priority	O <sub>C</sub>	Priority of the LR, if available.
MLC Number	C	The E.164 address of the involved GMLC, if applicable.
Event Time stamp	M	The time at which the Perform_Location_Request is sent by the SGSN.
Measurement Duration	O <sub>M</sub>	The duration of proceeding the location request.
Location	O <sub>M</sub>	The LAC and CI when the LR is received.
Routing Area Code	O <sub>M</sub>	The Routing Area Code from which the LCS originated.
Location Estimate	O <sub>C</sub>	The location estimate for the subscriber if contained in geographic position and the LR was successful.
Positioning Data	C	The positioning method used or attempted, if available.
LCS Cause	O <sub>C</sub>	The result of the LR if any failure or partial success happened as known at radio interface.
Cause for Record Closing	M	The reason for closure of the record from this SGSN.
Diagnostics	C	A more detailed information about the Cause for Record Closing if any failure or partial success happened.

Field	Category	Description
Node ID	O <sub>M</sub>	Name of the recording entity.
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	M	The Charging Characteristics flag set used by the SGSN.
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected.
System Type	O <sub>C</sub>	Indicates the type of air interface used, e.g. UTRAN. This field is present when either the UTRAN or GERAN air-interface is used. It is omitted when the service is provided by a GSM air interface.
Record Extensions	O <sub>C</sub>	A set of network operator/manufacture specific extensions to the record. Conditioned upon the existence of an extension.

### 6.1.8 Network induced location request (LCS-NI-CDR)

If enabled, an SGSN Network induced LCS record shall be produced for each mobile a network induced location request is performed via the SGSN. The fields in the record are specified in table 6.8.

**Table 6.8: SGSN Network induced LCS record (SGSN-LCS-NI)**

Field	Category	Description
Record Type	M	SGSN Network Induced LCS.
Recording Entity	M	The E.164 number of the SGSN.
LCS Client Type	C	The type of the LCS client that invoked the LR, if available.
LCS Client Identity	C	Further identification of the LCS client, if available.
Served IMSI	C	The IMSI of the subscriber if supplied.
Served MSISDN	C	The primary MSISDN of the subscriber if supplied.
SGSN Address	O <sub>M</sub>	The IP address of the current SGSN.
Served IMEI	O <sub>C</sub>	The IMEI of the ME, if available.
LCS QoS	C	QoS of the LR, if available.
LCS Priority	C	Priority of the LR, if available.
MLC Number	C	The E.164 address of the involved GMLC, if applicable.
Event Time stamp	M	The time at which the Perform_Location_Request is sent by the SGSN.
Measurement Duration	O <sub>M</sub>	The duration of proceeding the location request.
Location	O <sub>M</sub>	The LAC and CI when the LR is received.
Routing Area Code	O <sub>M</sub>	The Routing Area Code from which the LCS originated.
Location Estimate	O <sub>C</sub>	The location estimate for the subscriber if contained in geographic position and the LR was successful.
Positioning Data	C	The positioning method used or attempted, if available.
LCS Cause	O <sub>C</sub>	The result of the LR if any failure or partial success happened as known at radio interface.
Cause for Record Closing	M	The reason for closure of the record from this SGSN.
Diagnostics	C	A more detailed information about the Cause for Record Closing if any failure or partial success happened.
Node ID	O <sub>M</sub>	Name of the recording entity.
Local Record Sequence Number	O <sub>M</sub>	Consecutive record number created by this node. The number is allocated sequentially including all CDR types.
Charging Characteristics	M	The Charging Characteristics flag set used by the SGSN.
Charging Characteristics Selection Mode	O <sub>M</sub>	Holds information about how Charging Characteristics were selected.
System Type	O <sub>C</sub>	Indicates the type of air interface used, e.g. UTRAN. This field is present when either the UTRAN or GERAN air-interface is used. It is omitted when the service is provided by a GSM air interface.
Record Extensions	O <sub>C</sub>	A set of network operator/manufacture specific extensions to the record. Conditioned upon the existence of an extension.

## 6.2 Data description for PS online charging

[Editor's note: to be defined later]

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## Annex A (normative): Charging characteristics

Charging Characteristics can be supplied by the HLR to the SGSN as part of the subscription information. A subscriber may have charging characteristics assigned to his subscription and/or his subscribed APNs. The SGSN applies a pre-configured default if no charging characteristics are supplied by the HLR. The SGSN shall support three different charging characteristics default configurations:

- the home default profile for subscribers of the SGSN's PLMN;
- the visiting default profile for visitors using a GGSN belonging to the same PLMN as the SGSN;
- the roaming default profile for visitors using a GGSN belonging to their home PLMN.

The SGSN can determine the GGSN PLMN from the operator identifier part of the APN. Optionally the SGSN may support several visiting and roaming default profiles based on the MNC/MCC combination of the subscriber.

In the case of a home subscriber, the charging characteristics are selected by the SGSN according to the following procedures. For PDP context specific charging characteristics (i.e. those used for the S-CDRs that are generated for this PDP context):

- If the MS requests a particular APN then:
  - \* If the SGSN accepts this request (i.e. it has been verified against the subscription) then:
    - If it has been matched against the wildcard APN then:
      - If charging characteristics for the wildcard APN are present in the subscription information then they shall be used;
      - If no charging characteristics are present for the wildcard APN but subscription related charging characteristics are present, then they shall be chosen;
      - If neither of the two are present then the SGSN home default shall be applied.
    - If it has been matched against a specific subscribed APN then:
      - If charging characteristics for this APN are present in the subscription information then they shall be used;
      - If no charging characteristics are present for the APN but subscription related charging characteristics are present, then they shall be chosen;
      - If neither of the two are present then the SGSN home default shall be applied.
  - \* If the SGSN rejects the request then charging characteristics selection does not apply.
- If the MS does not request an APN then:
  - \* If the SGSN chooses a subscribed APN then:
    - If charging characteristics for this APN are present in the subscription information then they shall be used;
    - If no charging characteristics are present for the APN but subscription related charging characteristics are present, then they shall be chosen;
    - If neither of the two are present then the SGSN home default shall be applied.

- \* If only the wildcard APN is present in the subscription, i.e. the SGSN applies its configured default APN then:
  - If charging characteristics for the wildcard APN are present in the subscription information then they shall be used;
  - If no charging characteristics are present for the wildcard APN but subscription related charging characteristics are present, then they shall be chosen;
  - If neither of the two are present then the SGSN home default shall be applied.

For the non-PDP context specific CDR types, i.e. the M-CDRs and the SMS CDRs, the SGSN applies the subscription specific charging characteristics, or, if not supplied, it shall choose the home default profile as defined above.

In case of subscribers from other PLMNs, the SGSN may be configured to either apply the "home subscriber case" charging characteristics selection procedure defined above, or to ignore charging characteristics provided by the subscriber's HLR, and apply a default configuration instead. If default charging characteristics are selected for the foreign subscriber, then the SGSN shall choose either the visiting or roaming default profile for the PDP context specific charging characteristics, according to the roaming or visiting scenario, as described above. For M-CDRs and SMS CDRs, the operator can configure if the roaming or the visiting profile shall be applied, since no GGSN is involved.

Upon activation of a PDP context, the SGSN forwards the charging characteristics to the GGSN according to the following rules:

- if charging characteristics were received from the HLR, then they shall be sent as provided by the HLR, regardless of the home, visiting, or roaming case, and regardless of whether the SGSN applies the HLR supplied charging characteristics or chooses to ignore them;
- if no charging characteristics were received from the HLR, then the SGSN does not forward any charging characteristics to the GGSN.

The above procedure implies that no explicit transfer of the Charging Characteristics Selection Mode (see 3GPP TS 23.060 [61]) to the GGSN is necessary, because it is implicitly given as "subscribed" when the GGSN receives charging characteristics from the SGSN, and "non-subscribed" otherwise.

The GGSN shall also apply charging characteristics to its PDP contexts. It shall either apply the SGSN supplied parameters, or it may be configured to ignore the SGSN supplied charging characteristics in any combination of the following cases:

- visiting case, i.e. the subscriber belongs to a different PLMN;
- roaming case, i.e. the SGSN belongs to a different PLMN;
- home case, i.e. the subscriber belongs to the same PLMN as the GGSN; or
- unconditionally, i.e. it always ignores the SGSN supplied parameters.

If the GGSN ignores the parameters supplied by the SGSN, it shall nevertheless accept the PDP context request. It shall then apply its own pre-configured charging characteristics as appropriate, i.e. the home, visiting or roaming profile. The GGSN shall support the configuration of one set of default charging characteristics (i.e. home, visiting, roaming) for each of its supported APNs.

Charging Characteristics consists of a string of 16 bits designated as Profile (P) and Behaviour (B), shown in 3GPP TS 32.298 [41]. The first four bits (P) shall be used to select different charging trigger profiles, where each profile consists of the following trigger sets:

- **S-CDR:** activate/deactivate CDRs, time limit, volume limit, maximum number of charging conditions, tariff times;
- **G-CDR:** same as SGSN, plus maximum number of SGSN changes;
- **M-CDR:** activate/deactivate CDRs, time limit, and maximum number of mobility changes;
- **SMS-MO-CDR:** activate/deactivate CDRs;

- **SMS-MT-CDR:** active/deactivate CDRs.
- **LCS-MO-CDR.**
- **LCS-MT-CDR.**
- **LCS-NI-CDR.**

In addition to these trigger sets, the profile may also specify an optional charging gateway address. If this CGF address is configured in the GGSN's selected trigger profile, the GGSN shall apply it for the G-CDRs and send this charging gateway address in its GTP message exchange with the SGSN (overriding any other GGSN configured CGF address). In the home or visiting case, the SGSN shall apply the received CGF address to the S-CDRs pertaining to this PDP context. In the roaming case, or if no address is received from the GGSN, then the SGSN shall use the CGF address from its own selected charging characteristics trigger profile, or, if it does not exist, use the default CGF address. For M-CDRs and SMS CDRs, the SGSN shall use the CGF address configured in the charging characteristics that it applies to the respective CDRs, or if no such address is configured then the default CGF shall be used.

Table A.1 is an informative example intended for clarification.

**Table A.1: Example of charging characteristics profiles**

Profile Index bits 0 - 3	CGF Address	S-CDR					G-CDR	
		Active	Time limit	Volume limit	Change cond	Tariff times	Active	...
0	-	Yes	30 min	100 K	2	0-7, 7-12, ...		
1	100.128.35.20	No	-	-	-	-		
2	-	Yes	10 min	50 K	1	0-24		
..	..	..	..	..	..	..		

The remaining 12 (B) bits can be freely assigned to particular charging behaviours that the GSNs support. Examples of those behaviours are:

- Selection of the applicable idle context purge timer, i.e. use global value or use special value. This feature could be used to distinguish between customers and/or APNs whose PDP contexts should be purged after short (e.g. 30 minutes) or long (e.g. 12 hours) periods of inactivity.
- Use specific charging gateway address (override all other configured/selected CG addresses).
- Deactivate SMS-MO-CDRs for customers of the own PLMN using pre-configured SMSC addresses.
- Disable G-CDRs for roamers that use the HPLMN GGSN.
- Allow or inhibit the use of own GGSNs by visitors.
- Allow or inhibit network triggered QoS change (upgrade and/or downgrade).

The SGSN selects the charging characteristics for M-CDR generation upon the creation of a MM context. Both SGSN and GGSN select the charging characteristics for PDP context CDR generation (i.e. S-CDR and G-CDR, respectively) upon creation of a PDP context or secondary PDP context. Once selected, the charging characteristics shall be maintained throughout the lifetime of the MM or PDP contexts. If the SGSN receives modified subscriber information from the HLR (e.g. execution of a stand-alone Insert Subscriber Data procedure) which includes changes to the charging characteristics, they shall be applied only to new MM, PDP and secondary PDP contexts, this implies that the SGSN shall not send PDP context modifications for the existing PDP contexts to the GGSN.

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## Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
Sep 2003	S_21	SP-030410	--	--	Submitted to TSG SA#21 for Information	1.0.0	